College of Integrative Sciences and Arts
ARIZONA STATE UNIVERSITY

CHM 231 Syllabus
Elementary Organic Chemistry

Instructor Information

Instructor: Jason Maxwell
Office: San Tan 330G
Office Hours: M and Th 9-10am in-person or via Zoom (must request), or by appointment
Zoom Space: https://asu.zoom.us/j/9965513606
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This course is offered by the College of Integrative Sciences and Arts. For more information about the college, visit our website: https://cisa.asu.edu/ . If you have questions or concerns, please send your inquiry to cisa@asu.edu

Course Description

CHM 231 is an introductory course in organic chemistry and assumes a prior background in general chemistry. This course examines carbon chemistry focusing on structure, nomenclature and reactivity of functional groups found in a large number of organic compounds.

Enrollment Requirements

Prerequisite(s): CHM 101, 114, 116, or 118 with C or better OR Visiting University Student

Course Format

This course meets in-person for one hour and fifteen minutes twice a week. Attendance and participation in the lecture are essential for success in the course. The course utilizes gapped notes, where students follow along with the instructor as structures and reactions are drawn to fill in the notes for each section. Chapter quizzes, unit quizzes, and exams are assigned to test student comprehension and retention of chemical topics.

Course Materials: This course will use *Organic Chemistry 10th ed.* by John McMurry a free, openly licensed textbook from OpenStax and can be downloaded for free at https://openstax.org/details/books/organic-chemistry.

Course Learning Outcomes

At the completion of this course, students will be able to:

Chapter 1 – Structure and Bonding

- Understand the structure of the atom, its orbitals, and electronic structure.
- Understand valance bonding theory, hybridization of atomic orbitals in bond formation.
- Understand molecular orbital theory in bond formation.
- How to draw organic structures from chemical formulas.

Chapter 2 – Polar Covalent Bonds; Acids and Bases

- Distinguish bond polarity of polar and nonpolar bonds based on atom electronegativity.

- Determine polarity of molecules from dipole moments and molecular geometry.
- Understand how to determine formal charges on atoms in structures.
- How to draw resonance structures based on Lewis structures and formal charges.
- Define acids and bases based on the Brønsted–Lowry and Lewis theories.
- Predict acid and base strengths from pK_a values and understand characteristics of organic acids and bases.
- Understand noncovalent interactions between molecules and properties that arise from it.

Chapter 3 – Organic Compounds: Alkanes and Their Stereochemistry

- Understand different functional groups and their characteristic chemical reactivity
- How to draw and interpret simple alkane compounds and as a substituent
- How to name simple alkane compounds
- Understand properties and conformations of simple alkanes

Chapter 4 – Organic Compounds: Cycloalkanes and Their Stereochemistry

- How to name and draw cycloalkanes, and their cis- trans- isomers
- Understand cycloalkane conformations, axial and equatorial bonds, and their stability
- Understand conformation and stability of substituted cycloalkanes

Chapter 5 – Stereochemistry at Tetrahedral Centers

- How to assign chiral centers and determine chirality of compounds
- Understand when compounds are optically active
- Know the difference between different stereoisomers

Chapter 6 – An Overview of Organic Reactions

- Understand the different types of organic reactions
- How to draw reaction mechanisms showing electron movement with curved arrows
- Understand reaction rates, equilibriums, energies, transitions and intermediates

Chapter 7 – Alkenes: Structure and Reactivity

- How to name and draw alkenes, their cis- trans- isomers, and use E/Z designation
- Understand electrophilic addition reactions and its regiospecificity (Markovnikov rule)
- Carbocation structures, their stability and rearrangement by hydride or methyl shifts

Chapter 8 – Alkenes: Reactions and Synthesis

- How to prepare alkenes by elimination reactions
- Understand addition reactions by halides (X_2), halohydrins (HOX), and hydration (H_2O)
- Understand reduction by hydrogenation and oxidation by epoxidation and hydroxylation

Chapter 9 – Alkynes: An Introduction to Organic Synthesis

- How to name and draw alkynes
- How to prepare alkynes by elimination reaction of dihalides
- Understand addition reactions by halides (X_2), hydrogen halides (HX), and hydration (H_2O)
- Understand alkyne reduction, preparation of acetylide anions and its use in alkylation
- Know how to use retrosynthesis in organic chemical synthesis

Chapter 10 – Organohalides

- How to name and draw alkyl halides
- How to prepare alkyl halides from alkanes, alkenes, and alcohols
- Understand Grignard reactions of alkyl halides
- Know how to determine oxidation or reduction reactions of organic compounds

