**MCH-016**

# ASSIGNMENT BOOKLET

## M.Sc. in Chemistry Programme
## (MSCCHEM)

## INORGANIC CHEMISTRY 2

**Valid from 1st July, 2026 to 30th June, 2027**

**It is Compulsory to submit the Assignment before filling in the Term-End Examination Form.**

**School of Sciences**
**Indira Gandhi National Open University**
**Maidan Garhi, New Delhi-110068**
**(2026-27)**

Dear Student,

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 all the four 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:

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**ENROLMENT NO.:** ……

**NAME:** ……

**ADDRESS:** ……

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**COURSE CODE:** …….

**COURSE TITLE:** …….

**ASSIGNMENT NO.:** ……

**STUDY CENTRE:** ……..….. **DATE:** …….……...

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

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

3) Leave 4 cm margin on the left, top and bottom of your answer sheet.

4) Your answers should be precise.

5) Solve Part (A) and Part (B) of this assignment, and **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, 2026 to 30th June, 2027**. If you have failed in this assignment or fail to submit it by June, 2027, then you need to get the assignment valid from 1st July 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 this assignment.

We wish you good luck.

# Tutor Marked Assignment

# MCH-016: INORGANIC CHEMISTRY 2

**Course Code: MCH-016**
**Assignment Code: MCH-011/TMA/2026-2027**
**Maximum Marks: 100**

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

1. a) What are the kinetic consequences of reaction pathways like dissociation, interchange and association for substitution reactions. (5)

   b) Arrange the following in order of increasing rate of water exchange: (5)

   $[Ti(H_2O)_6]^{3+}$, $[Co(H_2O)_6]^{2+}$, $[Cr(H_2O)_6]^{3+}$, $[Zn(H_2O)_6]^{2+}$

   Justify your answer.

2. a) Explain the conjugate base (CB) mechanism, that is the base catalyzed hydrolysis. Give suitable diagrams for this. Give one example where hydrolysis leads to complete retention of configuration in which there is deprotonation of the amino group. (5)

   b) Why are polydentate complexes more theromodynamically stable than their monodentate counterparts? Explain the Ray-Dutt (rhomboid) twist mechanism for intramolecular racemization. (5)

3. a) Explain the mechanism of dissociation and stereochemical changes for *cis*-$[M(LL)_2BX]$ with the help of suitable diagrams. (5)

   b) With the help of a suitable example explain the role of the entering group in the substitution of square planar complexes. (5)

4. a) Give the situations when dissociate mechanism would be predicted for substitution in octahedral complexes. (5)

   b) If we compare the four-coordinate complexes Cd–$N_2S$ and Cd–$N_2O$, the former undergoes stereochemical inversion more rapidly than the latter. What is the most probable reason for this behaviour? (5)

5. a) Comment on ligands reducibility, electron transfer and the rate constants for the reaction: (5)

   $[Co(NH_3)_5(L)]^{2+} + [Fe(H_2O)_6]^{2+} \rightarrow Co^{2+} + H_2O + 5NH_3 + [Fe(H_2O)_5(L)]^{2+}$

| L | $k_2(M^{-1}s^{-1})$ | |
|---|---|---|
| $HCOO^-$ (formate) | 0.22 | formate is difficult to reduce |
| $CH_3COO^-$ (acetate) | 0.45 | acetic acid is difficult to reduce |
| $C_2O_4^{2-}$ (oxalate) | 8.5 | oxalate is more reducible |
| $HOOCCH_2COO^-$ (malonate) | 95 | malonate is easy to reduce |
| $NCS^-$ (thiocyanate) | $2.5 \times 10^3$ | thiocyanate is very easy to reduce |

| | | | |
|---|---|---|---|
| | b) | What are mixed valence complexes? How are the oxidation states of the metal centres in such complexes categorized in the case of electron transfer reaction? | (5) |
| 6. | a) | What structural features make siderophores highly selective for Fe(III)? Why are they also known as siderochromes? Why is Fe(III) more commonly transported by siderophores than Fe(II)? | (5) |
| | b) | Explain why iron in hemerythrin does not bind oxygen through a heme group. Explain the oxidation state changes that occur during oxygen binding in hemerythrin. | (5) |
| 7. | a) | What are the common types of iron–sulfur clusters found in ferredoxins? Where are the iron sulphur proteins located? How do ferredoxins differ from rubredoxin? | (5) |
| | b) | Discuss the coordination environment of Mg(II) in chlorophyll and compare it with Fe(II) in hemoglobin. Explain how transition metal ions participate in photosynthetic electron transfer. | (5) |
| 8. | a) | Describe the mechanism of oxygen evolution from water in Photosystem II. Discuss the structure of the active site of carboxypeptidase A. | (5) |
| | b) | Discuss the mechanism of proton transfer in carbonic anhydrase. | (5) |
| 9. | a) | Explain the way metal complexes may be use to probe the local conformational changes that may happen in the nucleic acid polymers. | (5) |
| | b) | What are the two main types of transition-metal complex reactions with polynucleotides? Give suitable examples and chemical equations for them. | (5) |
| 10. | a) | What are the differences between Hypernatremia and Hypokalemia? Give the diseases that may arise due to deficiency of zinc. | (5) |
| | b) | How have metals been used for MRI? Give a short account. | (5) |