SANTA CLARA UNIVERSITY **SUMMER TERM 2017**
ORGANIC CHEMISTRY I **CHEMISTRY 31**

LECTURE SYLLABUS

Course Organic Chemistry I, 31: Lecture and Laboratory
Time and Location Monday through Friday– 1:00-4:00 p.m., Daly Science 207

Lecture Text
The text for the lecture component of this course is optional. The following texts/resources may be useful for you in this course:
1. Virtual Text in Organic Chemistry: http://www.cem.msu.edu/~reusch/VirtualText/intro1.htm
2. Any reasonable organic chemistry text, electronic or print form, for lecture preparation by reading about topics to be covered in the subsequent lecture. McMurry (any edition) or texts by Loudon, Ege, Solomons and Wade are also good.

Course Materials
All course materials are posted on our class webpage: https://sites.google.com/a/scu.edu/chemistry-31---organic-chemistry-i/ and a Google folder I will share with you. You will need to obtain a copy of the two large packets, the Class Packet and the Problems Packet. Both are large documents, which can be printed from our Chem 31 page or purchased from Copy Craft for about $15 each (http://copycraft-ca.com, 341 Lafayette St, Santa Clara). We will refer to the Class Packet in lecture regularly, so you are expected to bring the Class and Problems Packets to every lecture. I will email additional materials as needed, including problem assignments after every lecture.

Laboratory Text and Materials
Required Text: *Laboratory Techniques in Organic Chemistry by Mohrig, Alberg, Hofmeister, Schatz and Hammond, 4th Edition*. You will use this text in Chem 31-33. Other materials for laboratory can be found on Chem 31 Laboratory webpage (https://sites.google.com/a/scu.edu/organic-chemistry-laboratory/). You also must bring your safety splash goggles (meaning they form fit to your face, safety glasses can not be used) lab coat and lab notebook to laboratory every day, including the first day your lab section meets. You can purchase a lab coat and goggles from the SCU Bookstore. Picture of the goggles we sell: http://www.safetyglassesusa.com/s3960d.html

Laboratory Notebook: You are required to use a notebook that we ordered especially for Chem 31-33, which can be purchased from the Campus Bookstore. The laboratory notebook is black with numbered, quad ruled pages, embossed with "Santa Clara University" from the Scientific Notebook Company Do not purchase other notebooks that could be on sale in the bookstore.

Supplements
Molecular model set. This is optional; very helpful for visualizing molecules in 3D throughout the sequence. You can purchase a kit from the bookstore, we sell the Darling Model Kits (http://www.darlingmodels.com/) but any model kit will suffice.

Problem notebook to record all of your solutions to the problems packet and other assigned problems.

Instructors
Lecture: Dr. Brian J. McNelis; Email: bmcnelis@scu.edu; Phone: 554-4797
Laboratory: Drs. Ruhland and Tichy

Office Hours Alumni Science 160 M-Th 4-5 pm; Other times by appointment

Course Objectives
This course will expand your understanding of fundamental principles in organic chemistry and their application to solving chemical problems. Additionally, you will apply the concepts from lecture in the laboratory setting. To do so, this course will meet the following objectives:

1. Communicating chemical information effectively. You will learn both the technical vocabulary used and the clear representation of chemical structures and reaction mechanisms.

2. Relating physical and structural properties of organic molecules with their reactivities. You will learn to identify and compare the molecular features that govern chemical reactivity.

3. Predicting the outcomes of chemical reactions. You will learn to think critically in applying central principles of organic chemistry to solve chemical problems in a rational manner.

4. Applying chemical principles in the laboratory. You will learn to execute independent experiments that supplement and complement the topics covered in lecture. You will become proficient in essential techniques for the reaction, isolation, and purification of organic compounds, and the proper disposal of waste produced in generating them. You will also learn the proper use and maintenance of a laboratory notebook as a record of your experimental work.

Course Content and Approach

This course will develop a number of basic concepts that will serve as the foundation for understanding organic chemistry. Learning these fundamentals will enable you to evaluate and comprehend all of the new material encountered during the organic chemistry sequence. The approach to achieve this objective is to reinforce these basic principles throughout the course demonstrating their application to problem solving.

An important goal of this introductory course is to teach the principles of organic reactivity through the careful study of each step in the reaction processes we encounter. A stepwise description of the reaction process is commonly referred to as the reaction mechanism. An understanding of mechanism is the foundation for further learning and problem solving in organic chemistry and eases the burden of memorization in the course by demonstrating the relationships between reactions. The use of mechanism in problem solving develops cognitive skills as the basic knowledge and understanding of chemical reactions must be applied to answer challenging questions on exams and problem sets. Developing the ability to critically analyze a reaction using the rules of chemical reactivity is one of the primary learning objectives for this course.

