

BUTTE COLLEGE

COURSE OUTLINE

I. CATALOG DESCRIPTION

CHEM 22 - Organic Chemistry II

5 Unit(s)

Prerequisite(s): CHEM 21

Recommended Prep: NONE

Transfer Status: CSU/UC

51 hours Lecture

102 hours Lab

This is the second course in a year-long study of organic chemistry designed for students majoring in chemistry and related science disciplines. The physical properties, reactions and reaction mechanisms of conjugated systems, aromatic compounds, carbonyl compounds (aldehydes, ketones, carboxylic acids and their derivatives), amines and biomolecules are studied. Laboratory work includes advanced techniques in reaction conditions, product separation, purification and spectroscopy. (C-ID CHEM 160S) (C-ID CHEM 160S = CHEM 21 and CHEM 22). Graded only.

II. OBJECTIVES

Upon successful completion of this course, the student will be able to:

- Demonstrate a conceptual understanding of the fundamental principles of modern organic chemistry.
- Use appropriate vocabulary to describe processes and to name compounds with various functional groups.
- Demonstrate analytical and problem solving skills in predicting the structure of the products for an organic reaction.
- Demonstrate skills toward designing multi-step syntheses of organic compounds.
- Demonstrate laboratory skills and employ standard laboratory techniques towards the synthesis, purification and analysis of organic compounds.

III. COURSE CONTENT

A. Unit Titles/Suggested Time Schedule

Lecture	
<u>Topics</u>	<u>Hours</u>
1. Review of Infrared and Nuclear Magnetic Resonance (NMR) Spectroscopy	2.00
2. Conjugated Systems	4.00
3. Aromatic Compounds	3.50
4. Electrophilic Aromatic Substitution Reactions	5.50
5. Carboxylic Acids and Phenols	2.00
6. Organometallic Reactions	3.50
7. Aldehydes and Ketones	4.50
8. Carboxylic Acid Derivatives	5.50
9. Enols and Enolates	6.50
10. Amines	3.00
11. Carbohydrates	4.50
12. Amino Acids and Proteins	4.00
13. Lipids and Nucleic Acids	2.50
Total Hours	51.00

	Lab	
<u>Topics</u>		<u>Hours</u>
1. Laboratory Exercises to review NMR Spectroscopy		6.00
2. Laboratory Exercises Involving Multi-Step Syntheses		6.00
3. Solid State IR Spectroscopy		3.00
4. Column Chromatography		3.00
5. Microscale Techniques		3.00
6. Inert Atmosphere Reaction Techniques		9.00
7. Mass Spectrometry		6.00
8. Diels Alder Reaction: Synthesis, Purification and Spectroscopic Analysis		6.00
9. Hydroboration Reaction: Synthesis, Purification and Spectroscopic Analysis		6.00
10. Electrophilic Aromatic Substitution Reaction: Synthesis, Purification and Spectroscopic Analysis		6.00
11. Grignard Reaction: Synthesis, Purification and Spectroscopic Analysis		6.00
12. Acetal Formation Reaction: Synthesis, Purification and Spectroscopic Analysis		6.00
13. Rearrangement Reaction: Synthesis, Purification and Spectroscopic Analysis		6.00
14. Lactonization Reaction: Synthesis, Purification and Spectroscopic Analysis		6.00
15. Fischer Esterification Reaction: Synthesis, Purification and Spectroscopic Analysis		6.00
16. Aldol Condensation Reaction: Synthesis, Purification and Spectroscopic Analysis		6.00
17. Stereoselective Reduction Reaction: Synthesis, Purification and Spectroscopic Analysis		6.00
18. Biodiesel Reaction: Synthesis and Spectroscopic Analysis		6.00
Total Hours		102.00

IV. **METHODS OF INSTRUCTION**

- A. Lecture
- B. Demonstrations
- C. Laboratory Experiments
- D. Homework: Students are required to complete two hours of outside-of-class homework for each unit of credit.

V. **METHODS OF EVALUATION**

- A. Quizzes
- B. Written Examinations
- C. Laboratory reports and notebooks
- D. Laboratory Exam

VI. **EXAMPLES OF ASSIGNMENTS**

- A. Reading Assignments
 1. Read the section on organometallic reactions in the textbook and be prepared to solve

synthetic and retrosynthetic problems in class and on exams.

2. Read the section on pH dependent forms of amino acids and be prepared to draw all protonation forms and decide what the predominant form is at a given pH on exams.

B. Writing Assignments

1. For the Hydroboration experiment, create a properly formatted 1-page typed lab report that includes a title, date, introduction, detailed procedure in third person passive voice, formal entries for IR, NMR and MS data, and a conclusion. This report will be graded along with your lab report.
2. Write a paragraph on an exam that explains why the hydrolysis of an ester is much more favorable in basic conditions than in acidic conditions. Include appropriate structures with your answer.

C. Out-of-Class Assignments

1. Complete the 1-page pre-lab assignment for the Diels Alder experiment. You will be asked to predict the major product of the reaction, complete a data table with relevant physical constants, and calculate the theoretical yield.
2. In order to prepare for the exam, complete the 14-page homework assignment on electrophilic aromatic substitution reactions.

VII. RECOMMENDED MATERIALS OF INSTRUCTION

Textbooks:

- A. Smith, J.G. Organic Chemistry. 4th Edition. McGraw-Hill, New York, 2013.
- B. Pavia, D.L. A Microscale Approach to Organic Laboratory Techniques. 5th Edition. Cengage Learning, 2012.
- C. Nichols, L.M. CHEM 22 Laboratory Manual. Current Edition. Butte College (publisher), 2014.

Materials Other Than Textbooks:

- A. Laboratory Notebook with non-removable pages

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