MCH-025

ASSIGNMENT BOOKLET

M.Sc. in Chemistry Programme
(MSCCHEM)

Electroanalytical and other Analytical Methods

(Valid from 1st July 2025 to 30th June 2026)

It is compulsory to submit the assignment before filling in the examination form

School of Sciences
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(2026)

Dear Learner,

Please read the section on assignments in the Programme Guide for M.Sc. in Chemistry that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, which would consist of one tutor-marked assignment for this course. The assignment is in this booklet, and covers both the blocks of the course. The total marks of all the parts are 100, of which 40% are needed to pass it.

Instructions for Formatting Your Assignments

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

1. On top of the first page of your answer sheet, please write the details exactly in the following format:

ENROLAMENT NO. :…..…….

NAME :……...

ADDRESS :……

COURSE CODE :……..

COURSE TITLE :……..

ASSIGNMENT NO :……..

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. Submit the complete assignment answer sheets within the due date.
6. The assignment answer sheets are to be submitted to your Study centre within the due date. Answer sheets received after the due date shall not be accepted.
   We strongly suggest that you retain a copy of your answer sheets.
7. This assignment is valid from 1st July, 2025 to 30th June, 2026. If you have failed in this assignment or fail to submit it by June 2026, then you need to get the assignment for the year 2027, and submit it as per the instructions given in the Programme Guide.
8. You cannot fill the examination form for this course until you have submitted the assignment.

Wishing you good luck

Tutor Marked Assignment

Electroanalytical and other Analytical Methods (MCH-025)

Course Code: MCH-025
Assignment Code: MCH-025/TMA/2026
Maximum Marks: 100

Note: Attempt all questions. The marks for each question are indicated against it.

1. **(a)** Give a difference between: **(5)**

   (i) oxidation and oxidizing agent

   (ii) reduction and reducing agent

   (iii) a galvanic cell and an electrolytic cell

   (iv) voltammetry and polarography

   (b) Consider the following electrochemical cell **(5)**

   $$Fe, Fe^{2+}(0.1M) \mid Cd^{2+}(0.001M), Cd$$

   (i) Write the cell reaction.

   (ii) Calculate the EMF of the cell. Where,

   $E^0_{Cd^{2+}/Cd} = -0.40V$ and $E^0_{Fe^{2+}/Fe} = -0.44V$

2. **(a)** What is Coulometer? Explain briefly. Write cathodic and anodic reaction of hydrogen-nitrogen coulometer, where 0.1 M hydrazine sulphate is used as the electrolyte. **(5)**

   (b) In a coulometric method, 200 mg of nitrobenzene in 100 cm^3 of methanol is reduced to phenyl hydroxylamine at a constant potential of -0.95 V (vs. SCE) applied to an Hg electrode. Following reaction takes 30 minutes to complete.

   $$C_6H_5NO_2 + 4H + + 4e^- \rightarrow C_6H_5\,NHOH + H_2O$$

   Calculate the percentage of nitrobenzene if above reduction requires 32℃ current. **(5)**

3. **(a)** What is dropping mercury electrode? Give its advantages. **(5)**

   (b) Indium and Cadmium ions in 0.1 M HCl give peaks at potentials -0.557 V and -0.597 V by differential pulse polarographic analysis. When a standard solution containing 0.4 ppm of indium is analysed, it gave peak current (in arbitrary units) corresponding to 100.25 at -0.557 V and 43.75 at -0.597 V. A standard solution containing 0.4 ppm of Cd gave $^{i}p_s$ 29.52 at -0.557 V and 64.8 at -0.597 V. What is the concentration of indium and cadmium in a sample if the peak current is 190 at -0.557 V and 120 at -0.597 V. **(5)**

4. **(a)** What are amperometric titrations? Draw common types of curves obtained in amperometric titrations. What will be the shape of the curve in bioamperometry for the titration of iodine by thiosulphate? **(5)**

   (b) What is common source of errors in thermogravimetric analysis (TGA)? A mixture of CaO and $CaCO_3$ is analysed by TGA. The result indicates that mass of the sample decreases from 250.6 mg to 190.8 mg only between 600°C and 900°C. Calculate the percentage of calcium carbonate in the mixture. **(5)**

5. **(a)** Explain how thermometric titrations are different than classical titrations. Discuss their advantages. **(5)**

   (b) What is the principle of differential scanning calorimetry (DSC)? Draw the schematic diagram of a DSC instrument. **(5)**

6. **(a)** How many α and β particles will be emitted in following successive decays.

   (i) $^{234}U \rightarrow \rightarrow \rightarrow {}^{210}Po$

   (ii) $^{231}Th \rightarrow \rightarrow \rightarrow {}^{211}Pb$

   (iii) $^{233}U \rightarrow \rightarrow \rightarrow {}^{213}Bi$

   (iv) $^{224}Ra \rightarrow \rightarrow \rightarrow {}^{208}Ti$ **(5)**

   (b) What are the common sources of neutron for neutron activation analysis (NAA)? What factors contribute to higher sensitivity in NAA? Briefly explain any one. **(5)**

7. **(a)** Explain why neutron induced reactions are most common whereas deuteron induced reactions require accelerator facility to carry out these reactions. **(5)**

   (b) In an isotope dilution analysis experiment, 15 mg radiolabelled analyte with specific activity 0.57 μCi/mg was added. After equilibration and chemical separation 2.76 mg pure analyte having specific activity 0.019 μCi/mg was isolated. Calculate the amount of analyte in the sample. **(5)**

8. **(a)** What is the difference between SEM and TEM? Write the advantages of TEM over SEM? **(5)**

   (b) Which components are used in the X-ray photoelectron spectroscopy (XPS) instrument? Briefly explain with a schematic diagram of XPS Instrumentation. **(5)**

9. **(a)** What information does the energy dispersive spectroscopy (EDS) provide? Write any three applications of EDS. **(5)**

(b) Briefly explain the basic principle of Auger Electron Spectroscopy (AES) with a suitable diagram. **(5)**

10. (a) Write the basic principle of Rutherford backscattering spectroscopy (RBS) also name the ions commonly used for primary beam in RBS. **(5)**

(b) How does atomic force microscopy (AFM) work? Explain briefly with their applications. **(5)**