



CREDIT COURSE OUTLINE

I. COVER PAGE

(1) CHEM 9

(2) ELEMENTARY ORGANIC CHEMISTRY
LABORATORY

(3) 3

Number

Title

Units

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="3">(4) Lecture / Lab Hours:</td> </tr> <tr> <td colspan="3">Total Course Hours</td> </tr> <tr> <td style="width: 30%;">Total Lec hours:</td> <td style="width: 30%;"></td> <td style="width: 40%; text-align: center;">1.00</td> </tr> <tr> <td>Total Lab hours:</td> <td></td> <td style="text-align: center;">6.00</td> </tr> <tr> <td>Total Contact hours:</td> <td></td> <td style="text-align: center;">126.00</td> </tr> <tr> <td colspan="3">Lec will generate <u>0</u> hour(s) outside work.</td> </tr> <tr> <td colspan="3">Lab will generate <u>0</u> hour(s) outside work.</td> </tr> <tr> <td colspan="3">(5) Grading Basis:</td> </tr> <tr> <td>Grading Scale Only</td> <td></td> <td></td> </tr> <tr> <td>Pass/No Pass option</td> <td></td> <td style="text-align: center;">X</td> </tr> <tr> <td>Pass/No Pass only</td> <td></td> <td></td> </tr> <tr> <td colspan="3">(6) Advisories:</td> </tr> <tr> <td colspan="3">Eligibility for English 126</td> </tr> <tr> <td colspan="3">Eligibility for English 125</td> </tr> <tr> <td colspan="3">(7) Pre-requisites(requires C grade or better):</td> </tr> <tr> <td colspan="3">CHEM 3A or CHEM 1A</td> </tr> <tr> <td colspan="3">Corequisites:</td> </tr> <tr> <td colspan="3">CHEM 8</td> </tr> </table>	(4) Lecture / Lab Hours:			Total Course Hours			Total Lec hours:		1.00	Total Lab hours:		6.00	Total Contact hours:		126.00	Lec will generate <u>0</u> hour(s) outside work.			Lab will generate <u>0</u> hour(s) outside work.			(5) Grading Basis:			Grading Scale Only			Pass/No Pass option		X	Pass/No Pass only			(6) Advisories:			Eligibility for English 126			Eligibility for English 125			(7) Pre-requisites(requires C grade or better):			CHEM 3A or CHEM 1A			Corequisites:			CHEM 8			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="3">(8) Classification:</td> </tr> <tr> <td style="width: 30%;"></td> <td style="width: 30%;"></td> <td style="width: 40%;"></td> </tr> <tr> <td></td> <td>Degree applicable:</td> <td style="text-align: center;">X</td> </tr> <tr> <td></td> <td>Non-degree applicable:</td> <td></td> </tr> <tr> <td></td> <td>Basic skills:</td> <td></td> </tr> <tr> <td colspan="3">(9) RC</td> </tr> <tr> <td colspan="3">Fulfills AS/AA degree requirement: (area)</td> </tr> <tr> <td colspan="3">General education category:</td> </tr> <tr> <td colspan="3">Area A Natural Sciences</td> </tr> <tr> <td colspan="3">Major:</td> </tr> <tr> <td colspan="3">Certificate of:</td> </tr> <tr> <td colspan="3">Certificate in:</td> </tr> <tr> <td>(10) CSU</td> <td>Baccalaureate:</td> <td style="text-align: center;">X</td> </tr> <tr> <td colspan="2">(11) Repeatable: (A course may be repeated three times)</td> <td style="text-align: center;">0</td> </tr> </table>	(8) Classification:							Degree applicable:	X		Non-degree applicable:			Basic skills:		(9) RC			Fulfills AS/AA degree requirement: (area)			General education category:			Area A Natural Sciences			Major:			Certificate of:			Certificate in:			(10) CSU	Baccalaureate:	X	(11) Repeatable: (A course may be repeated three times)		0
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(12) Catalog Description:

Reactions of the main functional groups of organic compounds such as alkanes, alkenes, alkylhalides, acids and esters, and a study of the physical properties of those compounds. Students will work hands-on with a melting point apparatus, a refractometer, a gas-chromatograph, an infra-red spectrometer and a nuclear magnetic resonance spectrometer. The course is designed to accompany an elementary organic chemistry lecture course such as Chemistry 8. This course, along with Chemistry 8, is a thorough preparation for the advanced organic chemistry courses, Chemistry 28A and 29A.

