بسم الله الرحمن الرحيم

جامعة آل البيت

جامعة آل البيت
دائرة ضمان الجودة والتخطيط

كلية .....العلوم.....

قسم .....الكيمياء.....

توصيف مساق: Chem 403321

1. معلومات مدرس المساق (Instructor)

اســـم (مدرس / منسق) المساق :	Basem Fares Ali
الساعـــــات المكتبيـــــــــــة :	9-10 (Sun, Mon, Thur)
رقم المكتب والرقـــم الفرعـــــي :	2142
البريـــــــــد الالكترونـــــــي :	bfali@aabu.edu.joi
مساعد البحث والتدريس/المشرف/الفني (إن وجد):	NA

2. وصف المساق (Course Description)

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.

3. بيانات المساق (Course Title)

رقم المساق: 403321	**اسم المساق: Inorganic Chemistry 2**	**المستوى: Year 3/ Level 1**
طبيعة المساق: نظري	**المتطلب السابق / المتزامن: 403221**	**وقت المحاضرة : 8-9**
العام الجامعي: 2020 / 2021	**الفصل الدراسي: Session 1- 2020/2021**	**عدد الساعات الدراسية: 3**

4. أهداف المساق (Course Objectives)

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

7. Understand the thermodynamics and kinetic aspects of metal complexes.	ز_
8. Describe various types of reaction mechanisms, kinetics and thermodynamics possible in coordination chemistry.	ح_
9. Elucidate the chemistry of organometallic compounds.	ط_

5. مخرجات التعلم (Intended Student Learning Outcomes)
(المعرفة والمهارات والكفايات)

يفترض بالطالب بعد دراسته لهذا المساق أن يكون قادرا على:

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.

1. محتوى المساق (Course Content)

الموضــوع	الأسبوع
Chapter 9: Coordination Chemistry I: Structures and isomers 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.	**1-3**

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.	**4-7**
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.	**8-11**
First Exam (week 11)	
Chapter 12 (Weeks) Coordination Chemistry IV: Reactions and Mechanisms Substitution reactions, Inert and Labile complexes, Mechanisms, Kinetics, Stereochemistry of reactions, Substitution reactions in octahedral complexes, Substitution reactions in square planar complexes.	**11-14**
Chapter 13 (Weeks 15) Organometallic Chemistry Background, Organic ligands and nomenclature, The 18-Electron Rule, Counting electrons, Carbonyl complexes, Other complexes.	**14-15**
Final Exam (week 16; All material covered)	

9. استراتيجيات التعليم والتعلم وطرق التقويم

(Teaching and learning Strategies and Evaluation Methods)

نوع التقويم/القياس (امتحان/عروض صفية/مناقشة/واجبات)	أنشطة التعلم	استراتيجيات التدريس	مخرجات التعلم	ت
- Examination	- Class notes - Assignments	- Power point Lectures - Oral discussions	Explain the fundamental concepts in coordination chemistry of transition metals.	1
- Examination	- Class notes - Continuous discussion of the material - Problem sets and solutions. - Assignments	- Power point Lectures - Problem solving - Oral discussions - Class room participation	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.	2
- Examination	- Class notes - Continuous discussion of the material - Problem sets and solutions. - Assignments	- Power point Lectures - Problem solving - Oral discussions - Class room participation	Identify and distinguish between different types isomers in coordination complexes.	3

- Examination	- Class notes - Continuous discussion of the material - Problem sets and solutions. - Assignments	- Power point Lectures - Problem solving - Oral discussions - Class room participation	Describe and explain the bonding in transition compounds by different bonding theories.	4
- Examination	- Class notes - Continuous discussion of the material - Problem sets and solutions. - Assignments	- Power point Lectures - Problem solving - Oral discussions - Class room participation	Predict and explain the molecular geometry and stereochemistry of coordination compounds, and recognize the factors that govern it.	5
- Examination	- Class notes - Continuous discussion of the material - Problem sets and solutions. - Assignments	- Power point Lectures - Problem solving - Oral discussions - Class room participation	Determine the electronic structure of common geometries (square planar, tetrahedral, and octahedral) metal complexes by applying crystal field theory.	6
- Examination	- Class notes - Continuous discussion of the material - Problem sets and solutions. - Assignments	- Power point Lectures - Problem solving - Oral discussions - Class room participation	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.	7
- Examination	- Class notes - Continuous discussion of the material - Problem sets and solutions. - Assignments	- Power point Lectures - Problem solving - Oral discussions - Class room participation	Predict and explain the location of ligands in the spectrochemical series based on Lewis basicity and pi-interactions.	8
- Examination	- Class notes - Continuous discussion of the material - Problem sets and solutions. - Assignments	- Power point Lectures - Problem solving - Oral discussions - Class room participation	Interpret the electronic spectra of coordination compounds.	9
- Examination	- Class notes - Continuous discussion of the material - Problem sets and solutions. - Assignments	- Power point Lectures - Problem solving - Oral discussions - 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.	11
- 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

1. تقييم الطلبة (Assessment)

الأساليب المستخدمة	توقيت التقييم	توزيع الدرجات لكل أسلوب
1-أعمال الفصل: (تقرير، وظائف، حضور)	خلال الفصل	0
2-امتحان تحريري أول	الأسبوع الرابع	25%
2-امتحان تحريري ثاني	الأسبوع السابع	25%
3-امتحان تحريري نهائي	أسبوع الامتحانات النهائية	50%

2. الكتاب المقرر (Text Book)

المرجع الرئيس	Inorganic Chemistry
المؤلف	G. L. Missler, P. J. Fischer and D. A. Tarr

الناشر	Pearson
السنة	2013
الطبعة	Fifth edition
الموقع الالكتروني للمرجع	ISBN-13: 978-0321811059; ISBN-10: 9780321811059

3. المراجع الإضافية (References) (وتشمل الكتب والبحوث المنشورة في الدوريات او المواقع الالكترونية)

F. A. Cotton, C. Murillo, G. Wilkinson, M. Bochmann, *Advanced Inorganic Chemistry*; 6 th ed., Wiley-Interscience: 1999.	−1
Inorganic Chemistry, by D.F. Shriver and P. W. Atkins, 4th edition, Oxford, 2006 or 3rd edition, Oxford, 1999.	−2
J. E. Huheey, E. A. Keiter and R. L. Keiter, *Inorganic Chemistry: Principles of Structures and Reactivity*; ed., Prentice Hall: 1997.	−3
N. N. Greenwood and A. Earnshaw, *Chemistry of the Elements*; 2nd ed.; Butterworth-Heinemann: 1997	−4