1. CURRENT DATE: Spring 2015
   Please indicate whether this is a NEW COURSE or a REVISION: Revision

   DATE OF PRIOR REVISION: Spring 2012

2. NAME OF REVISING INSTRUCTOR: Dr. Jason Polisar & Dr. Martin Epstein

3. COURSE #: CHEM 201

4. NAME OF COURSE: Organic Chemistry 1 - Lecture & Lab

5. COURSE DESCRIPTION:
   CHEM 201 Organic Chemistry 1 - Lecture & Lab
   5 credits

   In-depth study of: (i) the structure of organic compounds and the functional groups (bonding, acid-base properties, nomenclature, conformations, stereochemistry), and (ii) the synthesis and reactivity (including detailed mechanisms) of alkanes, alkenes, alkynes, halides, alcohols, ethers, epoxides, sulfides and organometallic reagents. Laboratory experiments are related to topics covered in lecture and emphasize organic laboratory techniques, synthesis and spectroscopic characterization of organic molecules.

   Notes: Organic Chemistry 1 is the first semester of a one-year (two-semester) comprehensive organic chemistry course designed for science or engineering majors transferring to a four-year college or for students fulfilling prerequisites for medical school or related programs. Class Hours: 4; Lab Hours: 3; Prerequisites: CHEM 111 (Inorganic Chemistry 2 - Lecture & Lab); Offered in Fall and Spring semesters and Summer Session 1.

6. NUMBER OF CREDITS: 5

7. NUMBER OF CONTACT HOURS PER WEEK
   a. Lab hours: 4
   b. Lecture hours: 3

8. APPROXIMATE FREQUENCY OF OFFERING THIS COURSE: Fall, Spring & Summer Session 1

9. PREREQUISITES or PLACEMENT SCORES: CHEM 111 (Inorganic Chemistry 2 - Lecture & Lab)

10. COREQUISITES: None

11. ASSOCIATED COURSES (such as field courses): None

12. PLACE OF THIS COURSE IN CURRICULUM:
    Required for Curriculum: Liberal Arts/Math & Science;
    Part of required/recommended sequence with CHEM 205.

13. ADDITIONAL COMMENTS/CLASS NOTES: Students must register for both a lecture and a lab section.
14. REQUIRED TEXTS AND/OR MATERIALS ¹:
   
   

   ¹Textbooks are subject to change each semester. For updated textbook requirements, please contact the WCC Bookstore.

15. STUDENT LEARNING OUTCOMES (SLOs) and COURSE OBJECTIVES

<table>
<thead>
<tr>
<th>SLO/Objectives* - Upon successful completion, the student will be able to:</th>
<th>This outcome will be measured* by one or more of the following instruments (exercises, tools, observations):</th>
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</thead>
<tbody>
<tr>
<td><strong>SLO 1: demonstrate an understanding of organic molecular structure and functional groups.</strong></td>
<td>Measure: Exam 1, Exam 2, Exam 3, Final Exam.</td>
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<tr>
<td>Objective 1: interpret and represent expanded, condensed and line-bond (skeletal) structures.</td>
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<tr>
<td>Objective 2: interpret and represent the possible conformations, constitutional isomers and stereoisomers of an organic molecule.</td>
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<td>Objective 3: describe and draw out the bonding/orbital overlap within an organic molecule, including resonance contributors where applicable.</td>
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<td>Objective 4: describe the structural features and properties of the common functional groups.</td>
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<tr>
<td><strong>SLO 2: demonstrate an understanding of alkene, alkyne, alcohol, epoxide, sulfide, halide, Grignard, organolithium and Gilman reagent reactivity.</strong></td>
<td>Measure: Exam 2, Exam 3, Final Exam.</td>
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<tr>
<td>Objective 1: predict the product(s) given a set of reaction conditions.</td>
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<tr>
<td>Objective 2: recall the reagents needed to carry out a functional group transformation.</td>
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<tr>
<td>Objective 3: solve multi-step synthesis problems.</td>
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<tr>
<td><strong>SLO 3: demonstrate a mechanistic understanding of non-carbonyl functional group reactivity and organometallic reactivity.</strong></td>
<td>Measure: Exam 2, Exam 3, Final Exam.</td>
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<tr>
<td>Objective 1: provide arrow (electron)-pushing mechanisms for most of the reactions encountered in the course and related transformations.</td>
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<tr>
<td>Objective 2: apply mechanistic and structural principles, such as steric and electronic effects, to explain the observed regio- and/or stereoselectivity of a reaction.</td>
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<tr>
<td><strong>SLO 4: demonstrate the ability to conduct organic chemistry experiments and to analyze data &amp; results.</strong></td>
<td>Measure: Class observation, laboratory reports and/or homework assignments, lab quizzes.</td>
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<tr>
<td>Objective 1: perform organic laboratory techniques such as distillation, recrystallization and extraction.</td>
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<tr>
<td>Objective 2: perform short reaction sequences.</td>
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<tr>
<td>Objective 3: interpret spectroscopic data.</td>
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</table>