II. COURSE OUTCOMES:

(Specify the learning skills the student demonstrates through completing the course and link critical thinking skills to specific course content and objectives.)

Upon completion of this course, students will be able to:

- I. Complete the reactions of simple aliphatic and aromatic molecules following instructions in an organic laboratory manual and safely handling organic chemicals and grounded glassware.
- II. Analyse products by obtaining the melting point, refractive index, infra red spectrum, gas chromatogram and nuclear magnetic resonance spectrum.
- III. Analyze the structural formula of an organic compound, recognize its functional groups and name it properly.
- IV. Draw a structural formula of an organic compound given the systematical name.
- V. Recognize chiral compounds and understand their physical properties.

III. COURSE OBJECTIVES:

(Specify major objectives in terms of the observable knowledge and/or skills to be attained.)

In the process of completing this course, students will:

- I. Follow step wise instructions for the reactions of simple aliphatic and aromatic molecules and practice writing correct reaction mechanisms of substitution reactions.
- II. Handle organic compounds and ground glassware safely.
- III. Analyze organic compounds by obtaining the melting points, refractive indexes, infra-red spectra, gas chromatograms and nuclear magnetic resonance spectra.
- IV. Gain an understanding of how to draw structural formulas and line-bond formulas given the systematic name of an organic compound.
- V. Analyze the structural formula of an organic compound, recognize its functional groups and learn how to name it properly using the systematic IUPAC nomenclature.
- VI. Gain a basic understanding of stereochemistry, recognizing asymmetric carbon atoms that cause chirality.

IV. COURSE OUTLINE:

Lecture Content:

- A. Covalent bonding in and basic shapes of organic molecules.
 - I. Lewis structures.
 - II. Calculation of electro-negativity differences and polar covalent and non-polar covalent bonds.
- B. Organic acids and bases.
 - I. Alkanes and cycloalkanes.
 - II. The basics of organic nomenclature, an introduction of the functional groups.
- C. Chirality and stereo-isomerism: Asymmetric carbon atoms and their effects on stereochemical behavior.
- D. Alkenes and alkynes: Nomenclature and reactions of alkenes, including the rule of Markovnikov and its mechanistic background.
- E. Halo-alkanes: Nucleophilic substitution reactions
 - I. First order reactions. Replacement of the halogen by nucleophiles such as methoxide, ethoxide, and cyanide at tertiary C atoms.
 - II. Second Order Reactions. Replacement of the halogen by nucleophiles at primary C atoms.
- F. Alcohols, ethers, thiols: Nomenclature and synthesis
- G. Benzene and its derivatives: Nomenclature and reactivity of substituted benzene rings.
- H. Aldehydes, ketones, amines and carboxylic acids. Nomenclature and reactivity.
- I. Introduction to biomolecules: carbohydrates, lipids, amino acids and proteins.

Lab Content:

- A. Safety procedures, Safety Quiz. Working with the Model Box.
- B. Molecular Modeling. Covalent bonding.
- C. Measuring Melting Point of an organic solid and Refractive Index of an organic liquid.
- D. Simple Distillation and Fractional Distillation.
- E. Extraction and Re-crystallization.
- F. Introduction to Spectroscopy. Infrared (IR) and Nuclear Magnetic Resonance (NMR).
- G. Identification of Alkanes and Cycloalkanes.
- H. Synthesis of Cyclohexene.
- I. Synthesis and Reactions of Acetylene.
- J. Qualitative tests for Alkyl halides and simple Hydrocarbons.
- K. Nucleophilic Substitution Reactions I. First order substitutions.
- L. Nucleophilic Substitution Reactions II. Second order substitutions
- M. Alcohols. The Grignard Reaction.
- N. Ethers. Identification and the Williamson ether synthesis.
- O. Aromatic Reactions. Reactions of toluene and other benzene derivatives.
- P. Oxidation of the side chain of toluene. The formation of benzoic acid.
- Q. Ester formation.
- R. Saponification. The reactions of esters with sodium hydroxide: soap making.
- S. The synthesis of Aspirin.
- T. Aldehydes and Ketones. Qualitative Tests.
- U. The synthesis of acetanilide, a precursor of Tylenol.
- V. Carbohydrates. Qualitative tests.
- W. Amino Acids and Proteins.
- X. The decomposition of hydrogen peroxide with the enzyme katalase.
- Y. Lipids, Fats, Oils and Steroids. Qualitative tests of Un-saturation in Lipids.

