Course Specification

(Postgraduate Programs)

Course Title:	**Advanced Inorganic Reaction Mechanisms**
Course Code:	**CHM 6112**
Program:	**Master of science in chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	*Course Specification Version Number*
Last Revision Date:	*Pick Revision Date.*

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A. General information about the course:

1. Course Identification:

1. Credit hours: 3 (3 Lectures, 0 Lab, 0 Tutorials)				
2. Course type				
A.	☐University	☐College	☐Department	☐Track
B.	☐Required		☒ Elective	
3. Level/year at which this course is offered: Level 2/Year 1				

4. Course General Description:

This course provides students for understanding the concepts of the inorganic reaction mechanisms, the Substitution Reactions, Stereochemistry of Octahedral Substitutions, Oxidation-Reduction Reaction. The course will extend to cover Oxidative Additions and Reductive Eliminations, Electron-Transfer Reactions, and Reactions of Free Radicals.

5. Pre-requirements for this course (if any):

Inorganic Molecular Spectroscopy – CHM 6111

6. Pre-requirements for this course (if any):

None

7. Course Main Objective(s):

- **Understand the basic reaction mechanisms of inorganic compounds,**
- **Know mechanistic methods of industrially and ecologically important processes.**
- **Be familiar with the principles and application of fundamental techniques for determination of composition, structure of chemical inorganic compounds.**
- **Have a basic information on the kinds of substitution, redox reaction.**
- **Recognize information on the knowledge accumulated in the field of inorganic reaction mechanisms in relevant areas.**

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**45**	**100 %**
2	E-learning		

No	Mode of Instruction	Contact Hours	Percentage
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**45**
2.	**Laboratory/Studio**	**0**
3.	**Field**	**0**
4.	**Tutorial**	**0**
5.	**Others (specify)……**	**0**
	Total	45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To recognize the substitution reactions for Square-Planer, Tetrahedral and Octahedral complexes.**	**K1. Inorg.; K2. Inorg.; K4. Inorg**	• Five hours/week lectures. • Self-study. • Home-exam.	• Regular Exams. • Assignments . • Short Quizzes. • Oral Discussion. Participation.
1.2	**To define the mechanisms of the Oxidation- Reduction Reaction, free radicals, and Electron-Transfer Reactions.**	**K1. Inorg.; K4. Inorg.**	• Five hours/week lectures. • Think, and justify the Oxidation-Reduction,	• Oral Discussion marks • Literatures Survey • Mini-seminar.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
			free radicals, and Electron-Transfer Reactions mechanism, using available references (SDL) online. • Open discussion.	Participation.
1.3	**To describe the Oxidative Additions and Reductive Eliminations reaction mechanisms.**	**K1. Inorg.; K4. Inorg.**	• Five hours/week lectures. • Group Discussion using available references (SDL)	• Assignments • Open Discussions. • Literatures Survey • Mini-seminar Participation.
1.4	**To list the application of fundamental techniques for determination of composition, structure of chemical inorganic compounds.**	**K1. Inorg.; K3. Inorg.; K4. Inorg.**	• Lectures activity. • Self-study • Deep discussion on types of inorganic reaction mechanisms.	• Questions in Lectures. • Short Quizzes and Exams. • Open Discussions. • Participation • Mini-seminar
2.0	**Skills**			
2.1	**To interpret the different types of inorganic reaction mechanisms.**	**S1. Inorg.; S2. Inorg**	• Lectures activity. • Self-study • Deep discussion on types of inorganic reaction mechanisms.	• Questions in Lectures. • Short Quizzes and Exams. • Open Discussions. • Participation • Mini-seminar

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.2	**To explain the concept of (SN1 and SN2) for the Inorganic Substitution Mechanisms and Electron-Transfer Reactions**	**S1. Inorg.; S2. Inorg.**	• Practice some reaction examples by proposing the reaction mechanism achieving. • Brainstorming. • Self-study.	• Questions in Lectures. • Participation • Oral Discussion • Short Quizzes.
2.3	**To justify the appropriate mechanism for the different classes of complexes**	**S1. Inorg.; S2. Inorg.; S3. Inorg.**	• Lectures and Oral Discussions. • Brainstorming Exercises.	• Questions in Lectures. • Short Quizzes and Exams. • Oral Discussion. • Participation
2.4	**To operate communication to different types of inorganic reaction mechanism, and its impact in Industry in KSA, accompanying writing of mini-Reports, operating electronic mail, and Network in communicating with others.**	**S1. Inorg.; S2. Inorg.; S4. Inorg.**	• Group Discussion and Assignments • Introduce several examples of inorganic reaction mechanism, which will require reading, writing, and oral presentation in groups. • Encourage students to use electronic mail to	• Oral Discussion. • Quizzes, and Exams. • Giving marks for Oral Discussion in Lectures. • Marks given for Assignments .

