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**Department: Chemistry**

**College: Education**

 **University: Salahaddin**

**Subject: Coordination Chemistry**

**Course Book:**

**Lecturer's name: Dr. Salim NA Saber**

**Academic Year: 2023 – 2024**

**Course Book**

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| **1. Course name** | Coordination Chemistry  |
| **2. Lecturer in charge** | ------- |
| **3. Department/ College** | Chemistry / Education  |
| **4. Contact** | Salim.saber@su.edu.krd  |
| **5. Time (in hours) per week**  | 2/w |
| **6. Office hours** | 4/w |
| **7. Course code** |  |
| **8. Teacher's academic profile** | Salim Najm Aldain BSc. Salahaddin University 2009 MSc. Huddersfield University 2012PhD. Spite site: Salahaddin university and UTM 2021My principal research interests lie in the field of biochemistry and the synthesis of bioactive metal complexes. I am currently investigating the anti-oxidant and anti-cancer drugs which are extracted from plants for my Ph.D. Using the latest separation techniques for purification and GC-MS and 1D, and 2D NMR to detect drug structure**.**  |
| **9. Keywords** | **Coordination bond, ligand transition elements, VBT, CFT, LFT and electronic spectrum**  |
| **10. Course overview:**In chemistry, a coordination complex or metal complex, is a structureconsisting of a central atom or ion (usually metallic), bonded to a surroundingarray of molecules or anions (ligands, complexing agents). The atom within a ligand that is directly bonded to the central atom or ion is called the donoratom. Polydentate (multiple bonded) ligands can form a chelate complex. Aligand donates at least one pair of electrons to the central atom / ion.Compounds that contain a coordination complex are called coordinationcompounds. The central atom or ion, together with all ligands form thecoordination sphere. Coordination refers to the "coordinate covalent bonds"(dipolar bonds) between the ligands and the central atom:  |
| **11**. **Course objective:**The aims of this course are to:* introduce the chemistry of coordination compounds (definition,recognition, preparation and application)
* provide you with knowledge on how to; name coordinationcompounds using IUPAC system of naming (nomenclature),
* classify coordination compounds based on their coordinationnumbers (coordination formula) and identify number and types of various isomers possible with each coordination compound(isomerism)
* identify various structures and hybridisation(s) possible with each coordination compound based on its coordination number(stereochemistry)
* expose you to the physical methods (magnetic properties,vibrational and electronic spectroscopy) used in structural analysis of coordination compounds
* explain the various bonding theories (valence bond theory, crystal field theory, ligand field theory and molecular orbital theory) and modifications resulting into spectrochemical series (due to trend observed in crystal field splitting) and nephelauxetic series (due totrend observed in cloud expansion)
* explain how complex formation can assist in stabilisation ofunusual oxidation states
* provide details of reaction kinetics and mechanisms,thermodynamics and stability constants as well as chelateformation and effect.

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| **12. Student's obligation**students are also to participate in the class 2/w and final examination at the end of the course. Each unit ends with worked examples and assignments to enable students have better understanding and perform excellently in this course. Having provided this much information on this course, it is expected that you should study the course material in details, organise and attend tutorialclasses**.** |
| **13. Forms of teaching:** Different form of teaching will be used to reach the objectives of the course, discussion and conclusion |
| **14. Assessment scheme**Students assessment by doing at least 2 tests during the course and a number ofquizzes, Report and home work‌ |
| **15. Student learning outcome:**On successful completion of the course, student should be able to:* identify coordination compounds, explain the methods used inpreparing them and state areas of their applications
* name, classify and identify the possible number of isomers of anygiven coordination compound.
* describe the structures and hybridisations of coordinationcompounds
* apply physical techniques in characterisation of coordinationcompounds
* explain the nature of bonding in coordination compounds through the various bonding theories
* apply the knowledge of coordination chemistry in stabilisation ofunusual oxidation states
* describe various types of reaction mechanism, kinetics andthermodynamics possible in coordination chemistry.
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| **16. Course Reading List and References:**1. **Coordination chemistry by Ajai kumar (your course book 100% explained)**
2. Transition Metal Chemistry by M. Gerloch, E.G. Constable
3. Introduction to Coordination Chemistry by Geoffrey A. Lawrance
4. Inorganic Chemistry by Shriver & Atkins
5. Inorganic Chemistry Gary L. Miessler Paul J. Fischer and Donald A. Tarr
6. INORGANIC CHEMISTRY by CATHERINE E. HOUSECROFT AND ALAN G. SHARPE
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| **17 A. The Topics: First semester**  | **Lecturer's name** |
| Week 1: **Introduction to coordination compounds**: Coordination compounds, Werner’s theory and evidence of Werner’s theory. Sidgwick concept, Effective atomic number, 18 electron rulesWeek 2: **Introduction to coordination compounds**: Classification of ligands, ambidentate ligands, bridging ligands, flexidentate ligands and macrocyclic ligands. Week 3: **IUPAC nomenclature of coordination compounds** Week 4: **IUPAC nomenclature of coordination compounds**Week 5: **Isomerism of coordination compounds:** structure isomerism and stereoisomerism, Week 6: **Exam1 midterm** Week 7: **Theories for metal -ligand bounding**: Valence bond theory (VBT) for octahedral geometry Week 8: **Theories for metal -ligand bounding:** Valence bond theory (VBT) for tetrahedra and square planer geometries and limitation of VBTWeek 9: **Theories for metal -ligand bounding:** Crystal field theory for Octahedral geometry Week 10: **Theories for metal -ligand bounding:** Crystal field theory for tetrahedra and square planer geometries and limitation of CFT.Week 11**: Midterm Exam 2** Week 12: **Theories for metal -ligand bounding:** Ligand field theory for Octahedral geometry (sigma, pi-donor and pi-accepter ligandsWeek 13: **Theories for metal -ligand bounding:** Ligand field theory for tetrahedra and square planer geometries. Week 14: **Review**:  | Dr. Salim NA Saber.**2 hours** |
| **17 B. The Topics: Second semester** | **Lecturer's name** |
| Week 1: **Colourer of coordination compounds:** Week 2: **Electronic spectra of coordination compounds**: the angular momentum, Microstate and Selection rules. Week 3: **Orgel diagram for d1, d4, d6 and d9** Week 4**: Orgel diagram for d2, d3, d8 and d7**Week 5**: Tanabe-Sugano Diagrams** Week 6: **Exam1 midterm** Week 7: **Magnetism: Magnetic properties of coordination compounds**Week 8: **Stability of complexes: thermodynamic stability** Week 9: **Stability of complexes: Kinetic stability stability**Week 10: **Substitution reaction in octahedral complexes: type of mechanism** Week 11**: Substitution reaction in square planer complexes:** Week 12**: Midterm Exam 2**Week 13: **Redox reaction: oxidation reduction reaction** and electron transfer reaction Week 14: **Redox reaction: oxidation reduction reaction** and electron transfer reaction Week 15: **Review**:  | Dr. Salim NA Saber.**2 hours** |
| **19. Examinations:****Two exams per semester: All type of questions will be used in exam such as:** Multiple choice, true-false, matching, completion, essay and Short answer |
| **20. Extra notes:** |
| **21. Peer review** |