Course Specification

(Bachelor)

Course Title:	Catalysis and Surface chemistry
Course Code:	CHM 1447
Program:	Bachelor of Science in Chemical Laboratories
Department:	Chemistry
College:	Science
Institution:	Imam Mohammed Ibn Saud Islamic University
Version:	1446-10-v1
Last Revision Date:	1446-10-v1

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: 3 (3, 0, 0)					
3 (3 Lectures, 0 Lab and 0 Tutorials)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: Level 7/ Fourth year					
4. Course general Description:					
This course describes the definitions and types of homogeneous and heterogeneous catalysts, extending to the preparation methods and characterization. This course designed to provide with the concepts of heterogeneous catalysis, theoretical, methodological and technical knowledge of the catalysts and catalytic cycle. The course will cover surface Chemistry: Solid surfaces and their characterization; Adsorption on solid surfaces: technique for measurement of adsorption.					
5. Pre-requirements for this course (if any)**:**					
Physical Chemistry- CHM 1346					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s): Industrial Catalysis, Reactions					
The student will gain information about surface Chemistry: Solid surfaces and their characterization; Adsorption on solid surfaces: technique for measurement of adsorption from gas phase and solution; Langmuir, Freundlich and BET adsorption isotherm: Enthalpy of adsorption; Adsorption on liquid surface. Gibb's adsorption equation; Surface film; Electro-capillary phenomena.This includes initiation to catalysis specifically acid-base and enzymatic catalysis.operate laboratory instruments.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**45**	**100%**
2	E-learning	**0**	**0**
3	Hybrid • Traditional classroom • E-learning	**0**	**0**
4	Distance learning	**0**	**0**

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 PLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To list the main concepts and applications of homogeneous and heterogeneous catalysis.**	**K1; K2; K3**	• Lectures and Group Discussions A Private study including home exam.	**Direct:** ✓Quizzes ✓Discussion ✓Participatio Exams
1.2	**To recognize the concept of acid-base catalysis and proton transfer and describe the acid-base cycle and its industrial application.**	**K1; K2; K3**	• Lectures with • group discussion. • Think, talk, and discuss concept of acid-base catalysis	**Direct:** ✓Oral Discussion ✓Exams ✓Participation
1.3	**To define surface chemistry and adsorption-desorption process, and list techniques for measurement of adsorption and surface area.**	**K1; K3**	▪ Lectures with group discussion. ▪ Think, talk, and discuss surface chemistry and adsorption-desorption process	**Direct:** ✓ Quizzes ✓ Home exam ✓ Oral discussions.
2.0	**Skills**			

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
2.1	**To differentiate homogenous and heterogeneous catalysis mechanisms, and estimate the kinetics and thermodynamic parameters of catalytic reactions and to calculate the adsorption parameters.**	**S1; S2; S3**	✓ Interactive lectures ✓ Brainstorming Group discussions	**Direct:** ✓ Short Quizzes and Exams. ✓ Participation ✓ Oral Discussion,
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**S1; S2; S3**	✓ Interactive lectures Group discussions	**Direct:** ✓ Questions in Lectures. ✓ Short Quizzes and Exams. ✓ Participation ✓ Oral Discussion,
2.3	**To demonstrate ability to participate in class by asking questions and giving answers.**	**S3**	✓ Interactive lectures ✓ Brainstorming Group discussions	**Direct:** ✓ Short Quizzes and Exams. ✓ Participation ✓ Oral Discussion,
2.4	**To show technical writing and oral communication skills through writing and oral presentation of mini-reports and operate electronic mail and Network in communicating with others.**	**S2; S3; k4**	✓ Interactive lectures ✓ Brainstorming • Group discussions	**Direct:** ✓ Short Quizzes and Exams. ✓ Participation ✓ Oral Discussion,
3.0	**Values, autonomy, and responsibility**			
3.1	**To appraise coordination and raise knowledge during various evaluations,**	**V1; V2**	• **Group discussion and assignments** • **homework**	**Direct:** ✓ **Oral tests** ✓ **Assignments**

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	initiatives, and mini reports to uphold scientific integrity.			homework marks

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction, Bulk, surface, Adsorption, adsorbate, adsorbent, Desorption, absorption, Physisorption, Chemisorption, surface area.	6
2.	Adsorption at Solid Liquid interface. Adsorption at Solid Gas interface, specific surface area.	9
3.	Adsorption isotherm, Henry's equation, Freundlich isotherm, Langmuir isotherm, Potential theory of adsorption, Dubinin-Radushkevich.	9
4.	Catalyst and catalysis, Types of catalysis, Classification of catalysis.	6
5.	Characteristics of catalytic reactions, Catalytic promoters, Catalytic poisons.	6
6.	Theories of catalysis. Biochemical or enzyme catalysis. Acid-base catalysis. Heterogeneous Catalysis. Industrial applications of catalysts	9
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1	6th/ 7th week	20 %
2.	Midterm 2	11th/ 12th week	20 %
3.	Quizzes, Home Works, class participation, and mini projects	During the semester	20 %
5.	Final Exam	16thweek	40 %
6.	Total	All weeks	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	Duncan J. Shaw, **Introduction to Colloid and Surface Chemistry**, ASIN : 0750611820, Butterworth-Heinemann; 4th edition (April 1, 1992), ISBN-10 : 9780750611824, ISBN-13: 978-0750611824
Supportive References	1. Paul C. Hiemenz, Raj Rajagopalan, ***Principles of Colloid and Surface Chemistry***, Third Edition, Revised and Expanded, CRC Press; 3rd edition (March 18, 1997), ISBN-10 : 0824793978, ISBN-13 : 978-0824793975 2. R.A. van Santen, Hans (J.)W. Niemantsverdriet, ***Chemical Kinetics and Catalysis***, Springer (May 10, 2013), ISBN-10 : 1475796447, ISBN-13 : 978-1475796445
Electronic Materials	• ***Blackboard*** • ***www. Elesevier.com***
Other Learning Materials	***None***

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Each of the class room 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)	

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.

Assessment Areas/Issues	Assessor	Assessment Methods
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
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		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**COUNCIL OF DEPARTMENT OF CHEMISTRY**
REFERENCE NO.	**3 (NO. 1/3)**
DATE	**5/3/1446- 8/09/2024**