مركز الاعتماد وضمان الجودة
ACCREDITATION & QUALITY ASSURANCE CENTER

Course Syllabus

1	**Course title**	Introduction to Catalysis	
2	**Course number**	0303423	
3	**Credit hours**	3	
	Contact hours (theory, practical)	3	
4	**Prerequisites/corequisites**	0303321	
5	**Program title**	BSc. In Chemistry	
6	**Program code**	0303	
7	**Awarding institution**	Science	
8	**School**	Science	
9	**Department**	Chemistry	
10	**Course level**	Third Year	
11	**Year of study and semester (s)**		
12	**Other department (s) involved in teaching the course**	N/A	
13	**Main teaching language**	English	
14	**Delivery method**	X Face to face learning ☐ Blended ☐Fully online	
15	**Online platforms(s)**	☐Moodle ☐Microsoft Teams ☐Skype ☐Zoom ☐Others……	
16	**Issuing/Revision Date**		

17 Course Coordinator:

Name: Afnan Al-Hunaiti	Contact hours:
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مركز الاعتماد وضمان الجودة
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18 Other instructors:

Name: Office number: Phone number: Email: Contact hours: Name: Office number: Phone number: Email: Contact hours:

19 Course Description:

As stated in the approved study plan.

20 Course aims and outcomes:

A- Aims:

This course explores the fundamental principles of catalysis, including the mechanisms of catalytic reactions, types of catalysts, and their application in industrial processes, environmental remediation, and green chemistry. Students will gain a comprehensive understanding of both homogeneous and heterogeneous catalysis, with an emphasis on recent developments and future trends in the field.

B- Students Learning Outcomes (SLOs):

SLO-1. **Problem Solving**: Graduates will be able to apply mathematical and scientific knowledge to identify, formulate, and solve technical or scientific problems relevant to the discipline of chemistry.

SLO-2. **Design**: Graduate will be able to use their understanding of chemistry concepts and principles to formulate and design systems, processes, procedures, or programs to meet desired goals and outcomes.

SLO-3. **Experimental Skills**: Graduates will be able to design, conduct, and analyze experiments or test hypothesis, utilizing appropriate chemical techniques and scientific judgments to draw meaningful conclusions.

SLO-4. **Communications**: Graduates will be able to communicate scientific information effectively and accurately to a range of audiences, including both technical and non-technical audiences.

SLO-5. **Ethics and Global Context**: Graduates will understand and apply ethical and professional responsibilities in the context of the impact of technical and scientific solutions on global, economic, environmental, and societal issues.

SLO-6. **Teamwork**: Graduates will be able to work effectively as a part of a team, establishing goals, planning tasks, meeting deadlines, and analyzing risk and uncertainty in the context of chemistry-related projects and initiatives.

SLO-7. **Handling Chemicals**: An ability to apply the proper procedures for safe handling of chemicals

SLO-1. **Problem Solving**: Student will be able to apply mathematical and scientific knowledge to identify, formulate, and solve catalysis efficiency and activity turn over time (TON) and turn over frequency (TOF)

SLO-2. **Design**: student will be able to use their understanding of catalysis concepts and principles to formulate and design the catalytic systems, processes, procedures, or programs to meet desired goals and outcomes.

SLO-3. **Communications**: Student will be able to communicate scientific information effectively and accurately to a range of audiences, including both technical and non-technical audiences.

مركز الاعتماد وضمان الجودة

SLO-4. **Ethics and Global Context**: Student will understand and apply ethical and professional responsibilities in the context of the impact of technical and scientific solutions on global, economic, environmental, and societal issues.

SLO-5. **Teamwork**: Student will be able to work effectively as a part of a team, establishing goals, planning tasks, meeting deadlines, and analyzing risk and uncertainty in the context of chemistry-related projects and initiatives.

Upon successful completion of this course, students will be able to:

CLO-1. Understand fundamental principles of catalysis, including reaction mechanisms and kinetics.
CLO-2. Analyze various types of catalysts, including heterogeneous, homogeneous, and biocatalysts.
CLO-3. Evaluate the design and optimization of catalyst systems for industrial applications.
CLO-4. Apply knowledge of catalysis to real-world problems, including environmental issues and sustainable practices.

		Student Outcomes (SO)						
		SO-1	SO-2	SO-3	SO-4	SO-5	SO-6	SO-7
Course Learning Outcomes (CLO)	CLO-1	✓	✓					
	CLO-2	✓	✓		✓	✓		
	CLO-3	✓	✓		✓			
	CLO-4	✓	✓					

21. Topic Outline and Schedule:

Week	Lecture	Topic	Student Learning Outcome	Learning Methods (Face to Face/Blended/ Fully Online)	Platform	Synchronous / Asynchronous Lecturing	Evaluation Methods	Resources
1	1.1	Overview of catalysis.	CLO-1	**Face to Face**	In class	NA	Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
	1.2	Introduction and Fundamental Catalytic Phenomena.	CLO-1	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes

