COURSE OUTLINE OF RECORD

Number: CHEM G225  TITLE: Organic Chemistry B

ORIGINATOR: Teresa Speakman  EFF TERM: Fall 2017
FORMERLY KNOWN AS:
DATE OF OUTLINE/REVIEW: 04-08-2017
CROSS LISTED COURSE: TOP NO: 1905.00
CID: CHEM 160S

SEMESTER UNITS: 5.0
HRS LEC: 72.0  HRS LAB: 108.0  HRS OTHER: 0.0
CONTACT HRS TOTAL: 180.0
STUDY NON-CONTACT HRS RECOMMENDED: 144.0

CATALOG DESCRIPTION:
A continuation of the study of the compounds of carbon and their reactions with emphasis upon structure/reactivity relationships and mechanisms, including chemistry of carbonyl compounds, aromatic compounds and molecules of biological importance. The laboratory includes reactions and workup design, separation and identification of an unknown mixture, multistep synthesis and additional spectroscopy.

JUSTIFICATION FOR COURSE:

PREREQUISITES:
- CHEM G220: Organic Chemistry A with a minimum grade of C or better
- CHEM A220: Organic Chemistry A with a minimum grade of C or better and
- CHEM A221: Organic Chemistry Laboratory 1 with a minimum grade of C or better

COREQUISITES:

ADVISORIES:

ASSIGNED DISCIPLINES:
- Chemistry

MATERIAL FEE: Yes [X] No [ ] Amount: $26.00

CREDIT STATUS: Noncredit [ ] Credit - Degree Applicable [X] Credit - Not Degree Applicable [ ]

GRADING POLICY: Pass/No Pass [ ] Standard Letter [X] Not Graded [ ] Satisfactory Progress [ ]

OPEN ENTRY/OPEN EXIT: Yes [ ] No [X]

TRANSFER STATUS: CSU Transferable[ ] UC/CSU Transferable[X] Not Transferable[ ]

LEVELS BELOW TRANSFER: Not Applicable

CALIFORNIA CLASSIFICATION CODES: Y - Not Applicable

NON CREDIT COURSE CATEGORY: Y - Not applicable, Credit Course

OCCUPATIONAL (SAM) CODE: E

REPEATABLE ACCORDING TO STATE GUIDELINES: No [X] Yes [ ] NUMBER REPEATS:

REQUIRED FOR DEGREE OR CERTIFICATE: No [ ] Yes [X]
- Chemistry(Associate in Arts)
- Chemistry(Associate in Arts)
- General Biology(Associate in Arts)
- General Biology(Associate in Arts)
- Liberal Arts: Emphasis in Science(Associate in Arts)
GE AND TRANSFER REQUIREMENTS MET:
IGETC Area 5: Physical and Biological Sciences
   5A: Physical Science
   5C: Laboratory Activity
CSU GE Area B: Scientific Inquiry and Quantitative Reasoning
   B1 - Physical Science
   B3 - Laboratory Sciences

PROGRAM LEVEL LEARNING OUTCOME(S) Supported by this course:

- develop an understanding of how chemistry is applied in other fields.
- improve problem-solving and critical thinking skills.
- develop a working knowledge of inorganic and organic chemistry, including calculations, reactions, and nomenclature.
- actively engage in hands-on experiences in both the classroom and the laboratory.
- write quality laboratory reports, with well-developed discussions and conclusions.
- develop confidence in their laboratory skills, operate independently during many procedures, and learn to design their own experiments.

COURSE LEVEL STUDENT LEARNING OUTCOME(S) Supported by this course:

1. Show how to synthesize a given compound, outlining the forward steps and reagents that are required using reactions learned in this semester.
2. Lab: Develop laboratory procedures such as separating and identifying an unknown mixture or evaluating reaction conditions.
3. Lab: Perform synthetic transformations in the lab, obtaining purified product in reasonable yield and purity.
4. Lab: Analyze NMR, IR and mass spectra to determine the structure of an organic compound.
5. Determine the correct names for organic molecules containing aromatic or carbonyl groups and draw the structure of such compounds from the name.
6. Predict the products, specify the reagents needed with correct stereochemistry and regiochemistry for reactions studied in this semester.
7. Evaluate reactive sites within a molecule by locating them and drawing correct electron-pushing arrows for reactions based on electronic properties and structure instead of rote memorization of mechanisms.

COURSE OBJECTIVES:

1. Use standard nomenclature rules to name a chemical structure or draw a chemical structure from a name for aromatic compounds, aldehydes, ketones, carboxylic acids, esters, amides and carbohydrates.
2. Predict the products and provide the appropriate reagents for common reactions of functional groups including dienes, aromatics, aldehydes, ketones, carboxylic acids, esters, amines and carbohydrates.
3. Generate a reaction mechanism that explains the regiochemistry and stereochemistry for reactions of dienes, aromatic rings, aldehydes, ketones, carboxylic acids, esters, amines and carbohydrates.

