University of Petra		
Faculty of Art & Sciences		كلية الآداب والعلوم
Department of Chemistry		قسم الكيمياء

Course Syllabus

Year : 2019/2020
Semester : 1st

Course No.	Course Title	Pre-requisite	Co-requisite	Credit Hours	ECTS
101435	Special Topics in Chemistry	101232		3	5

Instructor's Name	Instructor's email	Office No.	Office Ext.	Office Hours
Dr. Mohammed Alomari	mohammed.alomari@uop.edu.jo	07111	07111	Sun, Tue, Thu: 11-12 Tue: 1:30-2:30

Course Description	This course covers the following topics:
	• Bulk and surface structure of solids, experimental methods of surface characterization, molecule-surface interactions, principles of homogeneous and heterogeneous catalysis. This course typically discusses adsorption/desorption kinetics, surface reaction mechanisms, adsorption isotherms. • Colloid Chemistry

Course Objectives:
- To introduce the students to the basic concepts of surface chemistry.
- To introduce the students about the structure of the surfaces and the experimental method of surface characterization.
- To motivate the students to apply their chemical knowledge and skills to understand the adsorption, desorption processes.
- To provide the students with the principles of heterogeneous and homogeneous catalyst.

Course Intended Learning Outcomes (ILOs) and their Alignment with Program ILOs:
Upon successful completion of this course, students are expected to achieve the following learning outcomes:

Course ILOs	Program ILOs	Teaching and Learning Method	Assessment Method
Knowledge (K)			
Demonstrating the surface structures and understanding the experimental methods to study surface.	K (1)	White board, PowerPoint, Data show, discussions.	Exams, Quizzes
Understanding the colloid chemistry and surfactants.	K (2)		
Intellectual Skills (I)			
Using the thermodynamics and kinetics knowledge to understand the adsorption and desorption processes.	I (1)	White board, PowerPoint, Data show, discussions.	Exams, Quizzes
Performing kinetic studies to illustrate the surface reaction mechanisms.	I (2)	White board, PowerPoint, Data show, discussions.	Exams, Quizzes
Transferable Skills (T)			
This skill is already achieved through ILOs (1-3)			
Practical Skills (P)			
This skill is already achieved through ILOs (1-3)			

Course Schedule:

Week	Topic Details	Course ILO number	Reference
1	**Introduction** I.1 Heterogeneous Catalysis I.2 Why Surfaces? I.3 Where are Heterogeneous Reactions Important? I.3.1 Haber-Bosch Process I.3.2 Fischer-Tropsch Chemistry I.3.3 Three-way Catalyst I.4 Semiconductor Processing and Nanotechnology	K (1)	Text Book & References listed below
2-3	**Bulk and Surface Structure** 1.1 Introduction (& Miller Indices) 1.2 Surface Structures: fcc metals 1.3 Surface Structures: hcp metals 1.4 Surface Structures: bcc metals 1.5 Energetics of Surfaces 1.6 Relaxation & Reconstruction	K (1)	

	1.7 Particulate Metals 1.8 Other Single Crystal Surfaces		
4-6	**Surface Analysis Techniques** 2.1 Ultrahigh vacuum 2.1.1 The need for UHV 2.1.2 Attaining UHV 2.4 Scanning probe techniques Scanning tunnelling microscopy (STM) Scanning tunnelling spectroscopy (STS) Atomic force microscopy (AFM) Near-field scanning optical microscopy (NSOM) 2.6 Electron spectroscopy 2.6.1 X-ray photoelectron spectroscopy (XPS) 2.6.2 Ultraviolet photoelectron spectroscopy (UPS) 2.6.3 Auger electron spectroscopy (AES) 90 2.6.4 Photoelectron microscopy 2.7 Vibrational Spectroscopy (IR & EELS)	K (1)	
7-8	**Adsorption and Desorption** 3.1 Types of Interactions 3.2 Binding Sites and Diffusion 3.3 Physisorption 3.4 Non-dissociative Chemisorption 3.5 Dissociative Chemisorption: H2 on a Simple Metal 3.14 Classification of Reaction Mechanisms.	I (1)	
9-11	**Thermodynamics and Kinetics of Adsorption and Desorption** 4.1 Thermodynamics of Ad/desorption 4.3 Lateral Interactions 4.4 Rate of Desorption 4.5 Kinetics of Adsorption 4.6 Adsorption Isotherms from Kinetics 4.7 Temperature Programmed Desorption (TPD)	I (1), I (2)	
12-14	**Heterogeneous Catalysis** Catalysis Terms 6.3 Haber-Bosch Process (Ammonia synthsis) 6.5 Fischer-Tropsch Chemistry (syn gas) 6.6 Automotive Catalysis (Three-way catalyst)	I (1), I (2)	
14-16	**Colloid Chemistry** Colloidal systems Surface Tension of Surfactant Solutions Types of surfactants.	K (2)	

Assessment method	Grade	Dates	Notes
First Exam	30	Tus 19-11-2019	- Every student should bring his own scientific calculator when entering the exam lab. - Calculators are not allowed to be exchanged between students during exam. - Students are not allowed to carry their mobiles inside exam lab.
Second Exam	30	Sun 29-12-2019	
Participation	-		
Final Exam	40	-	
Total	100		

Alignment of Teaching and Learning Methods, Assessment and Course ILOs:

Teaching method	Contact Hours	Assessed through	ILOs numbers
Lectures	3 hrs / week	exams	All.

Learning References:

1- Textbook:	Surface Science: Foundations of Catalysis and Nanoscience, DR KURT W. KOLASINSKI, 3rd edition, John Wiley & Sons, Ltd 2012.
2- References:	Industrial Catalysis, *Jens Hagen, 2006 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany* Introduction to applied colloid and surface chemistry, GEORGIOS M. KONTOGEORGIS AND SØREN KIIL, John Wiley & Sons, Ltd 2016
3-Other Resources:	Lecture rooms with data show facility.

Course Policies:

- Attendance Policy: University regulations apply to attendance.
- Academic Honesty: Academic dishonesty is an unacceptable mode of conduct, and will not be tolerated in any form at Petra University. All persons involved in academic dishonesty and plagiarism in any form will be disciplined in accordance with University rules and regulations.

Approved by	Name
Head of Department	Dr. A.Tuweiq
Faculty Dean	Prof. Rami Abdelraheem