V. APPROPRIATE READINGS

Reading assignments may include but are not limited to the following:

I. Sample Text Title:

1. Recommended - Bettelheim, F.A. and Landesberg, J. M *Laboratory Experiments for Introduction to Organic and Biochemistry*, ed. 7th Brooks Cole, 2009, ISBN: 978-049539196
2. Recommended - Bruice, P *Essentials of Organic Chemistry*, ed. 2nd Pearson, Prentice Hall, Upper Saddle River, NJ, 2009, ISBN: 9780321596951
3. Recommended - Bailey, P.S. and Bailey, C.A *Organic Chemistry: A Brief Survey of Concepts and Applications*, ed. 6th Prentice Hall, 2004, ISBN: 9780139241191

II. Other Readings

1. Recommended - *Computer programs: B. Luceigh, Organic Chem TV I G. Lampman Organic Nomenclature*

- Global or international materials or concepts are appropriately included in this course
 Multicultural materials and concepts are appropriately included in this course

If either line is checked, write a paragraph indicating specifically how global/international and/or multicultural materials and concepts relate to content outline and/or readings.

VI. METHODS TO MEASURE STUDENT ACHIEVEMENT AND DETERMINE GRADES:

Students in this course will be graded in at least one of the following four categories. Please check those appropriate. A degree applicable course must have a minimum of one response in category A, B, or C.

A. Writing			
Check either 1 or 2 below			
X	1. Substantial writing assignments are required. Check the appropriate boxes below and provide a written description in the space provided.		
	2. Substantial writing assignments are NOT required. If this box is checked leave this section blank. For degree applicable courses you must complete category B and/or C.		
X	a) essay exam(s)	X	d) written homework
	b) term or other paper(s)		e) reading reports
X	c) laboratory report(s)		f) other (specify)

Required assignments may include but are not limited to the following:

Students will write formal lab reports that are essentially research papers on the subject of the experiment. They will research the background of the reaction by using the organic literature and available internet resources.

B. Problem Solving			
Computational or non-computational problem-solving demonstrations, including:			
X	a) exam(s)	X	d) laboratory reports
X	b) quizzes		e) field work
X	c) homework problems		f) other (specify):

Required assignments may include but are not limited to the following:

Laboratory reports, including pre-lab and post-lab questions.

Homework assignments. Problems from the text or from a hand-out or worksheet.

C. Skill demonstrations, including:			
X	a) class performance(s)		c) performance exams(s)
	b) field work		d) other (specify)

Required assignments may include but are not limited to the following:

Students need to demonstrate that they understand basic organic laboratory safety procedures.

They need to perform distillations, and as a measure of the purity of their prepared compound need to show how to determine the melting point or refractive index.

D. Objective examinations including:			
	a) multiple choice		d) completion
	b) true/false	X	e) other (specify):
	c) matching items		

COURSE GRADE DETERMINATION:

Description/Explanation: Based on the categories checked in A-D, it is the recommendation of the department that the instructor's grading methods fall within the following departmental guidelines; however, the final method of grading is still at the discretion of the individual instructor. The instructor's syllabus must reflect the criteria by which the student's grade has been determined. (A minimum of five (5) grades must be recorded on the final roster.)

If several methods to measure student achievement are used, indicate here the approximate weight or percentage each has in determining student final grades.

Lab reports 30% Homework assignments 10% Quizzes 20% Final Exam 40%

VII. EDUCATIONAL MATERIALS

For degree applicable courses, the adopted texts, as listed in the college bookstore, or instructor-prepared materials have been certified to contain college-level materials.