Chapter 11 – Reactions of Alkyl Halides: Nucleophilic Substitutions and Eliminations

- Understand substitution and elimination reactions with alkyl halides
- Know the characteristics of substitution reactions for S_N1 and S_N2 type reactions
- Know the characteristics of elimination reactions for E1 and E2 type reactions
- Know how to predict major products in elimination reactions using Zaitsev's rule

Chapter 12 – Structure Determination: Infrared Spectroscopy

- Understand how infrared spectroscopy is used in identifying organic compounds
- Know how to identify common functional groups from an IR spectrum

Chapter 13 – Structure Determination: Nuclear Magnetic Resonance Spectroscopy

- Understand how nuclear magnetic spectroscopy is used in identifying organic compounds
- Know how to identify and label unique signals in an H-NMR spectra

Chapter 15 – Benzene and Aromaticity

- How to name and draw aromatic compounds
- Know what constitutes an aromatic or antiaromatic compounds using the Hückel rule

Chapter 16 – Chemistry of Benzene: Electrophilic Aromatic Substitution

- Understand electrophilic aromatic substitution reactions of benzene
- Know how EAS is affect by substituents on a benzene ring
- Know oxidation and reduction reactions with aromatic compounds

Chapter 17 – Alcohols and Phenols

- How to name and draw alcohol and phenol compounds
- Properties of alcohols and phenols, and affects of acidity based on structure
- Preparation of alcohols from alkenes, by reduction of carbonyl compounds, and by Grignard reagents
- Reactions of alcohols to yield alkyl halides, and dehydration to form alkenes
- How to form carbonyl compounds by oxidation of alcohols
- How to protect alcohol groups during synthesis

Chapter 18 – Ethers and Epoxides; Thiols and Sulfides

- How to name and draw ethers, epoxides, thiol, and sulfides
- Reactions of epoxides by hydrolysis yielding diols, with amines, Grignard reagents and thiols

Chapter 19– Aldehydes and Ketones: Nucleophilic Addition Reactions

- How to name and draw ketones and aldehydes
- How to prepare aldehydes and ketones by oxidation of alcohols and acylation by EAS
- Oxidation of aldehydes yielding carboxylic acids
- Know nucleophilic addition of aldehydes and ketones by hydration yielding diols, by hydride reduction or Grignard reagents yielding alcohols, amines yielding imines or enamines, and alcohols to yield acetals, and its use as protecting groups
- Know conjugate nucleophilic addition to α,β-unsaturated aldehydes and ketones

Chapter 20 – Carboxylic Acids and Nitriles

- How to name and draw carboxylic acids
- Know structures and properties of carboxylic acids
- Know acidic properties of carboxylic acids and substituents effects on it
- How to prepare carboxylic acids by oxidation of alkylbenzenes, or 1° alcohols, and by phenyl Grignard reagents with CO_2

Chapter 21 – Carboxylic Acid Derivatives: Nucleophilic Acyl Substitution Reactions

- How to name and draw carboxylic acid derivatives
- Know reactions of carboxylic acids to yield acid chlorides, anhydrides, esters, amides, and alcohols
- Know reactions of carboxylic acid derivatives: acid halides, anhydrides, esters, and amides

Chapter 22 – Carbonyl Alpha-Substitution Reactions

- Know the how keto-enol tautomerization occurs in acidic or basic conditions
- How α-substitution reactions occur with enols
- Know how to form enolates, and alkylation by α-substitution reactions

Chapter 23 – Carbonyl Condensation Reactions

- Know the aldol condensation reaction that yield β-hydroxy carbonyl compounds
- Know how aldol products dehydrate to yield α,β-unsaturated products (conjugated enones)
- Understand the self aldol, mixed aldol, and intermolecular aldol reactions
- Understand the Claisen condensation, mixed Claisen condensation, and intermolecular Claisen condensation reactions (Dieckmann cyclization)
- Understand conjugate carbonyl addition reactions (Michael reaction)

Chapter 24 – Amines and Heterocycles

- How to name and draw amines
- Understand the properties of amines, and basicity effects of substituted arylamines
- How to prepare amines by reductive amination of aldehydes or ketones
- Understand nucleophilic acyl substitution reactions of 1° and 2° amines
- Know EAS of arylamines by modulating reactivity of amino group

