Advanced Organic Chemistry

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Office Hours:
Please see D2L for office hours.
Other meeting times available by email appointment.

Scheduled Class Meeting Time: Tuesdays 6:00 pm – 9:00 pm; 102 Brossman Hall

Course Description:
This course focuses on current theories of organic chemistry, with major emphasis on descriptive physical organic chemistry aspects as applied to structure, reactions, reaction mechanisms, and synthetic methods.

Course Learning Objectives: *Upon successful completion of Chemistry 435 you will be able to…*

1. Describe the Frontier Molecular Orbitals (FMO) for organic molecules.
2. Apply a non-mathematical understanding of FMO theory to chemical reactivity & reaction mechanisms.
3. Hypothesize plausible reaction mechanisms for organic reactions using Curved-Arrow Notation (CAN).
4. Understand how and why most organic functional groups react the way they do.
5. Predict plausible products of organic reactions using a mechanistic approach.
6. Apply what was learned to reason a solution for related mechanism problems.
7. Describe complex multi-step reaction mechanisms using the language of FMO theory and CAN.

Course Design & Organization: This is a blended course, including…

1. **Weekly online video lectures** (approximately 2 hours per week — instead of face-to-face lecture),
2. **Weekly detailed lecture notes provided** (posted on D2L and provided in print — for annotation purposes while watching the related videos), and a…
3. **Weekly three-hour recitation to complete all required problems together** (in class problem-sets, group work, and mini-student presentations of plausible answers); where we will work together to produce an answer key for each weekly problem-set.

New content topics are first presented online via the D2L course website or the free EdPuzzle website. Prior to each class meeting, think of annotating your notes while watching the lecture video as being pedagogically identical to reading the textbook chapter while annotating the textbook. The first few weeks of this course will be a partial review and expansion of physical organic chemistry concepts from second-year organic chemistry (see Chapters 1, 2, 3, & 6 of the Klein textbook). The course will then progress through different fundamental types of organic functional group reactivity using the interactions of filled and unfilled FMOs as our guide. This course is slow paced, continually builds on what is learned in the first month and is cumulative by nature.

This course is organized around the following physical organic chemistry concepts:

1. Atomic Orbitals, Molecular Orbitals, and Curved-Arrow Pushing Notation
2. Energy considerations, Stability, and Selectivity
3. Carbocations, Non-classical Carbocations, and Neighboring Group Participation
4. Addition to σ^*, pK_a, S_N2, and Migratory Displacements
5. Eliminations, Additions to π^*, Anions, and Alkali Organometallics
6. Electrophilic Addition to C=C
7. Enols, Enamines, and Enolates
8. Nucleophilic Sigma Bonds
9. Sulfur Chemistry & Phosphorous Chemistry

Why learn more Organic Chemistry? No matter what type of chemist you choose to be, there is a good chance that you will need to think about the reactivity of organic chemicals. It is also very likely that you will work with organic chemicals. Organic chemicals are everywhere and make up over 95% of the more than 200 million (and counting) known chemical substances. Natural and synthetic organic chemicals are in the clothes, cars, foods, toys, pharmaceuticals, plastics, and most other consumer goods that we use every day. Volatile organic chemicals are present in the air we breathe. A foundation in organic chemistry fundamentals is necessary to understand the structure, properties, and reactivity of drugs, biochemicals, and environmental chemicals, which impact biological metabolism, nutrition, disease, health, physiology, neurology, growth, and development. An understanding of organic chemistry can help us make rational social and political decisions with regard to chemicals in our society.

Materials: Chemistry 435 D2L course website. Free EdPuzzle website. Your Millersville email account. Lecture notes: found on D2L and must accompany you to each class meeting. Annotate each set of notes while watching the corresponding video. Recommended textbook—if interested in more in-depth reading, related to FMO theory as discussed and applied in this course: Molecular Orbitals and Organic Reactions, Student Edition, Ian Fleming, Wiley, 2009, ISBN 9780470746592.

Order of Topics & Tentative Weekly Schedule

Section	Week #	Activity
1	1	Arrow Pushing & Molecular Orbitals
	2	Arrow Pushing & Molecular Orbitals
	3	Molecular Orbitals & Energy
	4	Selectivity & Carbocations
	5	Non-classical Carbocations & Neighboring Groups
	6	Addition to Sigma Star
	7	Migratory Displacements & Eliminations
	8	Spring Break
2	9	Exam 1
	10	Additions to Pi Star
	11	Anions, Coordinated Anions, Alkali Organometallics
	12	Pi Bonds as Nucleophiles (Addition of Electrophiles to C=C)
	13	Enols, Enamines, Enolates, and Nucleophilic Sigma Bonds
	14	Exam 2
	15	Sulfur Chemistry & Phosphorous Chemistry
	16	Final Exam

Course Evaluation

Lecture Videos	300 points	30 %
Problem Sets	300 points	30 %
Midterm Exam 1	200 points	20 %
Midterm Exam 2	200 points	20 %
Final Exam	200 points	(can replace lowest midterm exam)