



# Course Specifications

<b>Course Title:</b>	<b>Chemistry of Catalysis</b>
<b>Course Code:</b>	<b>4023563-3</b>
<b>Program:</b>	<b>Chemistry / Industrial Chemistry</b>
<b>Department:</b>	<b>Chemistry Department</b>
<b>College:</b>	<b>Applied Science</b>
<b>Institution:</b>	<b>Umm Al-Qura University</b>



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## A. Course Identification

<b>1. Credit hours:</b> 3 (2 theoretical + 1 practical)
<b>2. Course type</b>
a. University <input type="checkbox"/> College <input type="checkbox"/> Department <input checked="" type="checkbox"/> Others <input type="checkbox"/>
b. Required <input checked="" type="checkbox"/> Elective <input type="checkbox"/>
<b>3. Level/year at which this course is offered:</b> 7th /4
<b>4. Pre-requisites for this course (if any):</b> NA
<b>5. Co-requisites for this course (if any):</b> NA

## 6. Mode of Instruction (mark all that apply)

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

## 7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
<b>Contact Hours</b>		
1	Lecture	28
2	Laboratory/Studio	42
3	Tutorial	
4	Others (specify)	
	<b>Total</b>	<b>70</b>
<b>Other Learning Hours*</b>		
1	Study	14
2	Assignments	4
3	Library	2
4	Projects/Research Essays/Theses	2
5	Others (specify)	
	<b>Total</b>	<b>22</b>

\* 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

<b>1. Course Description</b>
<ul style="list-style-type: none"> <li>The theoretical part includes introduction to catalysis, and its terminology and the methods of catalysts preparation. Homogeneous and heterogeneous catalysis. The</li> </ul>

student also will study the most recent spectroscopic and microscopic tools of catalyst characterization. Also, the student will study some applications of catalytic process

- The practical part contains some practical experiments using different techniques to understand the role of catalyst in the reaction and to study the effect of different parameters on catalysis

## 2. Course Main Objective

At the end of this course the student will be able to:

- Catalysis, its terminology, importance
- Types of catalysis
- Role of catalysts in reaction
- Catalytic reactors
- Applications of catalysis

## 3. Course Learning Outcomes

CLOs		Aligned PLOs
<b>1</b>	<b>Knowledge:</b>	
1.1	Recognize the types of catalysis	<b>K1</b>
1.2	Write the methods of catalyst preparation	<b>K1</b>
1.3	Define the catalyst activity, selectivity, TOF, TON....	<b>K3</b>
1.4	understanding of the role of catalyst in chemical reaction	<b>K5</b>
1.5	Are fully conversant with major aspects of catalysis terminology	<b>K1</b>
1.6	Understanding the most important catalytic applications	<b>K5</b>
<b>2</b>	<b>Skills :</b>	
2.1	understanding of concepts, principles and theories of catalysis	<b>S1</b>
2.2	evaluate, interpret the effect of catalyst on the reaction	<b>S4</b>
2.3	Problem-solving skills, relating to catalytic activity	<b>S7</b>
2.4	Basic interpersonal skills, relating to the ability to interact with other people and to engage in team working.	<b>S8</b>
2.5	Skills in experimental work related to catalysis	<b>S6</b>
<b>3</b>	<b>Competence:</b>	
3.1	Demonstrate skills in the usage of some equipments used in the Lab.	<b>C3</b>
3.2	Written and oral communication skills in class or laboratory discussions.	<b>C1</b>
3.3	Mathematical skills, in handling experimental data	<b>C4</b>

## C. Course Content

No	List of Topics	Contact Hours
1	Introduction (The phenomenon catalysis, mode of action of catalysts, activity, turnover Frequency TOF, turnover number TON [T 46], selectivity, stability, classification of catalysts and comparison of homogeneous and heterogeneous catalysis).	<b>4</b>
2	Economic importance of catalysts. Methods of catalyst preparation	<b>6</b>
3	exam	<b>2</b>
4	Some spectroscopic and microscopic tools of catalyst characterization.	<b>6</b>
5	Examples include catalysts for oxidation, including pollution clean-up; hydrogenation including hydrogenation and refining processes	<b>6</b>

6	Pollution control with particular reference to car exhausts	6
7	exam	2
<b>Total</b>		<b>32</b>
<b>No</b>	<b>Practical Part: List of Topics</b>	<b>Contact Hours</b>
1	Introduction	3
2	Catalytic Organic synthesis	3
3	Acetylation of Primary Amine (Preparation of acetanilide)	6
4	Pechmann Condensation for Coumarin Synthesis	3
5	Clay catalyzed solid acid synthesis of 7-hydroxy-4-methylcoumarin	6
6	Electrophilic Aromatic Substitution Reaction- (Nitration of phenol)	3
7	Esterification and Transesterification Reactions	3
8	Catalytic Decomposition of H <sub>2</sub> O <sub>2</sub> Using MnO <sub>2</sub> Solid Catalyst	3
9	Effect of Catalyst Amount on H <sub>2</sub> O <sub>2</sub> Decomposition Rate	3
10	Comparison Between Homogeneous and Heterogeneous Catalytic Decomposition of H <sub>2</sub> O <sub>2</sub>	3
11	Study The Effect Of Temperature on The Catalytic Decomposition of H <sub>2</sub> O <sub>2</sub>	3
12	Determination of Autocatalytic Part of The Reaction Between KMnO <sub>4</sub> and Oxalic Acid	3
<b>Total</b>		<b>42</b>

