Course Specifications

Course Title:	**Selected Topics in Physical Chemistry**
Course Code:	**633CHEM-2**
Program:	**Master of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**King Khalid University**

Table of Contents

A. Course Identification

1. Credit hours:	2
2. Course type	
a.	University ☐ College ☐ Department ■ Others ☐
b.	Required ■ Elective ☐
3. Level/year at which this course is offered:	Level 3 / Year 2
4. Pre-requisites for this course (if any)**:**	No prerequisite
5. Co-requisites for this course (if any)**:**	No co-requisite

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	2	100%
2	**Blended**	0	0
3	**E-learning**	0	0
4	**Correspondence**	0	0
5	**Other**	0	0

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	30
2	**Laboratory/Studio**	0
3	**Tutorial**	0
4	**Others** (specify)	0
	Total	30
Other Learning Hours*		
1	**Study**	30
2	**Assignments**	30
3	**Library**	15
4	**Projects/Research Essays/Theses**	15
5	**Others** (specify)	0
	Total	90

* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

B. Course Objectives and Learning Outcomes

1. Course Description

- This course describes different types of catalytic processes.
- The course gives an introduction about catalysis, followed by the main synthesis methods of catalysts preparation.
- Moreover, the course gives strong background about catalysis characterizations. Finally the course gives details about enzyme catalysis, heterogeneous catalysis, homogeneous catalysis, photocatalysis and electrocatalysis.

2. Course Main Objective

The main purpose of this course is to understand catalysis phenomena, types of catalysis and their applications. - Understand why heterogeneous catalysis is important and how studying surface chemistry greatly help to understand heterogeneous catalytic reactions. - Determine the properties of a surface and the types of adsorption at the surface. - Understand the events that occur at a catalyst surface and parameters that affect its performance. - Describe the basic principles of spectroscopic methods that are used for probing catalyst surface. (Catalyst Characterization) - Classify the different types of solid catalysts. - Identify the main preparation methods of solid catalysts. - Carry out practical exercises with some research papers to review what has been learnt in this course. - Know how relate the basic principles, given in this course, to recent research outcomes.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge:**	
1.1	To gain the knowledge of the fundamental concepts and principles of catalysis.	K1, K2, K3
1.2	To understand the theories and link them with the daily life phenomena..	K1, K2, K4
2	**Skills :**	
2.1	To analyze, interpret and explain the physical phenomena based on the course topics.	S1, S2
2.2	To use the mathematical equations to explain a certain physical phenomenon.	S1, S2
3	**Competence:**	
3.1	To present an oral explanation for a subject in the field.	C1,C2, C3 and C4
3.2	To interact positively with colleagues in a group work.	C2, C3 and C4
3.3	To contribute with colleagues to prepare and deliver a presentation and report of group work	C2
3.4	To summarize the literature and sources for a specific topic in the course.	C4

C. Course Content

No	List of Topics	Contact Hours
1	Introduction - Why catalysis - Understand catalysis phenomena - Types of catalysis - Properties of the good catalyst - Role of catalysis in economy - Industrial applications of catalysis	4
2	Catalysis synthesis Bulk catalysts and supports - Precipitation/co- precipitation - Sol/gel - Flame pyrolysis - Spreading/wetting - Melting/metallurgy - Raney alloys Supported catalysts - Impregnation - Grafting - Chemical vapour deposition - Immobilization of metal particle and clusters - Deposition-precipitation	6
3	Catalysts Characterizations - Elemental analysis	6

