CHEM 13CH: HONORS ORGANIC CHEMISTRY LABORATORY

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Fall 2020
Units:	3
Hours:	1 lecture, 6 laboratory per week (84 total per quarter)
Prerequisite:	CHEM 12B and CHEM 12BL or 13BH.
Corequisite:	CHEM 12C.
Advisory:	Not open to students with credit in CHEM 12CL.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Non-GE
Transferable:	CSU/UC
Grade Type:	Letter Grade Only
Repeatability:	Not Repeatable

Student Learning Outcomes

- Interpret experimental data through application of theoretical models
- Critically evaluate an experimental approach to rationalize the need for each element of an experimental design
- Safely handle Organic Chemicals
- Gain skill with common synthetic chemistry techniques

Description

Honors laboratory course to accompany CHEM 12C. Intended to introduce students to research methods, improve skill in application of laboratory techniques, and strengthen quantitative reasoning. Students work on challenging projects taken from the primary literature. Emphasis is on Physical-Organic Chemistry, Multi-step synthesis, and chemical reactions relevant to CHEM 12C.

Course Objectives

The student will be able to:
A. Safely handle and dispose of hazardous organic chemicals
B. Work independently to complete the synthesis, isolation and purification of Organic Compounds
C. Analyze Organic Compounds using Spectroscopic Methods
D. Quantify the Kinetics of an Organic Reaction
E. Quantify Structure-Reactivity relationships
F. Critically evaluate the primary literature
G. Communicate effectively using the language of Organic Chemistry
H. Work constructively and collaboratively with others

Course Content

A. Safely handle and dispose of hazardous organic chemicals (refer to Lab Content)
B. Work independently to complete the multi-step synthesis, isolation and purification of Organic Chemicals (refer to Lab Content)
C. Analyze Organic Compounds using Spectroscopic Methods (refer to Lab Content)
D. Quantify the Kinetics of an Organic Reaction (refer to Lab Content)
E. Quantify Structure-Reactivity relationships (refer to Lab Content)
F. Critically evaluate the primary literature
1. Deduce whether or not data supports a hypothesis
2. Relate graphical displays to current theoretical models
3. Extract information from article to adapt experiment as needed
4. Recognize critical elements of experimental design
E. Communicate effectively using the language of Organic Chemistry
1. Maintain complete and accurate records
2. Evaluate and discuss experimental results
3. Present and justify deductive reasoning to support experimental results
F. Work constructively and collaboratively with others

Lab Content

A. Safely handle and dispose of hazardous organic chemicals
1. Research and report on known health and safety risks for any chemical
2. Identify incompatibles to store chemicals and/or dispose of chemical waste accordingly
B. Work independently to complete the synthesis, isolation and purification of Organic Compounds
1. Application of laboratory techniques including air exclusion, extraction, distillation, recrystallization, TLC and column chromatography
a. Multistep synthesis. Complete one of the following or similar project:
1) Chemical Synthesis of a dipeptide from its constituent amino acids
a) Protection of N and/or C terminus
b) Peptide bond formation using EDC
c) Deprotection of N and/or C terminus
2) Enantioselective Synthesis of a Chiral epoxide using Jacobsen catalyst
a) Preparation of catalyst in three steps
b) Oxidation of prochiral alkene in presence of catalyst
b. Asymmetric Synthesis. Perform one of the following or similar project:
1) Synthesis of Warfarin using an organic chiral catalyst
2) Asymmetric synthesis of Wieland-Miesher Ketone through Robinson Annulation
3) Baker's yeast (Reductase) catalyzed reduction of ethylacetoacetate
C. Analyze Organic Compounds using Spectroscopic Methods
1. 1H and 13C NMR
a. Structural analysis of reactants and products
b. Kinetics by signal integration over time
c. Chiral Shift reagents to determine enantiomeric excess
2. Routine IR analysis of reactants and products
3. GC-MS to characterize unknown product distributions
D. Quantify the Kinetics of an Organic Reaction. Perform one of the following or similar project:
1. Invertase catalyzed hydrolysis of sucrose
2. General and Specific Acid Hydrolysis of an orthoester
E. Quantify Structure-Reactivity relationships. Perform one of the following or similar project:
1. LFER of Phenol Acidity by NMR titration or UV-Vis Spectroscopy
2. LFER in Benzoate Ester Hydrolysis through competitive kinetics followed by 13C NMR
3. LFER in Aldol Condensations through competitive kinetics followed by GC-MS
F. Critically Evaluate the Primary Literature (refer to Course Content)
G. Communicate effectively using the language of Organic Chemistry
1. Maintain complete laboratory notebooks
2. Write detailed procedures
3. Complete formal laboratory reports

H. Work constructively and collaboratively with others

Special Facilities and/or Equipment

FT-IR, NMR, GC, GC-MS, UV-Vis instrumentation, Chemistry Glassware, MP apparatus, Rotovap, Nitrogen line, access to primary literature sources in Chemistry.

Method(s) of Evaluation

A. Examination questions that require short answer written explanation of published experiment.
B. Organization and reporting of experimental results in formal laboratory report.
C. Formulation of experimental procedure by adapting those published in literature.
D. Poster and/or oral presentation of experimental results.

Method(s) of Instruction

A. Actively listening to lecture
B. Working in groups to plan experimental procedures
C. Engaged in discussion
D. Presenting experimental results

Representative Text(s) and Other Materials

Mohrig, Jerry R. Laboratory Techniques in Organic Chemistry: Supporting Inquiry-driven Experiments. New York, NY: W.H. Freeman, 2014.

Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

Required reading and writing may include:

A. Organizing and reporting of experimental results in formal laboratory report.

B. Researching published articles to aide in the planning and successful execution of an experiment.

Discipline(s)

Chemistry