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

Course Syllabus: Advanced Organic Chemistry I - ChemS 320

Division	Physical Science and Engineering Division
Course Number	ChemS 320
Course Title	Advanced Organic Chemistry I
Academic Semester	Fall
Academic Year	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
Class Schedule (Days & Time)	01:00 PM - 02:30 PM | Sun Mon

Instructor(s)

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

Name	Email

Course Information

Comprehensive Course Description	Advanced Organic Chemistry I will be focused on the understanding of structure, reactivity, and underlying mechanisms of organic chemistry. The basic mechanisms of organic chemistry underlie the function of biopolymers, drugs, and man-made “smart” materials. A mechanism-focused curriculum will be a convincing demonstration of the pervasiveness and interdisciplinary nature of modern organic chemistry. This course shall provide the students with an understanding of reactivity of organic species. CHEMS320 Syllabus **Examples of Chemical Selectivity** **Haloalkanes, Alcohols and Amines** 1. Nucleophilic Aliphatic Substitution 2. i) Overview and Mechanism 3. ii) Kinetics and reactivity; rate laws, 1 vs 2 vs 3, steric effects, carbocation stability - Hammond postulate, sigma (?) conjugation, allylic, benzylic and ?-carbonyl substrates iii) Stereochemical consequences; complete inversion in SN2, racemisation in SN1 1. iv) Solvent effects; SN1 in protic solvent, SN2 in dipolar aprotic solvent (v) Electrophiles; Comparison of leaving group ability of halides – bond strengths and pKa of HX; converting an alcohol to a halide; activation of alcohols as tosylates, cleavage of aryl methyl ethers. (vi) Nucleophiles (SN2 only); General considerations: nucleophilicity vs basicity, HARD and SOFT. Halides as nucleophiles - Finkelstein reaction; Oxygen based - Williamson ether synthesis, ether formation with diazomethane; Nitrogen based - Overalkylation of amines, Gabriel synthesis, azides; Phosphorus based - phosphonium salts and Arbuzov reaction; Carbon based - nitriles [enolates]. 1. 1,2-Elimination (beta-elimination): E1 & E2 (i) Overview (ii) Reactivity; 3 vs 2 vs 1 (iii) Regioselectivity (Orientation); Stability of alkenes, Saytzev orientation (iv) Stereochemistry of elimination (v) E1 vs E2 (vi) Elimination vs Substitution. SUMMARY (vii) Other important 1,2 eliminations (viii) The E1CB mechanism **Carbon-Carbon bond forming reactions** Introduction to control/selectivity in synthesis Concepts of control & selectivity in synthesis Electrophilic reagents Alkylating reagents Carbonyl Compounds Electrophilic Alkenes Nucleophilic Carbon Species Organometallic reagents Organomagnesium reagents (Grignard reagents) Organolithium reagents Organocopper reagents/Organocuprate (Gilman reagent) Organozinc reagents Stabilised Anions Enolates and Specific Enolate Equivalents Thermodynamic and Kinetic enolates. Alkylation of enone enolates Michael reaction Robinson Annelation Sulfur-stabilised carbanions Dithianes and concept of ‘Umpolung’ reactivity Sulfoxides Sulfones Sulfur Ylides (not strictly anions) Double bond forming reactions Wittig reaction (Phosphorous ylides) Horner-Wadsworth-Emmons Reaction Julia Olefination Peterson Olefination (Si stabilised anion) Allylic substitution reactions SN2 vs SN2’ Example synthetic sequences
Course Description from Program Guide	A focus on a deeper understanding of the structure and reactivity of organic molecules with an emphasis on reaction mechanisms. It is a review of aspects of physical organic chemistry, covering structure and bonding, stereochemistry, and kinetics and thermodynamics, as well as molecular orbital theory with an introduction to the use of computational tools, such as Gaussian 09.

