|  |  |
| --- | --- |
| **Course Title:** | **Chemistry of Transition Elements** |
| **Course Code:** | **CHEM 323** |
| **Program:** | **B.Sc. In Chemistry** |
| **Department:** | **Chemistry** |
| **College:** | **Science** |
| **Institution:** | **King Saud University** |

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# A. Course Identification

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1. Credit hours:** | | | | **3** | | | | | | | | | | | | |
| **2. Course type** | | | | | | | | | | | | | | | | |
| **a.** | University | |  | | College | | |  | Department | | | | **✓** | Others |  |  |
| **b.** | | Required | | | | **✓** | Elective | | |  |  | | | | | |
| **3. Level/year at which this course is offered:** | | | | | | | | | | | | **5 / 3rd year** | | | | |
| **4. Pre-requisites for this course** (if any)**: CHEM 223** | | | | | | | | | | | | | | | | |
| **5. Co-requisites for this course** (if any)**: Non** | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |

## 6. Mode of Instruction (mark all that apply)

| **No** | **Mode of Instruction** | **Contact Hours** | **Percentage** |
| --- | --- | --- | --- |
| **1** | **Traditional classroom** | 45 | 100% |
| **2** | **Blended** |  |  |
| **3** | **E-learning** |  |  |
| **4** | **Distance learning** |  |  |
| **5** | **Other** |  |  |

**7. Contact Hours** (based on academic semester)

|  |  |  |
| --- | --- | --- |
| **No** | **Activity** | **Contact Hours** |
| **1** | **Lecture** | 45 |
| **2** | **Laboratory/Studio** | - |
| **3** | **Tutorial** | - |
| **4** | **Others** (specify) | - |
|  | **Total** | 45 |

# B. Course Objectives and Learning Outcomes

|  |
| --- |
| 1. Course Description |
| Transition metals, and electronic configurations and metal complexes, oxidation numbers and coordination numbers in complex, Ligand and their types and Chelates.Naming of the metal complexes and also discussing the stereochemistry, kinetics, thermodynamics and spectroscopy of coordination compounds and their reactions.Theory of bonding in metal complexes, Werner’s theory and The effective atomic number.Valence bond theory, Crystal field theory Molecular, orbital theory and Ligand field theory. |
| 2. Course Main Objective |
| Develop an adequate appreciation of structure, shape and symmetry of inorganic molecules, the nature of chemical bonding, molecular orbitals, and the relationship between the electronic structure of molecules and their chemical properties and reactivity. |

## 3. Course Learning Outcomes

| **CLOs** | | **Aligned PLOs** |
| --- | --- | --- |
| 1 | **Knowledge and Understanding** |  |
| 1.1 | Recognize the fundamental concepts in the transition elements, coordination complexes, types of ligands, structures, isomerism in coordination complexes, symmetry…… | K1 |
| 1.2 | State the major principles and bonding theories (VBT, CFT,MOT and LFT) in coordination chemistry | K2 |
| 1.3 | Recall the background of coordination chemistry. And outline the use of some ligands, transition metals and coordination complexes in medicine, food industries and other applications. | K3 |
| 1... |  |  |
| **2** | **Skills :** |  |
| 2.1 | Apply various conceptual understanding of coordination chemistry principals and theories | S1 |
| 2.2 | Estimate the geometry and hybridization of the metal complexes. Calculate the CFSE of the metal complexes.Diagram of molecular orbital and ligand field theory.Estimate the John-Teller distortion | S2 |
| 2.3 | Develop solutions to Chemical problems and evaluate the various solution options by Giving the students critical thinking and problems questions. Prepare the student to become active learners. | S3 |
| 2... |  |  |
| **3** | **Values:** |  |
| 3.1 | To apply rational thinking and propose creative solutions to chemical problems with limited guidance. | V1 |
| 3.2 | To have the responsibility to address chemistry problems and coordinate effectively whether in a leadership role or as a member of a team. | V2 |
| 3.3 | To learn theoretically the ethical dimensions and code of practice on how to deal with the risks in real life. | V3 |
| 3... |  |  |

# C. Course Content

|  |  |  |
| --- | --- | --- |
| **No** | **List of Topics** | **Contact Hours** |
| 1 | Transition metals, and electronic configurations and metal complexes, oxidation numbers and coordination numbers in complex, Ligand and their types and Chelates | 6 |
| 2 | Nomenclature of coordination complexes and IUPAC rules and Coordination numbers and geometry | 6 |
| 3 | Types of Isomerism in coordination compounds,Stability of metal complexes | 6 |
| 4 | Theory of bonding in metal complexes, Werner’s theory and The effective atomic number.Valence bond theory. Crystal field theory (CFT) ,magnetic properties of a chemical substances, magnetic susceptibility and magnetic moments of coordination complexes | 12 |
| 5 | The Electronic Spectra of Coordination Compounds. Factors affecting the stability of complexes. Ligand field theory and Molecular orbital theory (MOT) of Octahedral complexes. | 12 |
| 6 | Role of transition metal ions in biology system. | 3 |
| **Total** | | 45 |