4. Use learned reactions to create multi-step syntheses.


I Lab Objectives
I.1. Carry out synthetic transformations of organic molecules, including multi-step synthesis.
I.2. Devise procedures for separation, purification and identification of organic compounds.
I.3. Design and carry out experiments.
I.4. Keep a neat and complete laboratory notebook and use the data therein to write comprehensive and well-reasoned laboratory reports.

COURSE CONTENT:

LECTURE CONTENT:

A. Nomenclature
   1. Aromatic compounds
   2. Aldehydes
   3. Ketones
   4. Carboxylic acids
   5. Esters
   6. Anhydrides
   7. Acid halides
   8. Amides
   9. Carbohydrates

B. Molecular Orbital Theory
   1. Conjugated systems
   2. Aromatic and antiaromatic systems

C. Diels-Alder reaction

D. Electrophilic Aromatic Substitution
   1. Mechanism via sigma complex
   2. Effect of substituents on rate of reaction
   3. Effect of substituents on regiochemistry
   4. Friedel-Crafts alkylation and acylation

E. Nucleophilic Aromatic Substitution
   1. Addition-elimination mechanism
   2. Elimination-addition (benzyne) mechanism
   3. Diazonium salts and their reactions

F. Synthesis of Aromatic Compounds

G. Nucleophilic Addition to Carbonyl
   1. Hydrates of aldehydes and ketones
   2. Acetals and hemiacetals
   3. Cyanohydrins
   4. Addition of organometallic reagents
   5. Addition of amines
   6. Protecting groups
   7. Wittig reaction

H. Addition-Elimination Reactions at Carbonyl
   1. Ester formation and hydrolysis
   2. Reactions of acyl halides
   3. Reactions of anhydrides
   4. Amide formation and hydrolysis

I. Reactions at the alpha-carbon of carbonyl compounds
   1. Acidity of hydrogens on alpha carbon
Formation of enols and enolates
3. Halogenation
4. Alkylation of enolates
5. Aldol reaction
6. Claisen condensation
7. Michael addition

J. Amines
1. Basicity
2. Reactions of amines
3. Synthesis of amines

K. Carbohydrates
1. Classification
2. Haworth projections
3. Reducing and nonreducing sugars
4. Mutarotation
5. Reactions of monosaccharides
6. Formation and structure of disaccharides
7. Structure of polysaccharides
8. Nucleotides

L. Amino Acids (as time permits)
1. Nomenclature
2. Acid-base properties
3. Peptide bonds

M. Organic Polymers (as time permits)
A. Addition Polymers
B. Condensation Polymers

LABORATORY CONTENT:

1. Laboratory safety
2. Review of techniques from organic chemistry I
3. New techniques
   a. Column chromatography
   b. UV/Visible spectroscopy
   c. Mass spectrometry
4. Development of experimental design
5. Synthetic transformations including multistep synthesis
6. Maintenance of a laboratory notebook.

Experiments and laboratory exercises are chosen to illustrate standard laboratory techniques and to correlate with reactions and mechanisms covered in the second semester lecture.

METHODS OF INSTRUCTION:

A. Lecture:
B. Lab:
C. Independent Study:

INSTRUCTIONAL TECHNIQUES:

Direct lecture, group problem-solving, active learning methods such as use of clickers

COURSE ASSIGNMENTS:
Writing Assignments

Laboratory reports, which include: analysis of experimental data; synthesis of ideas; presentation of a well-written, logical argument based on facts given or observed; prediction of mechanisms based on acidity arguments and other similar reactions; use of learned reactions to synthesize moderately
complex organic compounds.

**Reading Assignments**

Textbooks  
Handouts

**Out-of-class Assignments**

Textbook problems, problem sets on handouts

**METHODS OF STUDENT EVALUATION:**

Midterm Exam  
Final Exam  
Short Quizzes  
Written Assignments  
Essay Examinations  
Objective Examinations  
Report  
Problem Solving Exercises  
Skills Demonstration  

**Demonstration of Critical Thinking:**

Problem solving, essay, mechanism and synthesis questions on quizzes and exams, designing laboratory procedures, laboratory writeups requiring analysis of data and drawing sound conclusions from that data.

**Required Writing, Problem Solving, Skills Demonstration:**

Analysis of experimental data; synthesis of ideas; understanding of abstract concepts such as transition states, molecular orbital theory, and effect of reactant structure and reaction conditions to predict reaction products; presentation of a well-written, logical argument based on facts given or observed; prediction of mechanisms based on acidity arguments and other similar reactions; use of learned reactions to synthesize moderately complex organic compounds.

**TEXTS, READINGS, AND RESOURCES:**

**TextBooks:**


**LIBRARY:**

Adequate library resources include:

**Comments:**

**Attachments:**

Attached Files