We will begin reviewing some topics covered in general chemistry such as Lewis structures, molecular geometry, and atomic orbital hybridization. This leads into the topics of covalent bonding, molecular orbitals and the drawing conventions for organic compounds. From this background we will study three classes of organic compounds and their reactions: alkanes, alkyl halides, alkenes and alkynes. Using our understanding of atomic and molecular structure, we will study the relationship between structure and reactivity. To demonstrate the principles of organic reactivity, we will develop our understanding of each step of the reaction mechanisms so that reaction outcomes make "chemical" sense. This fundamental understanding of reaction mechanism will allow you to predict reaction results and interpret the new reaction processes encountered in this course. Other important concepts include: bond formation and cleavage, the strength of acids and bases, resonance and stereochemistry, and synthesis.

How to be Successful in Organic Chemistry

Educational studies have shown that learning/mastering material early in an organic chemistry course and having a proactive approach to seeking help leads to significantly improved performance.[1,2] My own experience over 25 years of teaching has shown that students who score lower on early assessments in the course usually earn C grades or lower. Why? In the early part of the course we are building the foundational principles of the course that you rely on all year. Without mastering these, students struggle to understand what we cover and simply try to memorize. This yields to poor performance, especially as we build on that foundational content. Development of strong problem-solving skills is a goal of this course and essential to your future success in science and related careers. My goal is for you to succeed to the best of your ability and effort, so I have detailed below the specific behaviors that will help you perform your best in this class.

1. *Lecture and Notes*

a. Come to lecture prepared and attend <u>every</u> lecture.

b. Before the lecture, review your notes from the previous class and after class, take 15-20 minutes to review your lecture notes and highlight any topics or concepts you do not understand fully. Reviewing your notes after lecture has been shown to dramatically increase concept retention.

c. Students' notes often contain errors or there are critical ommisions in recording important content. Look for gaps and mistakes and compare your notes with other students in the class; many times I find students are confused with what we covered in-class because their notes are incorrect. I post the notes and lecture videos after each class, so you can use that to check your notes and comprehension.

2. *Homework*
a. Do **all** the assigned problems. I send out a customized problem assignment via email after every lecture so that you are able to do all the assigned problems based on what we have covered. The Class and Problems Packets contain exam-level questions that my colleagues and I wrote and most are previous exam questions. If you can do all the assigned problems independently, you will be successful on exams. Expect to spend several hours each day working on problems.

b. **Don't look at the answer key to check your answers!!** The biggest challenge students have in this class is consulting the key too soon, which truncates the learning process. Ideally, you would never look at the answer key yourself; use a friend to check your answers or use your notes to make sure your answer is consistent with what we learned in class. If you cant get started on a problem, ask for a hint from me or another student in the class. I often give hints in the problem assignment for this purpose. If you have to look at the key, do so only after you have tried a difficult problem a number of times (try to rework the problem after doing other problems; I found waiting a day would often lead to success on a problem) with the help of your notes.

c. Score your work on every problem assignment and keep track of the number of correct and incorrect answers. Try to correct wrong answers with the help of your notes. Studying the answers on the key is very counterproductive since it gives you the impression of understanding the solution but without any real learning that would lead you to be able to do a similar problem in the future. An important part of the learning process is identifying errors in your thinking process as you solve problems—ask yourself "why did I get this wrong? What did I forget to consider?" Thinking about problems that challenge you this way will help you improve your problem solving skills.

3. *Seek Assistance*
a. I am available for posted office hours every week and by appointment if you have schedule conflicts. Bring your solved problems and specific questions about course content. Work with other students, but be sure to not give each other too much information to answer the problem.

b. Email. I will answer quick questions by email, but you have to send me a picture of the problem and your solution. I will reply with just enough info so you can try to correct your answers (this allows for a quick response that helps you but does not give you the answer) and sometimes I reply with a picture or a video and I often share those videos with the class.

Grades

Grades will be based on your performance two exams (100 points each) and the final exam (200 points). Your grade in laboratory will have a small but possibly significant impact on your overall final grade, possibly to increase or decrease your overall course grade. Unsuccessful completion of the laboratory work is grounds for failure in the course. Final grades will be based on a curve, which reflects your performance relative to the average for the class.

