This course introduces transition metals and their compounds. Topics will include properties, structures, types of ligands and their bonding modes, isomers, bonding, electronic spectra and reaction mechanisms of coordination compounds. A brief introduction to organometallic chemistry will be discussed.

1. Identify and understand the trends in properties and reactivity of the d-block elements.
2. Describe coordination compounds, name, classify and identify the possible number of isomers of any given coordination compounds.
3. Identify simple compound classes for transition metals and describe their chemical properties.
4. Understand the nomenclature, classification and properties of coordination compounds.
5. Discuss the concepts of metal ligand bonding in transition complex compounds through the different bonding theories.
6. Describe the coordination numbers and possible structures of coordination compounds.
7. Understand the thermodynamics and kinetic aspects of metal complexes.

8. Describe various types of reaction mechanisms, kinetics and thermodynamics possible in coordination chemistry.

9. Elucidate the chemistry of organometallic compounds.

(Intended Student Learning Outcomes)

After the completion of the course, Students will be able to
1. Explain the fundamental concepts in coordination chemistry of transition metals.
2. Write formulas of coordination complexes; identify the ligands and their donor atoms; determine coordination number and oxidation state of the metal, and the charge on any complex ion; name coordination compounds according to the latest IUPAC recommendations.
3. Identify and distinguish between different types isomers in coordination complexes.
4. Describe and explain the bonding in transition compounds by different bonding theories.
5. Predict and explain the molecular geometry and stereochemistry of coordination compounds, and recognize the factors that govern it.
6. Determine the electronic structure of common geometries (square planar, tetrahedral, and octahedral) metal complexes by applying crystal field theory.
7. Generate molecular orbital energy level diagrams for octahedral metal complexes in the absence of pi-bonding, and in the presence of both pi-donating and pi-accepting ligands.
8. Predict and explain the location of ligands in the spectrochemical series based on Lewis basicity and pi-interactions.
9. Interpret the electronic spectra of coordination compounds.
10. Describe the electronic selection rules and correlate the intensity and wavelengths of optical transitions with coordination geometry and electron configuration.
11. Recognize the difference between both thermodynamic and kinetic stability.
12. Identify the factors influencing complex stability (enthalpy and entropy effects).
13. Predict the reactivity of complexes (inert and labile complexes) in terms of reaction kinetics.
14. Describe the different pathways (Dissociative, Associative and Interchange mechanisms) of ligand substitution reactions in complexes.
15. Differentiate between coordination and organometallic compounds.

(Course Content)

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1-3</td>
<td>Chapter 9: Coordination Chemistry I: Structures and isomers</td>
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</table>

Introduction to Transition metal chemistry, Transition metals in the periodic Table, electronic structure and general properties. Coordination (classical) compounds, Historical background, Nomenclature of coordination compounds, Isomerism, Chirality, Hydrate, Coordination and Linkage isomerization, Coordination Numbers and Structures.
Chapter 10: Coordination Chemistry II: Bonding
Bonding theories, Valence Bond Theory, inner and outer orbital complexes, Electronic Neutrality Theory (ENT), Crystal Field Theory (CFT), Splitting diagrams in Tetrahedral, Octahedral and square planar complexes, Crystal Field Stabilization Energy (CFSE), preference of geometries based on AOM, Types of ligands and the spectrochemical series, The Jahn-Teller effect. Factors affecting the splitting, Ligand Field Theory (LFT), Molecular Orbital Theory (MOT), Angular Overlap Method (AOM), sigma donor and pi acceptor interactions.

First Exam (week 6)

Chapter 11 Coordination Chemistry III: Electronic transitions
Electronic spectra of coordination compounds, selection rules, Tanabe-Sugano diagrams, Jahn-Teller distortions and spectra, Charge transfer Spectra.

First Exam (week 11)

Chapter 12 (Weeks) Coordination Chemistry IV: Reactions and Mechanisms

Chapter 13 (Weeks 15) Organometallic Chemistry
Background, Organic ligands and nomenclature, The 18-Electron Rule, Counting electrons, Carbonyl complexes, Other complexes.

Final Exam (week 16; All material covered)

9. استراتيجيات التعليم والتعلم وطرق التقويم
(Teaching and learning Strategies and Evaluation Methods)

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<tr>
<th>نوع التقييم/القياس</th>
<th>أنشطة التدريس</th>
<th>استراتيجيات التدريس</th>
<th>مخرجات التعلم</th>
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<tbody>
<tr>
<td>- Examination</td>
<td>- Class notes</td>
<td>- Power point Lectures - Problem solving - Oral discussions</td>
<td>Explain the fundamental concepts in coordination chemistry of transition metals.</td>
<td>1</td>
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<tr>
<td>- Examination</td>
<td>- Class notes</td>
<td>- Continuous discussion of the material</td>
<td>- Problem sets and solutions. - Assignments</td>
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- Problem solving  
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| - Examination | - Class notes  
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- Problem solving  
- Oral discussions  
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- Problem solving  
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- Class room participation | Describe the electronic selection rules and correlate the intensity and wavelengths of optical transitions with coordination geometry and electron configuration. | 10 |
- Examination  | - Class notes  
| - Continuous discussion of the material  
| - Problem sets and solutions.  
| - Assignments  | - Power point Lectures  
| - Problem solving  
| - Oral discussions  
| - Class room participation  | Recognize the difference between both thermodynamic and kinetic stability.  

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- Examination  | - Class notes  
| - Continuous discussion of the material  
| - Problem sets and solutions.  
| - Assignments  | - Power point Lectures  
| - Problem solving  
| - Oral discussions  
| - Class room participation  | Identify the factors influencing complex stability (enthalpy and entropy effects).  

12

- Examination  | - Class notes  
| - Continuous discussion of the material  
| - Problem sets and solutions.  
| - Assignments  | - Power point Lectures  
| - Problem solving  
| - Oral discussions  
| - Class room participation  | Predict the reactivity of complexes (inert and labile complexes) in terms of reaction kinetics.  

13

- Examination  | - Class notes  
| - Continuous discussion of the material  
| - Problem sets and solutions.  
| - Assignments  | - Power point Lectures  
| - Problem solving  
| - Oral discussion  | Describe the different pathways (Dissociative, Associative and Interchange mechanisms) of ligand substitution reactions in complexes.  

14

- Examination  | - Class notes  
| - Continuous discussion of the material  
| - Problem sets and solutions.  
| - Assignments  | - Power point Lectures  
| - Problem solving  
| - Oral discussions  
| - Class room participation  | Differentiate between coordination and organometallic compounds.  

15

(Assessment)  

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<th>توزيع الدرجات لكل أسلوب</th>
<th>توقيت التقييم</th>
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<td>3-امتحان تحريري نهائي</td>
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(Text Book)  

Inorganic Chemistry  
G. L. Missler, P. J. Fischer and D. A. Tarr  
المؤلف
3. The additional references (References) (and include books and published research in journals or electronic sites):

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