



## Appendix 2

### Course Schedule

Semester Spring 2021

#### 1. Course information:

Course Code	CHEM 3013		Course name	Chemistry of Organic Compounds	
Credits	3	Type	Compulsory course	Cohort	2019
Department	Chemistry	Instructor	Dr. Jeanne L. Bolliger		

#### 2. Course expected learning outcomes

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

- 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

#### 3. Teaching Calendar:



Course Calendar	Date	Lecture	Student Assignment	Homework Due Dates
Week 1	02-03-21	Ch 1	Read Chapter 1 before class	
Week 2	09-03-21	Ch 2	Read Chapter 2 before class	
Week 3	16-03-21	Ch 3	Read Chapter 3 before class	
Week 4	23-03-21	Ch 6	Read Chapter 6 before class	HW 1
Week 5	30-03-21	Ch 4	Read Chapter 4 before class	
		Quiz 1	Chapters 1, 2, 3, and 6	
Week 6	06-04-21		(no class)	
Week 7	13-04-21	Ch 5	Read Chapter 5 before class	HW 2
Week 8	20-04-21	Ch 7	Read Chapter 7 before class	
Week 9	27-04-21	Ch 8	Read Chapter 8 before class	HW 3
Week 10	04-05-21		(no class)	
Week 11	11-05-21	Ch 9	Read Chapter 9 before class	
		Quiz 2	Chapters 4, 5, 7, and 8	
Week 12	18-05-21	Ch 10 Ch 11	Read Chapters 10 and 11 (IR only) before class	HW 4
Week 13	25-05-21	Ch 12	Read Chapter 12 before class	
Week 14	01-06-21	Ch 13	Read Chapter 13 before class	HW 5
Week 15	08-06-21	Ch 14	Read Chapter 14 before class	
Week 16	15-06-21	Ch 15	Read Chapter 15 before class	HW 6
		Quiz 3	Chapters 9, 10, 11 (IR only), 12, 13, and 14	
Final Exam	TBD		Chapters 1-15	



#### 4. Textbooks and reference books:

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

#### 5. Evaluation Forms and Scoring Standards:

Final exam: 50%, Others: 50%, other assignments, consisting of the following parts:

Evaluation Forms	Evaluation Content	Its Percentage of Others
Homework 1-6	Class Material	18%
Quizzes 1-3	Class Material	30%
Attendance	Attendance Records	2%
Final exam	Class Material	50%

#### 6. Tips for student success:

- 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.
- Try to solve the homework assignments yourself first before discussing the questions with your colleagues
- 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).

#### 7. Academic integrity:

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.

## 8. Other course details:

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**

### 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

- pK<sub>a</sub> 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 $\beta$ -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  $\alpha$ -carbons to  $C=O$ ,  $\alpha$ -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  $\beta$ -ketoacids and  $\beta$ -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  $\alpha$ -Hydrogens
- Aldol Reaction and Condensation
- Claisen Reaction and Condensation
- Dieckmann Condensation (Intramolecular Claisen condensation)
- Hydrolysis and Decarboxylation of  $\beta$ -Ketoesters
- Michael Addition Reactions