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
			submit Home Exams and Assignments.	
3.0	**Values, autonomy, and responsibility**			
3.1	**To perform a scientific presentation, research, and work independently and integrate with a collaborated group, Using IT to acquire, analyze, and communicate information**	**V1. Inorg.**	• Brainstorming. • Exercises • Group Discussion. • Teamwork.	• Oral Discussion. • Group Discussion • Assignments.
3.2	**To demonstrate his ability to the effectively collaboration and inter-professionalism in class discussions or team works, as well as independently.**	**V1. Inorg.; V2. Inorg.**	• Small Group tasks • Open discussion at classroom. • Office hour guiding. • Group Presentation of mini-projects	• Participation • Homework's • Mini project(s).

C. Course Content:

No	List of Topics	Contact Hours
1.	**Substitution Reactions**: Molecularity, Factors affecting on the substitution rate, Octahedral complexes, Acid hydrolysis, Anation reaction, Base hydrolysis, Reactions without metal-ligands cleavage, Substitution reactions in non-aqueous solvents.	8

2.	**Stereochemistry of Octahedral Substitutions**: Outer-sphere orientation, Substitution through dissociation (SN1 and SN1) processes, Attacks of reactants on ligands (not on metal), Linkage isomerism, Nucleophilicity in inorganic chemistry, npt Scale, The scale of Swain and Scott, Edwards'scale, The theory of "hard" and "soft" acids and bases, Substitutions on square-planar complexes, The mechanism of ligand replacements, Trans effect, Cis effect, Leaving group effects, Effect of the central metal ion, Substitution reactions of tetrahedral complexes, Substitutions of carbonyls.	8
3.	**Substitution Reactions of Square-Planer Complexes:** Factors controlling the reactivity, X-ray studies, trans, cis-effect theories, Polarization and π-bond theories, Effect of solvent, chelation , metal center.	6
4.	**Oxidation- Reduction Reaction**: outer-sphere mechanism, Franck-Condon Restrictions, Inner-Sphere mechanism, Two electron transfers.	8
5	**Oxidative Additions and Reductive Eliminations**: Oxidative Additions, Two-electron oxidative additions, Mechanism of Oxidative Addition of the Nucleophilic Substitution Type, One-electron Oxidative Additions, Reductive Eliminations.	4
6	**Electron-Transfer Reactions**: Franck-Condon Principle, Outer-Sphere Electron Transfer, Marcus Theory of Outer-Sphere Electron Transfer, Long-Range Electron Transfers in Biological Systems, Inner-Sphere Electron transfer, Reactions with solvated electrons.	6
7	**Reactions of Free Radicals:** Chain reactions, Stability of the metal-carbon, Oxidation of Transition Metal Complexes by hydroxyl radicals, Reduction of transition metal complexes by organic radicals.	5
Total		45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Class Activities (Open Discussion, Mini-reports, Oral Presentation, solving questions)**	**weekly**	**30 %**
2.	**Midterm Exam**	**9th week**	**30 %**
3.	**Final Exam**	**17 th week**	**40 %**
4.	**Total**		**100%**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	Chemical Kinetics and Inorganic Reaction Mechanisms, S. Asperger, 2nd Ed., Springer Science, Business Media New York, (2003). ISBN 978-1-4613-4871-9 ISBN 978-1-4419-9276-5 (eBook), DOI 10.1007/978-1-4419-9276-5. Reaction Mechanisms of Inorganic and Organometallic Systems, R. B. Jordan, Oxford University Press 2007. ISBN-10 : 0195301005 , ISBN-13 : 9780195301007.
Supportive References	
Electronic Materials	• European Journal Of Inorganic Chemistry • American Chemical Society (Relevant Journals) Saudi Digital Library.
Other Learning Materials	• Blackboard • Multimedia associated with the text book and the relevant websites.

3. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.
Technology equipment (projector, smart board, software)	• The rooms are equipped with data show, Smart Board, • WI-FI access.
Other equipment (depending on the nature of the specialty)	• None

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Direct: Questionnaire.
	Course Responsible	Direct: Course e-Portfolio. Indirect: Second examiner checklist-Course report.
	Peer Reviewer	Direct: Questionnaire. Indirect: External assessor report.
Effectiveness of students assessment	Program Leaders	Direct: Course e-Portfolio. Indirect: Course report.
Quality of learning resources	Students	Indirect: Second examiner checklist-Course report.
	Faculty (Academic Advisory-GCC)	Direct: course Entrance/Exit. Indirect: Observations - Accreditation review.
	Program Leaders	Direct: Course e-Portfolio. Indirect: Course evaluation survey- Observations- Syllabus review- Accreditation review.
	Course Responsible	
The extent to which CLOs have been achieved	Course Responsible	Direct: Exams - Course e-Portfolio. Indirect: Second examiner checklist-Course report.
	Program Leaders	Indirect: Exams.
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	Council of Chemistry Department
REFERENCE NO.	10 (No. 2/10)
DATE	21/04/1444- 15/11/2022