*Variations from this basic plan may occur depending on the individual instructor teaching the course and/or the time constraints of a given semester.
SUNY General Education Outcomes (Appendix A)

<table>
<thead>
<tr>
<th>Natural Sciences- Students will demonstrate:</th>
<th>Related Course SLO &amp; Measure</th>
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</thead>
<tbody>
<tr>
<td>understanding of the methods scientists use to explore natural phenomena, including observation, hypothesis development, measurement and data collection, experimentation, evaluation of evidence, and employment of mathematical analysis.</td>
<td>SLO 4 and Measure 4</td>
</tr>
<tr>
<td>application of scientific data, concepts, and models in one of the natural (or physical) sciences.</td>
<td>SLOs 1, 2 &amp; 3 and Measures 1, 2 &amp; 3</td>
</tr>
</tbody>
</table>

16. COURSE GRADING CRITERIA:
Lecture 1 = 75%
3 Exams (50% combined)
Cumulative Final Exam (25%)
(On the occasion of significant improvement on the final exam, more weight will be placed on the final exam.)

Lab 1, 2 = 25%

1 Variations from this basic plan may occur depending on the instructor. Instructors will state their grading procedures at the start of the term.
2 Exception: Students who fail the lab will fail the course regardless of their lecture average.

17. INSTRUCTIONAL METHODS: List the different instructional methods you might use, in the course of the semester. List supplementary learning options, if any:
- Traditional lecture with use of chalkboard
- Computer assisted diagrams and graphics
- Molecular Models
- Team work in the laboratory
- Homework assignments
- Solving specific questions related to content studied
- Written exams and distribution of study questions/previous exams
- Use of the Internet

18. TOPIC OUTLINE: Please see below.

19. UNIQUE ASPECTS OF COURSE (such as equipment, specified software, space requirements, etc.):
Organic chemistry laboratories and their associated equipment, instruments and chemicals.

CHEM 201 Lecture Topic Outline*

Ch. 1 Structure and Bonding
Bonding; Hybridization; Drawing Chemical Structures; Functional Groups; Intro to IR Spectroscopy

Ch. 2 Polar Covalent Bonds; Acids and Bases
Chemical Bonding (Ionic and Covalent); Electronegativity and Dipole Moments; Formal Charges; Resonance Structures; Acid Base Theory (Bronsted-Lowry, Lewis); Acid and Base Strength (pKₐ); Acid-Base Reactions; Organic Acids and Organic Bases

Ch. 3 Organic Compounds: Alkanes and their Stereochemistry
Alkanes, Alkane Isomers, and Alkyl Groups; Properties of Alkanes; Conformations

Ch. 4 Organic Compounds: Cycloalkanes and their Stereochemistry
Cis-Trans Isomerism in Cycloalkanes; Stability and Conformations of Cycloalkanes; Chairs
Ch. 5 Stereochemistry at Tetrahedral Centers
Enantiomers, the Tetrahedral Carbon and Chirality; Optical Activity; R/S Sequence Rules; Diastereomers and Meso Compounds; Racemic Mixtures, Resolution of Enantiomers; Prochirality; Chirality in Nature

Ch. 6 An Overview of Organic Reactions
Kinds of Organic Reactions (Radical and Polar); Mechanisms; Describing a Reaction (Equilibria, Rates, Energy Changes, Bond Energy; Transition States, and Intermediates)

Ch. 7 Alkenes: Structure and Reactivity
Preparation and use of Alkenes; Cis-Trans Isomerism; Alkene Stereochemistry and E/Z Designation; Stability of Alkenes; Electrophilic Addition Reactions; Markovnikov’s Rule: Carbocation Structure and Stability; Carbocation Rearrangements

Ch. 8 Alkenes: Reactions and Synthesis
Preparation of Alkenes via Elimination Reactions; Addition Reactions of Alkenes (Halogenation, Hydration, Halohydrins, and Hydrogenation); Oxidation of Alkenes (Epoxidation and Hydroxylation); Addition of Carbenes; Radical Additions to Alkenes (Polymer Formation); Reaction Stereochernmy

Ch. 9 Alkynes: An Introduction to Organic Synthesis
Preparation of Alkynes; Addition Reactions of Alkynes (X2, HX, H2O, H2); Oxidative Cleavage; Alkyne Acidity and Alkylation; Introduction to Organic Synthesis