Validation Language Level (check where applicable):	College-Level Criteria Met	
	YES	NO
Textbook	<u> X </u>	<u> </u>
Reference materials	<u> X </u>	<u> </u>
Instructor-prepared materials	<u> X </u>	<u> </u>
Audio-visual materials	<u> X </u>	<u> </u>

Indicate Method of evaluation:

- Used readability formulae (grade level 10 or higher)
- Text is used in a college-level course X
- Used grading provided by publisher
- Other: (please explain; relate to Skills Levels)

<i>Computation Level</i> (Eligible for MATH 101 level or higher where applicable)	<u> X </u>	<u> </u>
Content		
Breadth of ideas covered clearly meets college-level learning objectives of this course	<u> X </u>	<u> </u>
Presentation of content and/or exercises/projects:		
Requires a variety of problem-solving strategies including inductive and deductive reasoning.	<u> X </u>	<u> </u>
Requires independent thought and study	<u> X </u>	<u> </u>
Applies transferring knowledge and skills appropriately and efficiently to new situations or problems.	<u> X </u>	<u> </u>

List of Reading/Educational Materials

Recommended - Bettelheim, F.A. and Landesberg, J. M *Laboratory Experiments for Introduction to Organic and Biochemistry*, ed. 7th Brooks Cole, 2009, ISBN: 978-049539196

Recommended - Bruice, P *Essentials of Organic Chemistry*, ed. 2nd Pearson, Prentice Hall, Upper Saddle River, NJ, 2009, ISBN: 9780321596951

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Comments:

- This course requires special or additional library materials (list attached).
- X This course requires special facilities:
- Organic laboratory facility

Attached Files:

[CHEM 9 FORMS BC](#)

BASIC SKILLS ADVISORIES PAGE The skills listed are those needed for eligibility for English 125, 126, and Math 101. These skills are listed as the outcomes from English 252, 262, and Math 250. In the right hand column, list at least three major basic skills needed at the beginning of the target course and check off the corresponding basic skills listed at the left.

(eligibility for English 126)
(as outcomes for English 262)

- X Using phonetic, structural, contextual, and dictionary skills to attack and understand words.
- X Applying word analysis skills to reading in context.
- X Using adequate basic functional vocabulary

1. Students are required to read a college-level Chemistry textbook with sophisticated vocabulary.
2. Students are required to read lab manuals and understand safety procedures.
3. Basic analytical skills are required for good comprehension of dense readings.

skills. <input checked="" type="checkbox"/> Using textbook study skills and outlining skills. <input checked="" type="checkbox"/> Using a full range of literal comprehension skills and basic analytical skills such as predicting, inferring, concluding, and evaluating.	
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(eligibility for English 125) (as outcomes for English 252) <input checked="" type="checkbox"/> Writing complete English sentences and avoiding errors most of the time. <input checked="" type="checkbox"/> Using the conventions of English writing: capitalization, punctuation, spelling, etc. <input checked="" type="checkbox"/> Using verbs correctly in present, past, future, and present perfect tenses, and using the correct forms of common irregular verbs. <input checked="" type="checkbox"/> Expanding and developing basic sentence structure with appropriate modification. <input checked="" type="checkbox"/> Combining sentences using coordination, subordination, and phrases. <input checked="" type="checkbox"/> Expressing the writer's ideas in short personal papers utilizing the writing process in their development.	1. Students are required to write answers with complete English sentences. 2. To explain shifts in chemical equilibria, students need to write well organized and coherent prose. 3. Lab reports are required which necessitate the ability to write well organized and coherent prose.
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<u>Check the appropriate spaces.</u> <input type="checkbox"/> Eligibility for Math 101 is advisory for the target course. <input checked="" type="checkbox"/> Eligibility for English 126 is advisory for the target course. <input checked="" type="checkbox"/> Eligibility for English 125 is advisory for the target course. <i><u>If the reviewers determine that an advisory or advisories in Basic Skills are all that are necessary for success in the target course, stop here, provide the required signatures, and forward this form to the department chair, the appropriate associate dean, and the curriculum committee.</u></i>