# D. Teaching and Assessment

## 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| **Code** | **Course Learning Outcomes** | **TeachingStrategies** | **AssessmentMethods** |
| --- | --- | --- | --- |
| **1.0** | **Knowledge and Understanding** | | |
| 1.1 | Recognize the fundamental concepts in the transition elements, coordination complexes, types of ligands, structures, isomerism in coordination complexes, symmetry…… | Lecture  Blackboard  Extra classes for week students | * Oral, Quiz, and written exams * Samples of class and home assignments * Assessment of processes followed by students to solve problems |
| 1.2 | Describe the thermodynamic stability of complexes compounds, the stability constant, the chelate effect on complexes is investigated. |
| 1.3 | Define the theories of structure and bonding in complex molecules Werner’s Theory, EAN, |
| 1.4 | State the major principles and bonding theories (VBT, CFT,MOT and LFT) in coordination chemistry |
| 1.5 | Recognized the color and Magnetic properties of metal complexes.  Define the spectrochemical series and the John -Teller distortion. |
| 1.6 | Memorized and understand the role of transition metal ions in biology system. |
| **2.0** | **Skills** | | |
| 2.1 | Differentiate the variable oxidation and electronic configuration of transition metal complexes with others | Lecture  Whole group and small group discussion   * Class and home assignments * Case studies * Cooperative learning   Problem solving Comparative case studies Regular follow-up | * Oral and written exams * Samples of class and home assignments * Assessment of processes followed by students to solve problems * Individual discussion |
| 2.2 | Write the IUPAC name of metal complexes.Explain the stability and the isomerism of the complexes |
| 2.3 | Calculate the effective atomic number and analyses the counter ions.  Estimate the geometry and hybridization of the metal complexes. |
| 2.4 | Calculate the CFSE of the metal complexes. Diagram of molecular orbital and ligand field theory. |
| **3.0** | **Values** | | |
| 3.1 | To apply rational thinking and propose creative solutions to chemical problems in society with limited guidance. | Quizzes  Problem solving Comparative case studies Regular follow-up | * Assessment of processes followed by students to solve problems * Individual discussion |
| 3.2 | To have the responsibility to address chemistry problems and coordinate effectively whether in a leadership role or as a member of a team. |
| 3.3 | To learn theoretically the ethical dimensions and code of practice on how to deal with the risks in real life. |

## 2. Assessment Tasks for Students

| **#** | **Assessment task\*** | **Week Due** | **Percentage of Total Assessment Score** |
| --- | --- | --- | --- |
| **1** | Class activates ( in class quizzes, and homework) | Every two weeks | 15% |
| **2** | Midterm exams I | 6 | 20% |
| **3** | Midterm exam II | 12 | 20% |
| **4** | Final exam | 16 | 40% |
| **5** | Others and class participation | weekly | 5% |
| **6** |  |  |  |
| **7** |  |  |  |
| **8** |  |  |  |

**\*Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

# E. Student Academic Counseling and Support

|  |
| --- |
| **Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :** |
|  |

# F. Learning Resources and Facilities

## 1.Learning Resources

|  |  |
| --- | --- |
| **Required Textbooks** | Advanced Inorganic Chemistry, F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bochmann, 6th ed., 1999, J. Wiley & Sons. |
| **Essential References Materials** | Inorganic Chemistry; Principles of structure and Reactivity, J. E. Huheey, E. A. Keiter, R. L. Keiter, 4th ed., 1997, Harper Collins.  -Concepts and Models of Inorganic Chemistry, B. Douglas, D. McDaniel, J. Alexander, 3rd ed., 1994, John Wiley & Sons. |
| **Electronic Materials** | Electronic Materials, Web Sites |
| **Other Learning Materials** | Multi- media associated with the text book and the relevant websites |

## 2. Facilities Required

| **Item** | **Resources** |
| --- | --- |
| **Accommodation**  (Classrooms, laboratories, demonstration rooms/labs, etc.) | -Classrooms with at least 22 seats. Seats should not be bolted to the floor.  -Enough computer facilities labs and internet |
| **Technology Resources**  (AV, data show, Smart Board, software, etc.) | * Overhead projector * Whiteboard * Course book software   Internet, speakers, printers, photocopiers, and laptops for teachers. |
| **Other Resources**  (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | -Video cameras linked to TV circuits  -Molecular models.  -Chem Draw program (CD) |

# G. Course Quality Evaluation

| **Evaluation**  **Areas/Issues** | **Evaluators** | **Evaluation Methods** |
| --- | --- | --- |
| Quality of learning resources  Conduct questionnaires to course instructor and students. | Program leader | In-Direct assessment  (Surveys) |
| Effectiveness of teaching  Evaluation forms from student to course instructor. | Students | In-Direct assessment  (Surveys) |
| Effectiveness of teaching  Extent of achievement of course learning outcomes | Students | In-Direct assessment  (Surveys) |
| Effectiveness of teaching  Effectiveness of course assessment | Students | In-Direct assessment  (Feedback from current teachers and students) |
| Course assessment  Continuous review of the course to assure that it meets the latest updates. | Course coordinator | In-Direct assessment  (Feedback from current teachers and students) |
| Quality of learning resources  Conduct questionnaires to course instructor and students. | Program leader | In-Direct assessment  (Surveys) |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes,Quality oflearning resources, etc.)

**Evaluators** (Students,Faculty, Program Leaders,Peer Reviewer, Others (specify)

**Assessment Methods**(Direct, Indirect)

# H. Specification Approval Data

|  |  |
| --- | --- |
| **Council / Committee** | Dr/ Nouf Alotaibi and Dr/ Osamah Alduhaish |
| **Reference No.** |  |
| **Date** | March 2, 2022 |