Ch. 11 Reactions of Alkyl Halides: Nucleophilic Substitutions and Eliminations
$S_N2$, $S_N1$, E2, E1, E1cB Reactions; Zaitsev’s Rule; Deuterium Isotope Effect

Ch. 10 Organohalides
Preparation of Alkyl Halides and Grignards; Radical and Allylic Halogenation; Organic Coupling Reactions, Redox in Organic Chemistry

Ch. 17 Alcohols and Phenols
Properties of Alcohols and Phenols; Preparation and Reactions of Alcohols; Reactions of Phenols

Ch. 18 Ethers and Epoxides; Thiols and Sulfides
Synthesis and Reactions of Ethers; Cyclic Ethers (Epoxides); Reactions of Epoxides; Crown Ethers; Thiols and Sulfides

*Exact topic content and time allotted to topics will depend on the individual instructor and/or the time constraints of a given semester.

CHEM 201 Lab Topic Outline 1, 2

3. Recrystallization, IR and Melting Point of benzoic acid.
4. Extraction of Organic Compounds from Natural Sources: Trimyristin from Nutmeg.
5. Paper Chromatography
6. Dehydration of Cyclohexanol.
7. Dimerization of 2-Methylpropene
8. Preparation of Diphenylacetylene Starting from Trans-Stilbene.
9. Preparation of Butyl Bromide/Preparation of t-Butyl Chloride ($S_N2$/$S_N1$).
10. Oxidation of Isoborneol to Camphor.

1Some experiments require more than one lab period to complete.
2Based on an instructor’s preference, availability of equipment/supplies or constraints within a given semester, this laboratory schedule is subject to change, including but not limited to, the addition or replacement of one or more of the above experiments with the following experiments: Addition of Bromine to E-Cinnamic Acid in Methylene Chloride
   Substitution Reactions of Alkyl Halides: Relative Rates
   Triphenylmethanol with Hydroiodic Acid
APPENDIX A
SUNY GENERAL EDUCATION KNOWLEDGE AND SKILL AREAS

1. MATHEMATICS - Students will demonstrate the ability to:
   • interpret and draw inferences from mathematical models such as formulas, graphs, tables and schematics;
   • represent mathematical information symbolically, visually, numerically and verbally;
   • employ quantitative methods such as, arithmetic, algebra, geometry, or statistics to solve problems;
   • estimate and check mathematical results for reasonableness; and
   • recognize the limits of mathematical and statistical methods.

2. NATURAL SCIENCES - Students will demonstrate:
   • understanding of the methods scientists use to explore natural phenomena, including observation, hypothesis
     development, measurement and data collection, experimentation, evaluation of evidence, and employment of
     mathematical analysis; and
   • application of scientific data, concepts, and models in one of the natural (or physical) sciences.

3. SOCIAL SCIENCES - Students will demonstrate:
   • understanding of the methods social scientists use to explore social phenomena, including observation, hypothesis
     development, measurement and data collection, experimentation, evaluation of evidence, and employment of
     mathematical and interpretive analysis; and
   • knowledge of major concepts, models and issues of at least one discipline in the social sciences.

4. AMERICAN HISTORY - Students will demonstrate:
   • knowledge of a basic narrative of American history: political, economic, social, and cultural, including knowledge of unity
     and diversity in American society;
   • knowledge of common institutions in American society and how they have affected different groups; and
   • understanding of America’s evolving relationship with the rest of the world.

5. WESTERN CIVILIZATION - Students will:
   • demonstrate knowledge of the development of the distinctive features of the history, institutions, economy, society,
     culture, etc., of Western civilization; and
   • relate the development of Western civilization to that of other regions of the world.

6. OTHER WORLD CIVILIZATIONS - Students will demonstrate:
   • knowledge of either a broad outline of world history, or
   • the distinctive features of the history, institutions, economy, society, culture, etc., of one non-Western civilization.

7. HUMANITIES - Students will demonstrate:
   • knowledge of the conventions and methods of at least one of the humanities in addition to those encompassed by other
     knowledge areas required by the General Education program.

8. THE ARTS - Students will demonstrate:
   • understanding of at least one principal form of artistic expression and the creative process inherent therein.

9. FOREIGN LANGUAGE - Students will demonstrate:
   • basic proficiency in the understanding and use of a foreign language; and knowledge of the distinctive features of
     culture(s) associated with the language they are studying.

10. BASIC COMMUNICATION - Students will:
    • produce coherent texts within common college-level written forms;
    • demonstrate the ability to revise and improve such texts;
    • research a topic, develop an argument, and organize supporting details;
    • develop proficiency in oral discourse; and
    • evaluate an oral presentation according to established criteria.