Policy on Electronic Devices

Use of cell phones, laptop computers, or other electronic devices during class time is prohibited. An exception to this policy is the use of a tablet and stylus to take notes and draw pictures. This can be very effective, especially since you can draw directly on the Class and Problem Packet pdf documents. A laptop is not an effective note-taking device in organic chemistry, so if you are using a laptop in this class, it is assumed you are doing other work. Looking at the Class or Problems Packets electronically is not effective; these materials require annotation so a paper copy (or a tablet/iPad) must be used in lecture. ANY use of cell phones or other electronics (including calculators) during exams will be considered a breach of academic integrity.

Academic Integrity

You are expected to maintain the highest standards of academic integrity in both the lecture and laboratory components of this course. Giving or receiving unauthorized aid in any form will result in course failure. Please see me if you need clarification on what constitutes unauthorized aid in your lecture or laboratory work.

In the lecture, you will be asked to sign an academic integrity pledge on all quizzes and exams. The pledge reads: "I am committed to being a person of integrity. I pledge, as a member of the Santa Clara University community, to abide by and uphold the standards of academic integrity contained in the Student Conduct Code."

Standards

This course is a prerequisite for Chemistry 32, Organic Chemistry II. A grade of C- or higher in Chem 31 is strongly recommended before taking Chem 32. Students who receive grades lower than C- are urged to meet with their instructor before considering continuing on to Chemistry 32.

Disability Accomodation Policy

If you have a disability for which accommodations may be required in this class, please contact Disabilities Resources, Benson 216, http://www.scu.edu/disabilities as soon as possible to discuss your needs and register for accommodations with the University. If you have already arranged accommodations through Disabilities Resources, please discuss them with me during my office hours. Students who have medical needs related to pregnancy may also be eligible for accommodations.

While I am happy to assist you, I am unable to provide accommodations until I have received verification from Disabilities Resources. The Disabilities Resources office will work with students and faculty to arrange proctored exams for students whose accommodations include double time for exams and/or assisted technology. (Students with approved accommodations of time-and-a-half should talk with me as soon as possible). Disabilities Resources must be contacted in advance to schedule proctored examinations or to arrange other accommodations. The Disabilities Resources office would be grateful for advance notice of at least two weeks. For more information you may contact Disabilities Resources at 408-554-4109.

Discrimination and Sexual Misconduct (Title IX)

Santa Clara University upholds a zero-tolerance policy for discrimination, harassment and sexual misconduct. If you (or someone you know) have experienced discrimination or harassment, including sexual assault, domestic/dating violence, or stalking, I encourage you to tell someone promptly. For more information, please consult the University's Gender-Based Discrimination and Sexual Misconduct Policy at http://bit.ly/2ce1hBb or contact the University's EEO and Title IX Coordinator, Belinda Guthrie, at 408-554-3043, bguthrie@scu.edu. Reports may be submitted online through https://www.scu.edu/osl/report/ or anonymously through Ethicspoint https://www.scu.edu/hr/quick-links/ethicspoint/

1. Szu *et.al. Journal of Chemical Education, 88*, **2011**, 1238.
2. Horowitz *et. al. Journal of the Scholarship of Teaching and Learning*, *13*, **2013**, 120.

CLASS SCHEDULE

DAY	DATE	TOPIC
M	June 19	Introduction and Course Approach Structure and Covalent Bonds: Hybridizaton, Geometry and Bonding Rules Bond Polarity, Dipole Moment and Charge
T	June 20	Bond Length, Strength and Chemical Reactivity Drawing Organic Molecules Functional Groups Functional Groups and Introduction to Infrared Spectroscopy
W	June 21	Structural Variations in Hydrocarbon Chains - Isomerism Nomenclature Isomerism and Physical Properties ^{13}C NMR Spectroscopy Alkanes and Cycloalkanes: Conformational Analysis
Th	June 22	Sterechemistry and Chirality Formal Charge Organic Compounds as Acids and Bases Principles of Organic Reactivity and Stability
F	June 23	**EXAM 1** Principles of Organic Reactivity and Stability
M	June 26	Reaction Mechanisms and Energetics Example Reactions, Mechanisms and Reaction Coordinates
T	June 27	Nucleophilic Substitution and Elimination Reactions
W	June 28	Nucleophilic Substitution and Elimination Reactions
Th	June 29	Nucleophilic Substitution and Elimination Reactions-Review and Problems
F	June 30	**EXAM 2** Alkenes: Structure and Reactivity, Alkenes: Reactions and Synthesis
M	July 3	Alkenes: Reactions and Synthesis
T	July 4	Reactions of Alkynes
W	July 5	Reactions of Alkynes, Alkynes in Synthesis
Th	July 6	Alkynes in Organic Synthesis Review and Problems
F	July 7	**FINAL EXAM**