COURSE POLICIES

Attendance, Participation and Grades

- **Attendance** is vital to your academic success and missing class is one of the main reasons for doing poorly in the course.
- **Grades** will be available on Canvas. You have one week from the day grades are posted/papers returned to challenge the grade given on an assignment.
- **Accommodation for religious practices:** In compliance with ACD 304-04, students who need to be absent from class due to the observance of a religious holiday or participate in required religious functions must notify the faculty member in writing as far in advance of the holiday/obligation as possible. Students will need to identify the specific holiday or obligatory function to the faculty member. Students will not be penalized for missing class due to religious obligations/holiday observance. The student should contact the class instructor to make arrangements for making up tests/assignments within a reasonable time.
- **Accommodation for university-sanctioned activities:** In compliance with ACD 304-02, students who participate in university-sanctioned activities that require classes to be missed, should be given opportunities to make up examinations and other graded in-class work. However, absence from class or examinations due to university-sanctioned activities does not relieve students from responsibility for any part of the coursework required during the period of the absence.

COURSEWORK, ASSIGNMENTS AND EXAMS

- **Chapter Quizzes:** Chapter quizzes focus on the main concepts from each chapter, they are online available through the Canvas site. These quizzes are open note and book.
- **Unit Quizzes:** Unit quizzes focus on a given unit of chapters, emphasizing concepts related to their respective exam. These quizzes are open note and book.
- **EXAMS**
  - **Midterm Exams**: Three, 100-points midterm exams will be given during the semester. Material covered since the last exam will be the main focus. However, since topics build through the semester it is expected each exam will be cumulative. No exams will be dropped and no make-up exams will be given. **(See Make-up Exams.)**
  - **Final Exam:** The final exam is cumulative consisting worth a total of 200 points. The final exam cannot be taken at an alternative time or date, no exceptions!
  - **Resurrection Final Rule:** If your final exam percentage is better than one of your earlier exams, I will replace the lowest score with your final exam percentage. You must take all 3 midterm exams to be eligible for the resurrection final, this rule can only help you.
  - **Make-up Exams:** None of the graded exams will be dropped. Therefore, it is imperative that you plan for every exam, and plan travel and other events accordingly. An alternate exam may be administered prior to the scheduled time only in cases where travel for university-sanctioned business or function, which cannot be rescheduled and interferes with an exam date. If such plans do interfere with an exam date, then it is your responsibility to schedule an alternate exam date prior to the scheduled date. This alternate date must be finalized at least one week prior to the scheduled exam date, and must be taken in person. You must show documentation from the appropriate university official for an early exam to be administered. An alternate exam will not be administered after the original exam date. In cases of sudden illness or unanticipated emergency that prevents you from attending a scheduled exam, the final exam percentage will be substituted. This option can only be exercised once. A second missed exam will be scored as a zero. Personal travel, work schedules, traffic, etc. do not constitute grounds for a make-up exam.
- **Extra Credit:** There will be no extra credit opportunities assigned for this course.

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Point Distribution

Exams (3 mid-term, 1 final)	500
Chapter Quizzes	125
Unit Quizzes	125
Total	**750**

Course Grading System

Based on an accumulated percentage:

A	90-100	Excellent
B	80-89.9	Good
C	70-79.9	Average
D	60-69.9	Passing
E	< 60	Failure
XE	Failure due to Academic Dishonesty.	

NOTE: The grade percentage for **chapter and unit quizzes** will be scaled to the point distribution above. For your own protection, you should keep a copy of everything you hand in and keep your graded assignments at least until grades are finalized at the end of the semester in the event you wish to contest any grades before they are submitted.

