Course Specification

(Bachelor)

Course Title:	Industrial Catalysis
Course Code:	CHM 1349
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 (2, 3, 0)					
3 (2 Lectures, 3 Lab, 0 Tutorials)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 5/ Third year					
4. Course general Description:					
The course covered Introduction to catalysis: Fundamental Concepts of catalysis, types, advantages and disadvantages, Theories of acid-base, Acid-base equilibrium and acidity function. Preparation and characterization of catalysts: methods, structural analysis, surface analysis and others. Concepts of heterogeneous catalysis: Introduction and Definition History, catalysts and catalytic properties, general mechanism of action catalyst: diffusion, adsorption - desorption kinetics Industrial applications of selected catalysts; nanostructured carbon materials as catalysts, doped materials, metal oxides and others. Heterogeneous catalysis Area of application.					
5. Pre-requirements for this course (if any)**:**					
Principles of Physical Chemistry- CHM 1240					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s): Industrial Catalysis, Reactions					
At the end of the course, Students should be able: ✓ list the main concepts of homogeneous and heterogeneous catalysis. ✓ outline the concept of acid-base catalysis and proton transfer. ✓ describe some of industrial applications of heterogeneous catalysis. ✓ recall the mechanism of catalytic reactions.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**75**	**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**	**30**
2.	**Laboratory/Studio**	**45**
3.	**Field**	**0**
4.	**Tutorial**	**0**
5.	**Others (specify)**	**0**
Total		**75**

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 homogeneous and heterogeneous catalysis.**	**K1; K2**	• Six hours weekly, containing lectures and laboratory activities • A Private study, including a Homework	**Direct:** • exams, Quizzes • Homework Laboratory Reports • Participation
1.2	**To outline the concept of acid-base catalysis and proton transfer and describe the industrial application.**	**K1; K4**	• Two hours weekly, containing lectures • A Private study, including a Homework • Group discussion	**Direct:** • exams, Quizzes • Oral Discussion • Laboratory Reports • Participation
1.3	**To recall the mechanism of catalytic reactions**	**K1; K4**	• Lectures • laboratory experiments	**Direct:** • Participation, • Quizzes and MCQs,

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
			• Group discussion .	Laboratory reports and performance
2.0	**Skills**			
2.1	**To differentiate homogenous and heterogeneous catalysis mechanisms, and estimate the kinetics and thermodynamic parameters of catalytic reactions.**	**S1; S3**	• Lecturing, • group discussion Laboratory experiments performance	**Direct;** • Short quizzes Exams, • Solved problems marks • Homework assignment Laboratory reports
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**S2; S3**	• Lecturing, • group discussion • Laboratory experiments performance	**Direct;** • Short quizzes Exams, • Solved problems marks • Homework assignment • Laboratory reports
2.3	**To demonstrate ability to participate in class by asking questions and giving answers.**	**S3**	• Brain storming • Self-study	**Direct;** • Quizzes • Oral discussion • Laboratory reports
2.4	**To diagram and explain experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.**	**S2; S4**	• Group discussion • Laboratory experiments. • Brain storming	**Direct;** • Homework assignment, • Examination • Laboratory report and performance
3.0	**Values, autonomy, and responsibility**			
3.1	**Appraise teamwork and create awareness to maintain scientific**	**V2**	• Group discussion, assignments, and homework	**Direct** ✓Oral tests, ✓Sheets Marks

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	integrity during assessments, projects, and mini-projects.			✓Assignments and homework marks • Mini projects
3.2	**Show personal values and attributes such as honesty, empathy and respect for others**	**V1, V2**	• Teamwork and class discussions	**Direct** ✓ lab reports ✓ Mini projects

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction to catalysis**: Fundamental Concepts of catalysis, types, advantages and disadvantages, Theories of acid-base, Acid-base equilibrium and acidity function	6
2.	Preparation and characterization of catalysts: methods, structural analysis, surface analysis and others	6
3.	**Concepts of heterogeneous catalysis**: Introduction and Definition History , catalysts and catalytic properties, general mechanism of action catalyst: diffusion, adsorption - desorption kinetics	6
4.	Industrial applications of selected catalysts; nanostructured carbon materials as catalysts, doped materials, metal oxides and others.	6
5.	Heterogeneous catalysis Area of application: reactions and catalytic processes such as Hydrogenation reactions, ammonia synthesis and decompositions, oxidation reactions, other reactions.	6
	Laboratories Topics	
1	Safety principles	3
2	Catalysts for the decomposition of hydrogen peroxide	3
3	Catalytic degradation of dye on graphene-based materials	3
4	Catalytic degradation of dye on graphitic carbon nitride-based materials	3
5	Catalysts for hydrogen production from hydrolysis of sodium borohydride	3
6	Catalytic esterification of acetic acid with n-amyl alcohol over natural clay	3
7	Cement Analysis (Determination of insoluble residue)	3
8	Cement Analysis (Determination of Fe_2O_3 and Al_2O_3 and others)	3
9	Effect of catalyst weight on decomposition of hydrogen peroxide	3
10	Determination of activation energy of decomposition of H_2O_2	3
11	Gasometric technique for gases measurements (H_2O_2, and $NaBH_4$)	3

12	Determination of surface area of charcoal by adsorption of I_2	3
13	Study the corrosion of different metals in acidic medium using gravimetric method	3
14	Study the effect of organic inhibitors on the corrosion of metals in acidic medium	3
15	Revision and Lab. Reports overview	3
Total		75

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1	6th/ 7th week	10 %
2.	Midterm 2	11th/ 12th week	10 %
3.	Quizzes, Home Works, class participation, and mini projects	During the semester	10 %
4.	Laboratory	All the semester	30 %
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	Philippe Serp , Bruno Machado, **Nanostructured Carbon Materials for Catalysis (Catalysis Series, Volume 23)** Royal Society of Chemistry; 1st edition (March 2, 2015), ISBN-10 : 1849739099, ISBN-13 : 978-1849739092
Supportive References	Jens Hagen , **Industrial Catalysis: A Practical Approach**, ASIN : 3527331654, Wiley-VCH; 3rd edition (November 2, 2015), ISBN-10 : 9783527331659, ISBN-13 : 978-3527331659.
Electronic Materials	
Other Learning Materials	

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.** • **In each laboratory, a list of safety and precautions are provided.** • **In each lab has proper ventilation, and well equipped with instruments.** • **In each lab, containers for solid waste, liquid waste, and crushed glasses.** • **Each lab has a small pharmacy for first aid in case of an accident** • **In each lab, the rules, conditions, and safety mechanism as well list of Risk, Safety precautions according to Merck Catalogue are hanging in the labs**
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)	• **Appropriate Glasswares for carrying the requested experiments (conical flasks, beakers, measuring cylinders)** • **Appropriate fine chemicals and solvents (distilled Water ammonium nitrate)** • **Analytical balance (3 digits), Set gas laws with the glass jacket Data acquisition set for gas laws with glass jacket, PC, Windows® 95 or higher, calorimeter, thermometer, Filter papers , clamps, stands**

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.

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