جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Advanced Physical Chemistry I - ChemS 360

Division	Physical Science and Engineering Division
Course Number	ChemS 360
Course Title	Advanced Physical Chemistry I
Academic Semester	Fall
Academic Year	2018/2019
Semester Start Date	08/26/2018
Semester End Date	12/11/2018
Class Schedule (Days & Time)	02:30 PM - 04:00 PM | Mon Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
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Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	This course deals with physical chemistry at advanced level for students who study in Chemical Science program and relevant fields of chemistry. Physical chemistry is the area of chemistry that allows describing chemical phenomena in the most general way. It is fundamental to rationalize what happens in the laboratory, and to have a critical attitude towards planning, executing and analyzing results of experiments. In this course the fundamental and advanced concepts of thermodynamics and kinetics will be reviewed and efforts will be made to connect the abstract mathematical equations with real life situations in the lab. Initially, the course will focus on introducing the fundamental laws of thermodynamics, starting from the law of gases, to introduce key concepts such as energy, heat, work, and their connection. State functions, such as enthalpy, entropy and free energy will be introduced next. Then the course will move to describe phase diagrams, phase transitions and laws governing the behavior of mixtures. In latter part, the course will focus on introducing the concept of chemical changes in the system with respect to time, and of the kinetic describing transformations. The concept of the rate of a reaction, and the theories that can be used to derive reaction rates and catalysis will be discussed. All through the course efforts will be made to connect the abstract mathematic formulations to the empirical world with ad hoc chosen examples. Homework will be fundamental to fix the concepts delivered and to manipulate equations to apply them to real cases. The final goal is to pass the concept that the phenomena in the lab can be rationalized using the concepts of physical chemistry, to provide familiarity with these concepts, and to develop the critical mind needed to apply these concepts in the correct and most fruitful way.
Course Description from Program Guide	Review fundamental concepts and laws of thermodynamics and kinetics. Learn and describe concepts of chemical potential, internal energy and chemical equilibrium of the system. Essence of kinetics to describe changes of chemical system with time, i.e., rates of chemical reactions, dealing with molecules in motion, collisions and diffusion of gases, and how to establish rate expression.

Goals and Objectives	Initially, the course will focus on introducing the fundamental laws of thermodynamics, starting from the law of gases, to introduce key concepts such as energy, heat, work, and their connection. State functions, such as enthalpy, entropy and free energy will be introduced next. Then the course will move to describe phase diagrams, phase transitions and laws governing the behavior of mixtures. In latter part, the course will focus on introducing the concept of chemical changes in the system with respect to time, and of the kinetic describing transformations. The concept of the rate of a reaction, and the theories that can be used to derive reaction rates and catalysis will be discussed.
Required Knowledge	Undergraduate level of Physical Chemistry.
Reference Texts	Peter Atkins and Julio De Paula: Atkins' Physical Chemistry 10th Ed., Oxford University Press.
Method of evaluation	**20.00**% - Presentation **30.00**% - Midterm exam **20.00**% - Homework /Assignments **30.00**% - Final exam
Nature of the assignments	Homework are to assist students' understanding.
Course Policies	The course will cover fundamental aspect for physical chemistry. It is required to obtain basics of physical chemistry at this stage for MS and PhD students. Attendance is requested whenever possible to ensure that the content is covered.
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Mon 08/27/2018	Lec 1: Real gas
1	Thu 08/30/2018	Lec 2: Heat and work
2	Mon 09/03/2018	Lec 3: Enthalpy
2	Thu 09/06/2018	Lec 4: Entropy
3	Mon 09/10/2018	Lec 5: Helmholtz and Gibbs energies
3	Thu 09/13/2018	Exercise 1
4	Mon 09/17/2018	Exercise 2
4	Thu 09/20/2018	Recap of the 1st half of the course
5	Mon 09/24/2018	Lec 6: Physical transformation of pure phase
5	Thu 09/27/2018	Lec 7: Physical transformation of mixture
6	Mon 10/01/2018	Lec 8: Phase diagram mixture
6	Thu 10/04/2018	Lec 9: Activity
7	Mon 10/08/2018	Lec 10: Equilibrium
7	Thu 10/11/2018	Exercise 3
8	Mon 10/15/2018	Exercise 4
8	Thu 10/18/2018	Mid-term exam
9	Mon 10/22/2018	Lec 13: Gas molecular motion
9	Thu 10/25/2018	Lec 14: Liquid molecular motion diffusion
10	Mon 10/29/2018	Lec 15: Rate law
10	Thu 11/01/2018	Lec 16: 3 rxn examples
11	Mon 11/05/2018	Lec 17: Transition state theory
11	Thu 11/08/2018	Lec 18: Liquid reaction kinetics
12	Mon 11/12/2018	Lec 19: Electro-, homogeneous-, and bio-catalysis
12	Thu 11/15/2018	Lec 20: Surface science
13	Mon 11/19/2018	Lec 21: Heterogeneous catalysis
13	Thu 11/22/2018	Exercise 5
14	Mon 11/26/2018	Exercise 6
14	Thu 11/29/2018	Presentation by students 1
15	Mon 12/03/2018	Presentation by students 2
15	Thu 12/06/2018	Final exam
16	Mon 12/10/2018	

Note

The instructor reserves the right to make changes to this syllabus as necessary.