COURSE OUTLINE

Week	Date	Chapter and Topic	Suggested Homework
		Chp 1 and 2 Video Review	chp 1: 22, 23, 24, 26, 28, 30, 35, 41, 42, 49, 52, 54 chp 2: 24, 25, 26, 29, 30, 35, 36, 38, 40, 41, 43, 45, 55, 57, 58, 59, 61, 64
1	Aug 21	Chp 3 Alkanes	22, 23, 25, 28, 31, 35, 36, 38, 42
	Aug 23	Chp 4 Cycloalkanes and Their Stereochemistry	28, 29, 30, 32, 35, 37, 38, 42, 43
2	Aug 28	Chp 5 Stereochemistry at Tetrahedral Centers	32, 35, 37, 39, 40, 41, 43, 47, 52, 65, 70, 71
	Aug 30	Chp 6 An Overview of Organic Reactions **Unit 1.1 Quiz (Chp 1-4) Opens**	17, 27, 29, 30, 32, 33, 34, 44
3	Sept 4	**Labor Day Observed-No Class**	
	Sept 6	Chp 7 Alkenes-Structure and Reactivity **Unit 1.2 Quiz (Chp 5-8) Opens**	26, 27, 30, 37, 38, 39, 46, 54, 57
4	Sept 11	Chp 8 Alkenes-Reactions and Synthesis	26, 27, 29, 30, 40, 41, 48
	Sept 13		
5	Sept 18	**EXAM 1**	
	Sept 20	Chp 9 Alkynes-An Introduction to Organic Synthesis	18, 19, 24, 26, 27, 31, 37, 38, 39, 42, 43, 49
6	Sept 25	Chp 10 Organohalides Chp 11 Reactions of Alkyl Halides-Nucleophilic Substitutions and Eliminations **Unit 2.1 Quiz (Chp 9-11) Opens**	Chp 10: 18, 19, 21, 27, 29 Chp 11: 25, 26, 27, 28, 41, 42, 47, 50, 51, 55, 56, 57, 58, 64
	Sept 27	Chp 12 & 13 IR and H-NMR Spectroscopy	Chp 12: 30, 31, 32, 33, 36, 43 Chp 13:
7	Oct 2	Chp 15 Benzene and Aromaticity **Unit 2.2 Quiz (Chp 12-16) Opens**	

	Oct 4	Chp 16 Chemistry of Benzene-Electrophilic Aromatic Substitution	
8	Oct 9	**Fall Break-No Class**	
	Oct 11		
9	Oct 16	**EXAM 2**	
	Oct 18	Chp 17 Alcohols and Phenols	
10	Oct 23	Chp 18 Ethers and Epoxides; Thiols and Sulfides	
	Oct 25	**Unit 3.1 Quiz (Chp 17-18) Opens**	
11	Oct 30	Chp 19 Aldehydes and Ketones-Nucleophilic Addition Reactions	
	Nov 1	Chp 20 Carboxylic Acids and Nitriles **Unit 3.2 Quiz (Chp 19-20) Opens**	
12	Nov 6	Chp 21 Carboxylic Acid Derivatives: Nucleophilic Acyl Substitution Reactions	
	Nov 8		
13	Nov 13	**EXAM 3**	
	Nov 15	Chp 22 Carbonyl Alpha-Substitution Reactions	
14	Nov 20	Chp 23 Carbonyl Condensation Reactions	
	Nov 22		
15	Nov 27	Chp 24 Amines and Heterocycles **Unit 4 Quiz (Chp 22-24) Opens**	
	Nov 29	**Final Exam Review**	
16	Dec 4	**FINAL EXAM**	

Prohibition of Commercial Note Taking Services: In accordance with ACD 304-06 Commercial Note Taking Services, written permission must be secured from the official instructor of the class in order to sell the instructor's oral communication in the form of notes. Notes must have the note taker's name as well as the instructor's name, the course number, and the date.

Grade Appeals: ASU has formal and informal channels to appeal a grade. If you wish to appeal any grading decisions, please see http://catalog.asu.edu/appeal.

Incompletes: A mark of "I" (incomplete) is given by the instructor when you have completed most of the course and are otherwise doing acceptable work but are unable to complete the course because of illness or other conditions beyond your control. You are required to arrange with the instructor for the completion of the course requirements. It must be recorded on the Request for Grade of Incomplete form (http://students.asu.edu/forms/incomplete-grade-request).

Drop and Add Dates/Withdrawals: Please refer to the academic calendar on the deadlines to drop/withdraw from this course. Consult with your advisor and notify your instructor if you are going to drop/withdraw this course. If you are considering a withdrawal, review the following

ASU policies: Withdrawal from Classes, Medical/Compassionate Withdrawal. Please note that the ASU Academic Calendar only refers to withdrawal for the academic portion of your study abroad program. Please refer to the Study Abroad Withdrawal Policies for important dates regarding withdrawing from your Faculty Directed program.

Email Communications: All email communication for this class will be done through your ASU email account. You should be in the habit of checking your ASU email regularly as you will not only receive important information about your class(es), but other important university updates and information. You are solely responsible for reading and responding if necessary to any information communicated via email. For help with your email go to: http://help.asu.edu/sims/selfhelp/SelfHelpHome.seam?dept_pk=822 and file a help desk ticket by clicking on "My Help Center."

UNIVERSITY POLICIES

Academic Integrity: Academic honesty is expected of all students in all examinations, papers, laboratory work, academic transactions and records. The possible sanctions include, but are not limited to, appropriate grade penalties, course failure (indicated on the transcript as a grade of E), course failure due to academic dishonesty (indicated on the transcript as a grade of XE), loss of registration privileges, disqualification and dismissal. For more information, see http://provost.asu.edu/academicintegrity.