## 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	<b>Knowledge</b>		
1.1	Recognize the types of catalysis	Scientific discussion and Lectures	Mid-tern and final written exams.
1.2	Write the methods of catalyst preparation	Scientific discussion, library based study and Lectures	Mid-tern, oral and final written exams.
1.3	Define the catalyst activity, selectivity, TOF, TON....	Scientific discussion and Lectures	Mid-tern, oral and final written exams.
1.4	understanding of the role of catalyst in chemical reaction	Scientific discussion, web based study and Lectures	Mid-tern and final written exams.
1.5	Are fully conversant with major aspects of catalysis terminology	Scientific discussion and Lectures	Mid-tern and final written exams.

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.6	Understanding the most important catalytic applications	Scientific discussion, library-based study and Lectures	Mid-tern, oral and final written exams.
<b>2.0</b>	<b>Skills</b>		
2.1	understanding of concepts, principles and theories of catalysis	Scientific discussion, library based and Lectures	Periodic tests and assignments, final exam
2.2	evaluate, interpret the effect of catalyst on the reaction	Lecture and web-based study.	Periodic tests and assignments, final exam
2.3	Problem-solving skills, relating to catalytic activity	Lectures	Mid-tern and final written exams
2.4	Basic interpersonal skills, relating to the ability to interact with other people and to engage in team working.	Practical experiments in groups and web-based studies in groups.	Evaluate the results of collective works and duties as well as knowing the contribution of each individual in labs.
2.5	Skills in experimental work related to catalysis	Lab. discussion and practical experiments.	Practical exams.
<b>3.0</b>	<b>Competence</b>		
3.1	Demonstrate skills in the usage of some equipments used in the Lab.	Lab. discussion and practical experiments	Practical exams.
3.2	Written and oral communication skills in class or laboratory discussions.	Work in groups in the Lab and in preparing some reports	Evaluate the results of collective works and duties as well as knowing the contribution of each individual in labs.
3.3	Mathematical skills, in handling experimental data	Lab discussion	Practical exams.

## 2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Homework or activities.	--	10 %
2	Midterm Exam.	8	20 %
3	Practical Exams.	14	30 %
4	Final Exam. (2 hours exam)	16	40 %

\*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 :

- Presence of faculty members to provide consulting and advice.
- Office hours: during the working hours weekly, and the creation of appropriate means.

## F. Learning Resources and Facilities

### 1. Learning Resources

<b>Required Textbooks</b>	<p>1. Catalysis Concepts and Green Applications, Gadi Rothenberg, John Wiley &amp; Sons, 2008.</p> <p>2. Catalysis for Renewables From Feedstock to Energy Production, Gabriele Centi and Rutger A. van Santen, WILEY-VCH Verlag GmbH &amp; Co. KGaA, Weinheim, 2007.</p> <p>3. Synthesis of Solid Catalysts, Krijn P. de Jong, WILEY-VCH Verlag GmbH &amp; Co. KGaA, Weinheim, 2007.</p> <p>4. Industrial Catalysis: A Practical Approach, Second Edition. Jens Hagen WILEY-VCH Verlag GmbH &amp; Co. KGaA, Weinheim, 2006, ISBN: 3-527-31144-0.</p> <p>5. B. Cornils, W. A. Herrmann, R. Schlögl, C.-H. Wong Catalysis from A to Z A Concise Encyclopedia 2nd ed 2003, ISBN 3-527-30373-1</p> <p>6. Catalytic Air Pollution Control: Commercial Technology, Johnson Matthey PLC, Orchard Road, Royston, Hertfordshire SG8 5HE, UK; 2010</p>
<b>Essential References Materials</b>	
<b>Electronic Materials</b>	<p><a href="http://en.wikipedia.org/wiki">http://en.wikipedia.org/wiki</a></p> <p><a href="http://www.chemhelper.com/">http://www.chemhelper.com/</a></p> <p><a href="http://www.chemweb.com">http://www.chemweb.com</a></p>
<b>Other Learning Materials</b>	

### 2. Facilities Required

Item	Resources
<p><b>Accommodation</b> (Classrooms, laboratories, demonstration rooms/labs, etc.)</p>	classroom capacity (50) students.
<p><b>Technology Resources</b> (AV, data show, Smart Board, software, etc.)</p>	Computer connected with Data show and TV
<p><b>Other Resources</b> (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)</p>	Lab. With Equipment required for conducting catalytic experiments

## G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment.	Program Leaders	Periodic review of final exams and the student's degrees in this course.
Extent of achievement of course learning outcomes.	Peer Reviewer	Checking selected exam papers, and student assignments.

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Quality of learning resources	Students	Complete the questionnaire evaluation of the course in particular
Effectiveness of teaching and assessment	Program leader	Direct
Extent of achievement of CLO's	Peer Reviewer	Direct

**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	
Reference No.	
Date	

Received by: Dr. Ismail Althagafi

Department Head

Signature:



Date: 20/12/2019

