Syllabus

Course: **CHEM 3013, Survey of Organic Compounds**

Semester: **Spring 2021**

Lecture: **yes, Tuesdays, 8:50-11:15 am**

Lab: **no**

Instructor: **Dr. Jeanne L. Bolliger**

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Credits: **3**

Course code: **CHEM 3013**

Course Description:

Terminal, one-semester organic chemistry lecture course covering the general principles of nomenclature, structure, bonding, methods of preparation, reactions and use of acyclic, cyclic, and aromatic compounds.

Prerequisites:

Passing grade in General Chemistry.

Course Objectives:

- Attend class
- Complete and submit homework on schedule
- Complete scheduled quizzes
- Take the final exam

Learning Objectives:

- Know how to draw organic molecules
- Know the most important functional groups in organic compounds and how to prove that they are present
- Know the most basic organic reactions and be able to apply these to molecules

Course Learning Outcomes:

Demonstrate a general knowledge of organic molecules and the ability to predict their reactions under given conditions.

Office Hours:

By appointment, or just after class.

Required Texts:

Introduction to Organic Chemistry (6th Edition) by William Brown and Thomas Poon, Wiley Publishing – Prior editions are acceptable.

Recommended Texts:

The solutions manual accompanying the book is recommended.

Reading Assignments:

Read the chapters in the book before class.

Assignment Submission and Classroom Conduct Policy:

Assignments must be submitted according to the schedule. Late assignments will not be accepted.

Dress Code Requirements:

N/A

PPE (Personal Protective Equipment for Lab Only):

N/A

Attendance and late arrival policy:

Attendance is mandatory and late arrival will not be accepted.

Classroom Behavior:

You should pay attention to the material taught in class and participate. It is best for your learning if you fill in the blanks in your handouts during the live-streamed lecture. You may do this on paper or on a tablet.

Cell phones should be switched to silent and you should not play with the phone during class time. Please stow your cell phone out of sight in your jacket pocket or your bag. Not acceptable is watching other videos on your cell phone, playing games on your cell phone or computer, or chatting with friends on WeChat. In repeated cases, you may be required to deposit your cell phone in the front of the room during class times.

You also should not be working on homework problems from other classes.

Grading Policy:

Assignment	**Points**	**%**
Homework Assignments 1-6 (15 points each)	90 points	18%
Quizzes 1-3 (50 points each)	150 points	30%
Attendance (-1 point for each missed class)	10 points	2%
Final Exam	250 points	50%
Total:	500 points	100%

Grades are earned on a straight percentage base:

A – 85% - 100%

B – 75% - 84%

C – 60% - 74%

F – 0% - 59%

Academic Misconduct:

Cheating or helping others cheat will result in penalties on exams and quizzes. Cheating will result in 0 points for that exam. Using your cell phone during exams and quizzes will count as cheating and result in 0 points.

Homework: Please try to solve the problems yourself first. You can discuss the problems with your colleagues to understand the question but have to solve the questions yourself. **Do not** just copy someone else's answers.

Laptop Computers:

Laptop computers or tablets may be used to take notes during class. You will require a (laptop) computer to complete the quizzes.

Permissible Calculators:

None.

Syllabus Fee/Course Receipt:

N/A

Course Outline:

The order in which we will look at the material is not the same as in the book. We will go through the chapters in the following order:
Chapter 1, 2, 3, 6, 4, 5, 7, 8, 9, 10, 11 (only IR), 12, 13, 14, 15

Learning Recommendations:

- You need to understand the material so that you can apply it
- The best way to learn organic chemistry is to solve problems. The problems in our book are very good. I recommend doing them for practicing for the final exam.
- My questions will be like the ones in the book and the homework, but I will **not always** simply use exactly the same question (for example I might use a question but change the molecule for it).