	• X-ray powder diffraction • UV-Vis spectroscopy • Raman Spectroscopy • Temperature program technique • Microscopy (TEM and SEM) • Physisorption measurements (BET surface area)	
4	Terminologies of catalysis (Tutorial) • Conversion • Selectivity • Turn over (turn over number, turn over frequency) • Deactivation	4
5	Faces of catalysis 1- Enzymatic catalysis (Lecture) • What are the enzymes • Enzyme nomenclature • Classification of enzymes • The active sites in enzymes • Specificity • Lock-key theory • Deactivation of enzymes	2
6	Faces of catalysis 2- Heterogeneous catalysis (Lecture) • Classifications the different types of solid catalysts. • Oxides, clays, zeolites, heteropoly acids • Natural zeolite • Synthetic zeolite • How to prepare zeolite • Zeolites in petrochemical industry	2
7	Faces of catalysis 3- Homogeneous catalysis (Lecture) • Organometallic complexes • Catalytic steps in homogeneous reactions • Wilkinson's Catalyst • Wilkinson's catalyst selectivity • Cationic catalysts • Chiral hydrogenation catalysts • Hydroformylation (Otto Roelen's catalyst)	3
7	Faces of catalysis 4- Photocatalysis (Lecture) • Photocatalytic applications • Antimicrobial Effect • Self-Cleaning Effect • Photocatalysts • TiO_2 – an Ideal Photocatalyst • Essential Physicochemical Properties of TiO_2 • Visible-Light Active Photocatalyst	3

Total	30

D. Teaching and Assessment

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

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge**		
1.1	To gain the knowledge of the fundamental concepts and principles of catalysis..	Lectures, interactive teaching sessions, problems solving sessions	Written exams, electronic quizzes, Oral discussion and examinations
1.2	To understand the theories and link them with the daily life phenomena..		
2.0	**Skills**		
2.1	To analyze, interpret and explain the physical phenomena based on the course topics..	Lectures, problems solving sessions	Written exams
2.2	To use the mathematical equations to explain a certain physical phenomenon..		Oral discussion,
3.0	**Competence**		
3.1	To present an oral explanation for a subject in the field.	Lectures.	Oral presentation.
3.2	To interact positively with colleagues in a group work.	Interactive teaching sessions	Oral presentation on a group report
3.3	To contribute with colleagues to prepare and deliver a presentation and report of group work	Interactive teaching sessions	Discussion within a group
3.4	To summarize the literature and sources for a specific topic in the course.	Guided reading of books and articles	Written Reports and summaries

2. Assessment Tasks for Students

#	*Assessment task	Week Due	Percentage of Total Assessment Score
1	Written Reports and summaries	5th	10
2	Oral discussion	8th	5
3	Presentations and reports	4-7th	5
4	Midterm exam-1	6th	15
5	Midterm exam-2	11th	15
6	Final exam	16th	50

***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 :

10 office hours are offered for students for individual consultations. Communications are available on-site, phone conversations, and chatting by social media.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	1. J.A. Moulijn, Catalysis: an integration approach, 2002, Amsterdam
Essential References Materials	1. J. M. Thomas, W. J. Thomas, Principles and Practice of Heterogeneous Catalysis, VCH Germany 1997. 2. G. Attard, C. Barnes, Surfaces, Oxford University Press, 2004. 3. J. W. Niemantsverdriet, Spectroscopy in Catalysis, WILEY-VCH England, 2007. 4. K. W. Kolasinski, Surface Science: Foundations of Catalysis and Nanosciences, , Wiley England 2008 5. G. Ertl, H. Knozinger & J. Weitkamp, Preparation of Solid catalysts., Wiley-VCH, 1999. 6. L, Lawrie, Handbook of Industrial Catalysts, Springer 2011.
Electronic Materials	1. http://portal.kku.edu.sa/KKU_Website/ar/deanships/Library_Affairs/index.htm 2. http://www.sdl.edu.sa/Pages/Default.aspx 3. http://www.sciencedirect.com/ 4. http://www.scopus.com/home.url
Other Learning Materials	No other learning materials.

2. Facilities Required

Item	Resources
Accommodation Classrooms, laboratories, demonstration) (.rooms/labs, etc	Classroom and computer lab
Technology Resources AV, data show, Smart Board, software,) (.etc	Data show
Other Resources Specify, e.g. if specific laboratory) equipment is required, list requirements or (attach a list	-

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Course delivering	Student	Questionnaire
Course contents (update)	Plan and curriculum committee	Report
Teaching materials	Faculty	Meeting
Learning materials	Student	Discussion
Assignment	Program instructor and Faculty	Report
Exams	Program instructor and Faculty	Report

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	**Chemistry Department Council**
Reference No.	**Session number 22**
Date	**27/04/2021M / 15/09/1442H**