Goals and Objectives	The objective of the course is to gain both intuitive and quantitative understanding of the mechanistic aspects of organic chemistry. **Course Contents** Aromatic substitutions Carbonyl reactions and formation Haloalkanes, alcohols and amines pKa in organic chemistry Functional group interconversion Synthesis problems Advanced organic chemistry
Required Knowledge	Introductory Organic Chemistry General Chemistry Introductory Physical Chemistry
Reference Texts	Required Text and Class Materials *A Guidebook to Mechanism in Organic Chemistry* (Sixth Edition), by Peter Sykes (Prentice Hall, **1996**). The text is available from the library and as an ebook. Required Software Current version of HyperChem Professional or a similar molecular modeling program. KAUST has a site license for HyperChem, and an evaluation version is also available. The student should have the software installed on their computer no later than the second week of class. Recommended Reference Books and Resources 1. *March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure* (Sixth Edition), by Michael B. Smith and Jerry March (Wiley, 2007), or earlier editions of March. 2. *Advanced Organic Chemistry, Part A: Structure and Mechanisms* (Fifth Edition), by Francis Carey and Richard Sundberg (Springer, 2007), or any other edition. 3. A plastic molecular modeling set.
Method of evaluation	**75.00**% - Final exam **25.00**% - Midterm exam
Nature of the assignments	Problems will be discussed in class as required.
Course Policies	Attendance Policy Lecture attendance is mandatory. If the student is unable to attend on the date indicated, the instructor will be notified at least a day in advance, and the problem set (if applicable) will be submitted electronically no later than the end of the lecture period. Academic Honesty Policy The highest levels of academic integrity are expected in this class. The code of student conduct will be strictly enforced. Academic dishonesty will result in reductions in grades and/or expulsion from this class. The specific rules for this class are as follows: Exams are closed book, individual work. Problem sets (if assigned) are open book, individual work. You are free to use any books, journals, databases, computer software or study aids. If you miss one or more lecture periods, and wish to obtain lecture notes for these, you are strongly encouraged to work together with your classmates and obtain the missing notes from them. Proper attribution is expected when using any information from the scientific literature, textbooks, or the Web. Lack of proper attribution or verbatim copying of content will result in an automatic zero grade for an entire quiz, exam question, or problem set.
Additional Information	There is **NO** grading curve in this class.

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Sun 08/25/2019	Semester starts
1	Mon 08/26/2019	Advanced Organic Chemistry (see syllabus)
2	Sun 09/01/2019	Advanced Organic Chemistry (see syllabus)
2	Mon 09/02/2019	Advanced Organic Chemistry (see syllabus)
3	Sun 09/08/2019	Advanced Organic Chemistry (see syllabus)
3	Mon 09/09/2019	Advanced Organic Chemistry (see syllabus)
4	Sun 09/15/2019	Advanced Organic Chemistry (see syllabus)
4	Mon 09/16/2019	Advanced Organic Chemistry (see syllabus)
5	Sun 09/22/2019	University holiday
5	Mon 09/23/2019	Saudi National Day
6	Sun 09/29/2019	Advanced Organic Chemistry (see syllabus)
6	Mon 09/30/2019	Advanced Organic Chemistry (see syllabus)
7	Sun 10/06/2019	Advanced Organic Chemistry (see syllabus)
7	Mon 10/07/2019	Advanced Organic Chemistry (see syllabus)
8	Sun 10/13/2019	Advanced Organic Chemistry (see syllabus)
8	Mon 10/14/2019	Advanced Organic Chemistry (see syllabus)
9	Sun 10/20/2019	Advanced Organic Chemistry (see syllabus)
9	Mon 10/21/2019	Advanced Organic Chemistry (see syllabus)
10	Sun 10/27/2019	Mid-semester break
10	Mon 10/28/2019	Mid-semester break
11	Sun 11/03/2019	Mid-semester break
11	Mon 11/04/2019	Mid-semester break
12	Sun 11/10/2019	Mid-semester break
12	Mon 11/11/2019	Mid-semester break
13	Sun 11/17/2019	Mid-semester break
13	Mon 11/18/2019	Mid-semester break
14	Sun 11/24/2019	Mid-semester break
14	Mon 11/25/2019	Mid-semester break
15	Sun 12/01/2019	Mid-semester break
15	Mon 12/02/2019	Mid-semester break
16	Sun 12/08/2019	Exams
16	Mon 12/09/2019	Exams

Note

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