	1.3	Rate laws and catalytic kinetics, Catalyst activity and selectivity.	CLO-1	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
2	2.1	Homogeneous catalysis	CLO-1	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
	2.2	heterogeneous catalysis	CLO-1	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
	2.3	Biocatalysts and enzyme catalysis	CLO-1	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
3	3.1	Catalyst Materials, Properties, and Preparation	CLO-1	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
	3.2	Types of catalysts: metals, metal oxides, zeolites,	CLO-1	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
	3.3	Methods for catalyst preparation: impregnation, co-precipitation, sol-gel	CLO-1	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
4	4.1	Methods for catalyst preparation: co-precipitation, sol-gel	CLO-1	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
	4.2	Methods for catalyst preparation: impregnation, co-precipitation,	CLO-2	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes

		sol-gel						
	4.3	Catalyst Characterization	CLO-2	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
5	5.1	Techniques for characterizing catalysts (e.g., BET, TGA, XRD)	CLO-2	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
	5.2	Techniques for characterizing catalysts (e.g., BET, TGA, XRD)	CLO-2	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
	5.3	Surface area and porosity	CLO-2	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
6	6.1	Reaction Mechanisms	CLO-2	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	6.2	Mechanisms of heterogeneous catalysis.	CLO-2	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	6.3	Types of heterogeneous catalysts	CLO-2	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
7	7.1	Homogeneous Catalysis	CLO-3	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	7.2	Mechanisms and applications of homogeneous	CLO-3	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to

		catalysis.						Applications
	7.3	Mechanisms and applications of homogeneous catalysis.	CLO-3	**Face to Face**	In class			Catalysis - From Principles to Applications
8	8.1	Role of ligands and metal catalysts in organic synthesis.	CLO-3	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	8.2	Role of ligands and metal catalysts in organic synthesis.	CLO-3	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	8.3	Role of ligands and metal catalysts in organic synthesis.	CLO-3	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
9	9.1	Biocatalysis and Enzyme Catalysis	CLO-3	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	9.2	Biocatalysts and their applications	CLO-3	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	9.3	Enzyme catalysis and traditional synthetic methods.	CLO-3	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
10	10.1	Enzyme catalysis and traditional synthetic methods.	CLO-4	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications

	10.2	Catalyst Design and Optimization	CLO-4	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	10.3	Types of reactors: batch, continuous, and fixed bed reactors.	CLO-4	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
11	11.1	Techniques for measuring catalytic activity and selecting appropriate testing conditions.	CLO-4	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
	11.2	catalyst deactivation: poisoning, sintering, and fouling.	CLO-4	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
	11.3	Hydrogenation of Organic Compounds	CLO-4	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
12	12.1	Hydrogenation of Organic Compounds	CLO-4	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	12.2	Dehydrogenation of Organic Compounds	CLO-4	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	12.3	Dehydrogenation of Organic Compounds	CLO-4	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications

	13.1	Catalytic Oxidations of Inorganic and Organic Compounds	CLO-4	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
13	13.2	Mechanisms of catalytic oxidation reactions.	CLO-4	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	13.3	Mechanisms of catalytic oxidation reactions.	CLO-4	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	14.1	Mechanisms of catalytic oxidation reactions.	CLO-4	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
14	14.2	Applications of oxidation chemistry in industrial processes.	CLO-4	**Face to Face**	In class		Quizzes + Exam	Catalysis - From Principles to Applications
	14.3	Case studies on selective catalytic reduction and oxidation (SCR), (SOR) technologies	CLO-4	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
	15.1	Catalysis in Green Chemistry	CLO-4	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
15	15.2	Advances in catalyst technology	CLO-4	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial Catalytic Processes
	15.3	Examples of New catalytic technology:	CLO-4	**Face to Face**	In class		Quizzes + Exam	Fundamentals of Industrial

								Catalytic Processes

22 Evaluation Methods:

Opportunities to demonstrate achievement of the SLOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	SLOs	Period (Week)	Platform
Home Work	10	All	All	Every week	Face to Face
Presentation	10	All	All	Every week	Face to Face
Quizzes	10	All	All	Every week	Face to Face
Mid	30	All	All	8	Face to Face
Final	50	All	All	16	Face to Face

23 Course Requirements

(e.g: students should have a computer, internet connection, webcam, account on a specific software/platform…etc): N/A

24 Course Policies:

A- Attendance policies:

Attendance is taken each class.

Six unexcused absences will result an "F" grade.

B- Absences from exams and submitting assignments on time:

The highest four marks from all the quizzes will be considered. No make-up exams will be held for the quizzes, regardless of the excuse.

The highest four marks from all the Home works will be considered. No make-up exams will be held for the quizzes, regardless of the excuse.

Course Coordinator will take care for student whom absent for the midterm exam.

Dean Office will take care for student whom absent for the final exam.

C- Health and safety procedures:

N/A

D- Honesty policy regarding cheating, plagiarism, misbehavior:

Students are expected to adhere to the standards of academic honesty. Collaboration and discussion are encouraged, cheating of any kind is not tolerated.

E- Grading policy:

F- Available university services that support achievement in the course:

25 References:

A- Required book(s), assigned reading and audio-visuals:

Fundamentals of Industrial Catalytic Processes (2016), Catalysis - From Principles to Applications" by M. Beller and R. A. Sheldon

C.H. Bartholomew & R. Farrauto-Wiley

B- Recommended books, materials, and media:

Catalysis: Concepts and Green Applications" By: Gadi Rothenberg, Wiley, 2008.

online journal articles from Catalysis Reviews and Journal of Catalysis.

Access to online databases like ScienceDirect and Wiley Online Library for research papers on catalysis.

26 Additional information:

Name of Course Coordinator: Afnan Al-hunaiti Signature: ---------- Date: 25/2/2024
Head of Curriculum Committee/Department: Deeb Taher--------- Signature: ----------
Head of Department: Firas Awwadi ---------- --- Signature: ----------
Head of Curriculum Committee/Faculty: ---------- Signature: ---------- -
Dean: ---------- Signature: ----------