Keywords

Chapter 1: Bonding and Shape (review from General Chemistry)

- Electron configuration
- Lewis structures
- Bonding
- Shapes of molecules
- Polarity
- Resonance

Chapter 2: Acids and Bases

- pKa values
- Acid Base equilibria
- Resonance effects, inductive effects

Chapter 3: Alkanes and Cycloalkanes

- Naming
- Structure
- Physical properties

Chapter 4: Nomenclature and Properties of Alkenes and Alkynes

Chapter 5: Reactions of Alkenes and Alkynes: Regio- and Stereoselectivity, Reaction Mechanisms, Use of Curved Arrows

- Hydrohalogenation
- Hydration (acid catalyzed)

- Hydroboration-Oxidation
- Bromination
- Hydrogenation

Chapter 6: Chirality

- Assign R and S
- Isomers: Enantiomers, Diastereomers, Stereoisomers, Constitutional Isomers
- Meso compounds

Chapter 7: Nucleophilic Substitution Reactions and β-Elimination: Reaction Mechanisms, Energy Diagrams, Rate Equations, Nucleophiles and Electrophiles, Curved Arrows

- S_N1
- S_N2
- E1
- E2
- **Solve suggested problems in book and make sure you understand them!**

Chapter 8: Alcohols, Ethers, and Thiols: Nomenclature and Properties

- Synthesis of Alcohols
- Conversion of Alcohols to Alkyl Halides, Alkenes and Alkynes
- Oxidation of Alcohols to Aldehydes, Ketones and Carboxylic Acids
- Synthesis of Ethers: Williamson Ether Synthesis
- Synthesis and Reactivity of Epoxides
- Synthesis of 1,2-Diols (via Epoxides: anti, via OsO_4: syn addition)
- Synthesis and Reactivity of Thiols

Chapter 9: Reactions involving aromatic compounds:

- Oxidation of Benzylic Position
- Electrophilic aromatic substitution: mechanism and substituent effects (o/p or m-directing groups): Nitration, Halogenation, Sulfonation, Friedel Crafts Alkylation and Acylation, other alkylations
- Reduction of nitro to amines

Chapter 10: Nomenclature, Properties, and Reactivity of Amines

Chapter 11: IR spectroscopy

- **Functional Groups!!!!**
- How to use IR to confirm or eliminate certain molecular structures

Chapter 12: Aldehydes and Ketones: Nomenclature, Synthesis and Reactivity

- Nucleophilic Addition to C=O
- Synthesis of ketones and aldehydes: Oxidation of primary and secondary alcohols with PCC, Friedel Crafts acylation
- Reduction of carbonyl groups to alcohols: Hydrogenation (with H_2 and metal catalyst), reduction with hydride reagents ($LiAlH_4$, $NaBH_4$, $LiBH_4$), reduction with organometallic reagents (Grignard and organolithium reagents)
- Protecting groups: Silyl protecting groups for alcohols, Acetals as protecting groups for ketones and aldehydes
- Imine formation and reductive amination
- Keto-enol tautomerization, acidity of hydrogens on α-carbons to C=O, α-halogenation
- Oxidation of aldehydes

Chapter 13: Carboxylic Acids: Nomenclature, Properties, Synthesis and Reactivity

- Synthesis: Oxidation of benzylic carbons, oxidation of aldehydes, oxidation of primary alcohols, addition of Grignard reagents to CO_2
- Reduction of carboxylic acids with $LiAlH_4$ to primary alcohols
- Conversion of carboxylic acids to acid chlorides
- Conversion of carboxylic acids to esters (Fischer esterification)
- Conversion of carboxylic acids to amides (via ester or acid chloride)
- Decarboxylation reactions of β-ketoacids and β-dicarboxylic acids

Chapter 14: Carboxylic acids, acid chlorides, acid anhydrides, esters, amides, nitriles

- Nomenclature
- Nucleophilic Acyl Substitution Reactions: mechanism, reactivity trends
- Hydrolysis of carboxylic acid derivatives, ester formation, transesterification, amide formation
- Reactions of esters and acyl (acid) chlorides with Grignard reagents
- Reduction of carboxylic acid derivatives

Chapter 15: Enolate Anions

- Acidity of α-Hydrogens
- Aldol Reaction and Condensation
- Claisen Reaction and Condensation
- Dieckmann Condensation (Intramolecular Claisen condensation)
- Hydrolysis and Decarboxylation of β-Ketoesters
- Michael Addition Reactions

Other things I would like to specify:

- Class attendance is mandatory. A class attendance list will be maintained. You must show up on time and are not allowed to leave early without permission.
- Cell phones should be switched to silent and you should not play with the phone during class time.
- Cheating or helping others cheat will result in penalties both on exams and homework. Cheating on exams or quizzes will result in 0 points for that exam.
- Homework **must** be turned in by the scheduled date and time via Canvas (see schedule). Late homework assignments will not be accepted.
- Quizzes are done during class time via the quizzes function in Canvas. You will need a laptop computer or another computer for completing them.