Harassment Prohibited: ASU policy prohibits harassment on the basis of race, sex, gender identity, age, religion, national origin, disability, sexual orientation, Vietnam era veteran status, and other protected veteran status. Violations of this policy may result in disciplinary action, including termination of employees or expulsion of students. Contact the professor if you are concerned about online harassment of any kind, and he/she will put you in contact with the Dean of Students office.

Mental Health: As a student, you may experience a range of challenges that can interfere with learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation. These emotional health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. ASU Counseling Services provides counseling and crisis services for students who are experiencing a mental health concern. Any student may call or walk-in to any ASU counseling center for a same day or future appointment to discuss any personal concern. Here is the Web site: https://eoss.asu.edu/counseling. After office hours and 24/7 ASU's dedicated crisis line is available for crisis consultation by calling 480-921-1006.

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Students with Disabilities: If you need academic accommodations or special consideration of any kind to get the most out of this class, please let me know at the beginning of the course. If you have a disability and need a reasonable accommodation for equal access to education at ASU, please call Disability Resources for Students, found here: https://eoss.asu.edu/drc

Downtown Phoenix Campus University Center building, Suite 160 Phone: 602.496.4321 E-mail: DRCDowntown@asu.edu	**Tempe Campus** Matthews Center building, 1st floor Phone: 480.965.1234 E-mail: DRCTempe@asu.edu
Polytechnic Campus Sutton Hall - Suite 240 Phone: 480.727.1039 E-mail: DRCPoly@asu.edu	**West Campus** University Center Building, Room 130 Phone:602.543.8145 E-mail: DRCWest@asu.edu

Establishing a Safe Environment: Learning takes place best when a safe environment is established in the classroom. In accordance with SSM 104-02 of the Student Services Manual, students enrolled in this course have a responsibility to support an environment that nurtures individual and group differences and encourages engaged, honest discussions. The success of the course rests on your ability to create a safe environment where everyone feels comfortable to share and explore ideas. We must also be willing to take risks and ask critical questions. Doing so will effectively contribute to our own and others intellectual and personal growth and development. We welcome disagreements in the spirit of critical academic exchange, but please remember to be respectful of others' viewpoints, whether you agree with them or not.

Student Conduct Statement: Students are entitled to receive instruction free from interference by other members of the class. If a student is disruptive, an instructor may ask the student to stop the disruptive behavior and warn the student that such disruptive behavior can result in withdrawal from the course. An instructor may withdraw a student from a course when the student's behavior disrupts the educational process under USI 201-10 (http://www.asu.edu/aad/manuals/usi/usi201-10.html).
Students are required to adhere to the behavior standards below:

- Arizona Board of Regents Policy Manual Chapter V– Campus and Student Affairs: Code of Conduct http://www.azregents.edu/policymanual/default.aspx
- ACD 125: Computer, Internet, and Electronic Communications http://www.asu.edu/aad/manuals/acd/acd125.htm, and
- ASU Student Academic Integrity Policy http://www.asu.edu/studentaffairs/studentlife/srr/index.htm

Title IX: Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs. As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling, is available if you wish discuss any concerns confidentially and privately.

Statement on Inclusion: ASU is a comprehensive public research university, measured not by whom we exclude, but rather by whom we include and how they succeed; advancing research and discovery of public value; and assuming fundamental responsibility for the economic, social, cultural and overall health of the communities it serves.

Syllabus Disclaimer: The course syllabus is an educational contract between the instructor and students. Every effort will be made to avoid changing the course schedule, but the possibility exists that unforeseen events will make syllabus changes necessary. The instructor reserves the right to make changes to the syllabus as deemed necessary. Students will be notified in a timely manner of any syllabus changes via email, or in the Announcements section on Canvas.

CAMPUS RESOURCES

As an ASU student you have access to many resources on campus. This includes tutoring, academic success coaching, counseling services, financial aid, disability resources, career and internship help and many opportunities to get involved in student clubs and organizations. Students are required to adhere to the behavior standards below:

- Tutoring: http://studentsuccess.asu.edu/frontpage
- Counseling Services: http://students.asu.edu/counseling
- Financial Aid: http://students.asu.edu/financialaid
- Disability Resource Center: http://www.asu.edu/studentaffairs/ed/drc/
- Major/Career Exploration: http://uc.asu.edu/majorexploration/assessment
- Career Services: http://students.asu.edu/career
- Student Organizations: http://www.asu.edu/studentaffairs/mu/clubs/