CHEM 12BL: ORGANIC CHEMISTRY LABORATORY

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Summer 2025
Units:	2
Hours:	6 laboratory per week (72 total per quarter)
Prerequisite:	CHEM 12AL.
Corequisite:	Completion of or concurrent enrollment in CHEM 12B.
Advisory:	Not open to students with credit in CHEM 13BH.
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
- Safely handle Organic Chemicals
- Gain skill with common synthetic chemistry techniques

Description

Laboratory course to accompany CHEM 12B. Emphasis is on spectroscopic methods for the structure elucidation of organic compounds. Provides extensive practice in the synthesis, purification, isolation, and characterization of organic target molecules. For chemistry and other STEM majors, and for pre-professional students in dentistry, medicine, pharmacy, and veterinary medicine, or any other interested students that have mastered the prerequisites.

Course Objectives

The student will be able to:

1. Safely handle and dispose of hazardous chemicals
2. Execute techniques common in experimental organic chemistry
3. Provide a rationale for each step in an experimental design
4. Analyze data to draw conclusions about a chemical system
5. Communicate effectively using the language of organic chemistry
6. Work constructively and collaboratively in groups

Course Content

See Lab Content, below.

Lab Content

1. Safely handle and dispose of hazardous chemicals
    a. Research and summarize published safety data sheets on laboratory chemicals
    b. Categorize and segregate hazardous waste to avoid undesired reactions between incompatible compounds
    c. Apply care and skill to safely handle hazardous compounds
2. Practice common laboratory techniques to acquire skill in the preparation, isolation, and purification of organic compounds using guided inquiry laboratory projects as exemplified below:
    a. Free-radical chlorination of alkane and determination of product distribution by gas chromatographic analysis of products
    b. Selective reduction of 3-nitroacetophenone
    c. Diels-Alder reaction: a green chemistry approach including solventless and aqueous reaction with structure elucidation via high field 1H NMR spectroscopy
    d. Grignard reaction under anhydrous conditions
    e. Multistep synthesis: benzoin condensation, borohydride reduction, and acetonide formation with evaluation of stereoselectivity via NMR spectroscopy
    f. Spectroscopic identification of an unknown organic compound
    g. Characterization of organic products by melting point
    h. 1H and 13C nuclear magnetic resonance
        i. Chemical shift
        ii. Acquisition of FT NMR (1H or 13C) and/or FT IR spectra on isolated products
        iii. Spin coupling
        iv. Peak integration
        v. Sensitivity and resolution: low field vs. high field spectrometers
        vi. Chemical equivalence and magnetic equivalence
        vii. First-order versus second-order spectra
        viii. Diastereotopicity
        ix. Determination of the structure of simple organic compound given the molecular formula and the 1H NMR spectrum
        x. Isolation/purification of organic compounds
        xi. Thin-layer chromatography to follow reaction progress and assess purity
        xii. Column chromatography to remove polar impurities
        xiii. Distillation (micro and standard scale)
        xiv. Routine liquid-liquid extraction and recrystallization
        xv. Gas chromatographic separation of product
3. Provide a rationale for each step in an experimental design
    a. Justify proportions of reactants and reagents used
    b. Identify components in aqueous and organic layers during extraction/work-up steps
    c. Predict potential side products and how the procedural steps prevent or limit them
4. Data analysis and precision/error assessment
    a. Computing margins of error in volume, weight, and chromatographic signal integration measurements
    b. Propagation of error in computation
5. Effective communication using the language of organic chemistry
    a. Laboratory notebook preparation
    b. Maintenance of complete and accurate records of experiments
    c. Develop conclusions based on assessment of self-generated data
6. Work constructively and collaboratively in groups

Special Facilities and/or Equipment

1. Chemistry laboratory with adequate chemicals and equipment for conducting the prescribed course.
2. Each student is issued a laboratory bench locker containing specialized glassware and equipment for both mini- and micro-scale organic synthesis.
3. Instrumentation maintained for shared routine use includes analytic balances, melting point apparatus, polarimeters, gas chromatographs, UV-visible spectrophotometers, FTIR spectrophotometers, GC-MS and 1H/multinuclear 60 MHz FT NMR instruments.

Method(s) of Evaluation

Methods of Evaluation may include but are not limited to the following:

Writing laboratory reports/post lab summaries reports
Demonstrating skill in safe handling of organic chemicals
Written examination on course content
Recording data and observations
Summarizing chemical hazards from published SDS information
Critical evaluation of procedural steps in prelab exercises and/or quizzes

Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

Students will prepare, isolate, purify, and characterize organic compounds

Students will formulate hypotheses and critically evaluate the experiment designed to test it
Students will work with partner(s) to analyze experimental data
Students will draw conclusions based on first-hand experience
Students will discover the connection between experiment and real-world applications
Students will actively participate in instructor-led discussion of experimental design

Representative Text(s) and Other Materials

Mohrig, Jerry, David Alberg, Gretchen Hofmeister, Paul Schatz, and Christina Noring Hammond. Laboratory Techniques in Organic Chemistry. 2014.

Although this text is more than 5 years old, it is still in print and is a seminal text that describes laboratory methodology and techniques rather than providing prescriptive activities and is still therefore up to date.

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

1. Students will conduct a preliminary analysis of experimental procedures with the application of prior knowledge.
2. Students will evaluate and reflect on experimental results and summarize their findings in a post-lab report.
3. Students will draw their own conclusions based on first-hand observations and discuss them verbally and in writing.

Discipline(s)

Chemistry