CONTENT REVIEW
CHEM 3A INTRODUCTORY GENERAL CHEMISTRY
CHEM 1A GENERAL CHEMISTRY
CHEM 8 ELEMENTARY ORGANIC CHEMISTRY

REQUISITES	
Corequisite -- CHEM 8 ELEMENTARY ORGANIC CHEMISTRY	
<ul style="list-style-type: none"> Analyze the structural formula of an organic compound, recognize its functional groups and name it properly. Draw a structural formula of an organic compound given the systematic name. Identify S and R stereoisomers. Complete the reactions of simple aliphatic and aromatic molecules, showing the reaction mechanisms. Analyze simple IR and NMR spectra to determine the structure of an unknown compound. 	<ul style="list-style-type: none"> Gain an understanding of how to draw structural formulas and line-bond formulas given the systematic name of an organic compound. Gain a basic understanding of stereochemistry, recognizing asymmetric carbon atoms that cause chirality. Follow step wise instructions for the reactions of simple aliphatic and aromatic molecules and practice writing correct reaction mechanisms of substitution reactions. Analyze the structural formula of an organic compound, recognize its functional groups and learn how to name it properly using the systematic IUPAC nomenclature. Analyze organic compounds by obtaining the melting points, refractive indexes, infra-red spectra, gas chromatograms and nuclear magnetic resonance spectra.
Subject Prerequisite -- CHEM 3A INTRODUCTORY GENERAL CHEMISTRY	

- Construct and balance a chemical reaction and use the reaction to predict stoichiometric quantities.
- Competent knowledge and understanding of the periodic table and the ability use the periodic table to solve chemical problems.
- Understand acid-base reactions and how to calculate pH.
- Safely conduct laboratory experiments implementing concepts and principles learned in lecture.
- Name and draw Lewis diagrams of inorganic and molecular compounds from the formula and vice versa.

- Gain an understanding of how to draw structural formulas and line-bond formulas given the systematical name of an organic compound.
- Follow step wise instructions for the reactions of simple aliphatic and aromatic molecules and practice writing correct reaction mechanisms of substitution reactions.
- Analyze the structural formula of an organic compound, recognize its functional groups and learn how to name it properly using the systematical IUPAC nomenclature.

Subject Prerequisite -- CHEM 1A GENERAL CHEMISTRY

- Collect and analyze data and have reasonable conclusions. Assessed by the lab practical.
- Competent knowledge of the periodic table, molecules, and compounds. Assessed from a pre-test administered at the beginning of the semester and the final exam administered at the end of the semester.
- Ability to apply skills to solve chemical problems especially math skills. Assessed from a pre-test administered at the beginning of the semester and the final exam administered at the end of the semester.

- Gain an understanding of how to draw structural formulas and line-bond formulas given the systematical name of an organic compound.
- Follow step wise instructions for the reactions of simple aliphatic and aromatic molecules and practice writing correct reaction mechanisms of substitution reactions.
- Analyze the structural formula of an organic compound, recognize its functional groups and learn how to name it properly using the systematical IUPAC nomenclature.
- Analyze organic compounds by obtaining the melting points, refractive indexes, infra-red spectra, gas chromatograms and nuclear magnetic resonance spectra.

ESTABLISHING PREREQUISITES OR COREQUISITES

Every prerequisite or corequisite requires content review plus justification of at least one of the seven kinds below. Prerequisite courses in communication and math outside of their disciplines require justification through statistical evidence. Kinds of justification that may establish a prerequisite are listed below.

Check one of the following that apply. Documentation may be attached.

1. ____ The prerequisite/corequisite is required by law or government regulations.
Explain or cite regulation numbers:
2. ____ The health or safety of the students in this course requires the prerequisite.
Justification: Indicate how this is so.
3. ____ The safety or equipment operation skills learned in the prerequisite course are required for the successful or safe completion of this course.
Justification: Indicate how this is so.
4. ____ The prerequisite is required in order for the course to be accepted for transfer to the UC or CSU systems.
Justification: Indicate how this is so.
5. ____ Significant statistical evidence indicates that the absence of the prerequisite course is related to unsatisfactory performance in the target course.
Justification: Cite the statistical evidence from the research.
6. X The prerequisite course is part of a sequence of courses within or across a discipline.
7. ____ Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course: