CHEM M07A: ORGANIC CHEMISTRY I

Originator
csjoiner

Co-Contributor(s)

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College
Moorpark College

Attach Support Documentation (as needed)
December_2021_C-ID_Newsletter (4).pdf
Chem 150.pdf

Discipline (CB01A)
CHEM - Chemistry

Course Number (CB01B)
M07A

Course Title (CB02)
Organic Chemistry I

Banner/Short Title
Organic Chemistry I

Credit Type
Credit

Start Term
Fall 2022

Catalog Course Description
Emphasizes molecular structure, chemical and physical properties, and the preparation and reactivities of organic molecules with an emphasis on reaction mechanisms, synthesis, structure determination, and applications. Involves, through hands-on laboratory work, the use of appropriate methods, techniques, and instrumentation for the synthesis, purification and identification of organic compounds discussed in the lecture portion.

Additional Catalog Notes
Course requires use of a lab coat and goggles.

Taxonomy of Programs (TOP) Code (CB03)
1905.00 - Chemistry, General

Course Credit Status (CB04)
D (Credit - Degree Applicable)

Course Transfer Status (CB05) (select one only)
A (Transferable to both UC and CSU)

Course Basic Skills Status (CB08)
N - The Course is Not a Basic Skills Course

SAM Priority Code (CB09)
E - Non-Occupational

Course Cooperative Work Experience Education Status (CB10)
N - Is Not Part of a Cooperative Work Experience Education Program

Course Classification Status (CB11)
Y - Credit Course

Educational Assistance Class Instruction (Approved Special Class) (CB13)
N - The Course is Not an Approved Special Class

Course Prior to Transfer Level (CB21)
Y - Not Applicable

Course Noncredit Category (CB22)
Y - Credit Course

Funding Agency Category (CB23)
Y - Not Applicable (Funding Not Used)

Course Program Status (CB24)
1 - Program Applicable

General Education Status (CB25)
Y - Not Applicable

Support Course Status (CB26)
N - Course is not a support course

Field trips
Will not be required

Grading method
(L) Letter Graded

Alternate grading methods
(O) Student Option- Letter/Pass
(P) Pass/No Pass Grading

Does this course require an instructional materials fee?
No

Repeatable for Credit
No

Is this course part of a family?
No

Units and Hours

Carnegie Unit Override
No

In-Class

Lecture
Minimum Contact/In-Class Lecture Hours
52.5
Maximum Contact/In-Class Lecture Hours
52.5

Activity

Laboratory
Minimum Contact/In-Class Laboratory Hours
105
Maximum Contact/In-Class Laboratory Hours
105

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
157.5
Total Maximum Contact/In-Class Hours
157.5

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class
Minimum Outside-of-Class Hours
105
Maximum Outside-of-Class Hours
105

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
262.5
Total Maximum Student Learning Hours
262.5

Minimum Units (CB07)
5
Maximum Units (CB06)
5

Prerequisites
CHEM M01B or equivalent

Entrance Skills

Entrance Skills
CHEM M01B

Prerequisite Course Objectives
CHEM M01B-determine how rates of chemical reactions are measured, written, and used to deduce probable reaction mechanisms as well as describe the transition state and collision theory of reactions that produce effective collisions.
CHEM M01B-state the general principles of Arrhenius, Bronsted-Lowry, and Lewis acid/base theories, explain the nature of the pH scale as well as perform a multitude of pH calculations, plot and analyze titration curves, solve quantitative buffer solution problems using the Henderson-Hasselbalch equation, calculate the value of all equilibrium species for a polyprotic acid, and predict the relative strengths of binary and oxoacids.

CHEM M01B-define solubility equilibria and use the law of mass action to write equilibrium expressions, perform equilibrium calculations involving the solubility product constant, predict if precipitates will form upon mixing ionic solutions of various concentrations, identify complex ions, write equilibrium formation and dissociation reactions, calculate equilibrium values for complex ion solutions, and calculate the solubility of slightly soluble solutes in solutions involving the formation of complex ions.
CHEM M01B-apply the principles of acid/base and solubility equilibria in quantitative and qualitative chemical analyses.
CHEM M01B-define entropy, Gibbs Free Energy, and calculate changes in entropy and Gibbs Free Energy in a chemical reaction for standard and nonstandard state conditions in order to determine overall spontaneity.
CHEM M01B-correlate the combined concepts of equilibrium, free energy change, and cell potential.
CHEM M01B-distinguish between and note the properties of various organic compounds including functional group recognition, draw resonance structures for a molecule or ion and utilize the curved arrow formalism within a given mechanism, and identify major products in certain organic chemistry reactions.
CHEM M01B-describe the different types of nuclear radiation and decay, discuss and quantify radioactive decay rates and their half-life, calculate the energy associated with nuclear reactions, and compare and contrast the processes of nuclear fission and fusion.
CHEM M01B-conduct various quantitative and qualitative experiments with adherence to safety protocols, record observations and express numerical values appropriately, analyze acquired data, and formulate proper conclusions through written expression of results.
CHEM M01B-identify coordination compounds, assign nomenclature, and properties.

Requisite Justification

Requisite Type

Prerequisite

Requisite

CHEM M01B or equivalent

Requisite Description

Course in a sequence

Level of Scrutiny/Justification

Required by 4 year institution

Student Learning Outcomes (CSLOs)

	Upon satisfactory completion of the course, students will be able to:
1	demonstrate an understanding of organic structure by identifying and classifying specific structural characteristics of organic molecules containing multiple stereogenic centers, including absolute configuration of stereogenic centers, atomic orbital hybridizations, bond angles, functional groups, and stable chair and Newman conformations.
2	record and present the results of their experiments in several formats, perform the basic chemical techniques of organic chemistry, and conduct simple synthetic reactions in a safe and efficient fashion.
3	visualize organic molecules and represent them in accepted forms and apply these to determine how structure influences the function and reactivity of these molecules.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	describe how various organic molecules are used in medicine, industry, and the household and how their use impacts daily life and draw correct Lewis structures for a wide variety of main-group compounds, identify hybrid and molecular orbitals utilized in bonding, and convert formulas into various three dimensional structural representations including skeletal (bond-line) structures and resonance hybrids.
2	name cyclic and acyclic compounds containing alcohols, halides, alkenes and alkynes using the International Union of Pure and Applied Chemistry system (IUPAC), name small compounds using common (e.g., iso, sec-, tert-) prefixes, identify and name compounds containing common functional groups such as halides, alkenes, alkynes, carbonyl groups, alcohols, amines, aromatic rings and ethers.
3	identify conformational isomers, draw Newman projections and cyclohexane chair forms that accurately portray axial and equatorial groups, and predict which Newman projection and chair form will be most stable and least stable.
4	identify stereoisomers, label a stereocenter using the Cahn-Ingold-Prelog rules, distinguish between and define the terms enantiomer, diastereomer, meso, chiral and achiral, and provide examples of chiral molecules without stereocenters.

5	predict both the magnitude and direction of the polarity of organic molecules, identify intermolecular forces between organic molecules, and understand how intermolecular forces influence boiling point, solubility, nucleophilicity, and reactivity of organic compounds.
6	predict the course of any acid-base reaction based on p K a values and organic structures, rank common functional groups in order of their p K a values, draw “electron arrows” to indicate the flow of electrons in Lewis acid-base reactions, and identify various reagents that will quantitatively deprotonate an alcohol and an alkyne.
7	draw the mechanism and predict the products of inter- and intramolecular nucleophilic substitution (S N) reactions, including stereocenter inversion during an S N 2 reaction, racemization of stereochemistry during an S N 1 reaction, and carbocation rearrangements. Students should be able to rank carbocations in the correct order of stability and list various groups in order of their nucleophilicity and use these skills to rank the rate of similar S N reactions that vary in the nature of the substrate.
8	use Zaitsev’s rule to predict which alkenes will be most stable, label alkenes as E or Z using the Cahn-Ingold-Prelog rules, predict whether a given nucleophile will give predominately elimination or substitution in a reaction, draw the mechanisms of E2 and E1 reactions, and use this information to predict the major and minor products of substitution and elimination reactions of electrophiles bearing a leaving group.
9	draw the mechanism and predict the products of addition reactions to alkenes and alkynes including reactions that demonstrate the stereochemical ramifications of the addition of halogens and hydrohalogens (in the presence and absence of water), the difference between acid-catalyzed hydration and hydroboration as methods of adding hydroxy groups, and the consequences of tautomerization to the enol products formed during hydration of alkynes.
10	draw the mechanism and predict the products of redox reactions of alkenes and alkynes, including epoxidation, stereoselective dihydroxylation, ozonolysis, catalytic hydrogenation, and stereoselective reduction of alkynes to cis and trans alkenes. Also, plan synthetic strategies using alkynyl nucleophiles.
11	draw the mechanism and predict the products of substitution, elimination, and redox reactions of alcohols, ethers, and epoxides, including the Williamson ether synthesis, dehydration reactions catalyzed by acids and other reagents, conversions of alcohols to alkyl halides using hydrohalogens and other reagents, tosylate formation, oxidations of alcohols to form aldehydes, carboxylic acids, and ketones, acid-catalyzed decomposition of ethers, and the stereochemical ramifications of epoxide-opening reactions in the presence and absence of acid catalysts.
12	rank radicals in the correct order of stability, demonstrate (using bond energy tables) which free-radical halogenations are endothermic and exothermic, write out initiation, propagation, and termination steps that occur in a free-radical reaction, and predict which hydrogen is most likely to be substituted in an alkane given the structure and nature of the halide involved.
13	predict properties of ultraviolet-visible (UV-Vis) spectra of conjugated dienes, explain how conjugation affects molecular orbitals and bond lengths in polyenes, and predict the strength of participation of dienes and dienophiles in Diels-Alder reactions based on molecular structure.
14	explain the use of infrared spectroscopy and mass spectrometry in the determination of organic chemical structure, identify specific functional groups from infrared (IR) spectral data, and use IR and mass spectra (MS) data to make determinations about organic structures.
15	identify the causes and origins of the nuclear magnetic resonance (NMR) effect, correlate chemical shifts in NMR spectra with structure and predict the integrations, positions and peak splitting of signals in proton spectroscopy, and be able to both predict the NMR spectra given structure of compounds and to deduce their structure based on spectral data.
16	separate and purify compounds using recrystallizations, simple, fractional, and steam distillations, extractions (including acid-base extractions), filtrations, and chromatography (including gas chromatography (GC), and thin layer chromatography (TLC), and determine purity and identity of samples through the use of melting point, infrared spectroscopy, and NMR spectroscopy.
17	demonstrate safe laboratory practice while synthesizing organic compounds by refluxing reactants, isolate these compounds, qualitatively and quantitatively determine the success of the reaction, record results in a properly formatted laboratory notebook, and report results.

Course Content

Lecture/Course Content

6% Radical Reactions:
Initiation - propagation - termination mechanism and its use in the halogenation of alkanes and allylic carbons and in radical addition to double bonds

6.00%
Conjugation, Resonance, and Dienes:
Conjugated dienes and polyenes, resonance and resonance hybrid, 1,2-vs. 1,4-electrophilic addition, Diels-Alder reactions

6.00%
Elimination Reactions:

Kinetics and thermodynamics of the elimination reaction (E1 vs E2), synthesis of alkenes from alcohols, effect of base strength on substitution/elimination ratios, and rearrangements of carbocations

6.00%
Alcohols, Ethers, and Epoxides:
Structure, preparation, and physical properties, Williamson ether synthesis, dehydration reactions catalyzed by acids and other reagents, conversions of alcohols to alkyl halides using hydrohalogens and other reagents, tosylate formation, catalyzed decomposition of ethers, nucleophilic epoxide-opening reactions in the presence and absence of acid catalysts

6.00%
Structure:
preparation, and physical properties, addition reactions, Markovnikov's rule, hydrohalogenation in the presence and absence of a peroxide catalyst, acid-catalyzed hydration, hydroboration, halogenation in the presence and absence of water

5.00%
Alkynes:
Structure, preparation, and physical properties, hydrohalogenation, tautomerization, acid-catalyzed hydration, and hydroboration. Use of alkynyl nucleophiles in synthesis

6.00%
Oxidation/Reduction:
Catalytic hydrogenation, stereoselective reduction of alkynes to alkenes, hydride nucleophiles, epoxidation, stereoselective dihydroxylation, ozonolysis, oxidation of alcohols using PCC and Jones' reagents

6.00% Infrared Spectroscopy and Mass Spectrometry:
Method, laboratory use, interpretation, structure determination

6.00%
NMR Spectroscopy:
Method, laboratory use, number of signals, position of signals, integration, spin–spin coupling, complex splitting, ^{1}H NMR and ^{13}C NMR

5.00% Combined Spectroscopy and Structure Determination:
Use of IR, MS, and NMR to determine structures of organic molecules

6.00%
Structure and Bonding:
Lewis structures, octet violators, isomerism, resonance forms, molecular geometry, bond-line notation, hybridization, formal charges, bond length, bond strength, electronegativity, and polarity

6.00% Introduction to Organic Molecules:
Functional groups, IUPAC nomenclature, and intramolecular forces

6.00% Alkanes:
physical properties, Newman projections, and chair conformations

6.00%
Stereochemistry:
Chirality, stereogenic centers, enantiomers, diastereomers, rotation of polarized light, optical activity without chiral centers, meso compounds and the use of *R/S* notations

6.00%
Acid/Base Reactions:
Acid and base strength, pK_a, equilibria, reaction mechanism with "electron arrows", and Lewis acids and bases

12.00%
Substitution Reactions:
Kinetics and thermodynamics of radical and nucleophilic substitution reactions (S_N1 vs S_N2), nucleophilicity, equilibrium determination using pK_a values, distinguishing intermediates vs. transition states, energy diagrams, ΔH and ΔG, solvent effects, utility in synthesis of
halides, alcohols, ethers, nitriles, alkynes and related compounds

Laboratory or Activity Content

3.00% Safety in the Organic Laboratory

7.00% Properties of Organic Compounds:
Melting point, boiling point, stereochemistry

30.00%
Separation and Purification of Organic Compounds:
Recrystallization, simple distillation, fractional distillation, steam distillation, gas chromatography, thin layer chromatography

30.00%
Characterization and Identification of Organic Compounds:
Infrared spectroscopy (IR), gas chromatography – mass spectrometry (GC-MS), proton and carbon nuclear magnetic resonance spectroscopy (^{1}H & ^{13}C NMR)

30.00%
Synthesis of Organic Compounds:

“Standard-scale” and micro-scale synthesis, separation, purification, and characterization of organic compounds including reflux techniques. Keep lab notebooks, analyze and report results

Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):

Written expression
Problem solving exercises
Skills demonstrations

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Computational homework
Group projects
Individual projects
Journals
Laboratory activities
Laboratory practical examinations
Laboratory reports
Objective exams
Oral presentations
Problem-solving exams
Problem-solving homework
Quizzes
Reports/papers
Research papers
Skills demonstrations
Skills tests or practical examinations
Written analyses
Written homework
Other (specify)
Classroom Discussion
Projects
Participation
Reports/Papers/Journals

Other

Multi-week experiments with written reports; multi-step synthesis and retrosynthesis problems

Instructional Methodology

Specify the methods of instruction that may be employed in this course

Audio-visual presentations
Class activities
Class discussions
Collaborative group work
Computer-aided presentations
Demonstrations
Distance Education
Field trips
Group discussions
Guest speakers
Instructor-guided interpretation and analysis
Instructor-guided use of technology
Internet research
Laboratory activities
Large group activities
Lecture
Modeling
Observation
One-on-one conference
Practica
Problem-solving examples
Readings
Small group activities
Web-based presentations

Other (specify)

Specify other method of instruction

Chemical demonstrations performed by instructor
Hands-on multi-step organic synthesis and purification reactions

Describe specific examples of the methods the instructor will use:

Chemical demonstrations performed by instructor.

Instructor will demonstrate the assembly of equipment for lab work.

Instructor will observe lab students to ensure proper hands-on multi-step organic synthesis and purification reactions.

Utilization of curved-arrow mechanisms during lecture to understand electronic requirements of various common organic reactions.

Representative Course Assignments

Writing Assignments

written answers to concept questions from lectures. An example would be: Determine which hydrogen atom in glutamic acid is most acidic and explain how you arrived at this choice.

written analysis of popular articles about organic chemistry that appear in the general media.

written documentation of the background, procedure, results, and conclusions of an experiment conducted in the laboratory, utilizing the the format of a typical American Chemical Society journal article.

Critical Thinking Assignments

examine spectroscopic data, for example an infrared spectrum, UV-Vis spectrum, and/or an NMR spectrum, to determine the structure of an unknown organic compound.

develop synthetic schemes that will produce specific organic products as the major product without the production of harmful by-products. An example would be: Synthesize 2-butanone starting from acetylene and any other substances that do not contain carbon atoms.

propose chemical mechanisms for organic transformations that are grounded on precedent and good chemical logic.

Reading Assignments

research relevant background material related to a reaction performed in the lab and use this to write an introduction to a laboratory report.

use the chemical literature to determine a method to synthesize an alcohol from an alkyl halide and adapt this procedure in the laboratory to convert iodoethane to ethanol.

Skills Demonstrations

demonstrate proper use of glassware while performing a reflux, simple distillation, and extraction.

obtain an infrared spectrum and a ^{1}H NMR spectrum of organic liquids and solids.

Other assignments (if applicable)

determine the structure of an unknown organic molecule by observing its infrared, ^{1}H NMR, and mass spectra.

Outside Assignments

Representative Outside Assignments

propose, while working with other students in the class, a synthetic scheme that will produce a specific organic product and research the costs associated with the starting materials, solvents, and catalysts used in this specific scheme.

conduct library or Internet research to learn about specific name reactions and present the history, mechanism, and industrial uses of one of them to the class.

solve homework problems selected from the textbook or from an online homework system such as WileyPlus, Mastering Chemistry, or Sapling Learning.

Articulation

C-ID Descriptor Number

CHEM 150

Status

Approved

Additional C-ID Descriptor(s)

C-ID Descriptor(s)	Status
CHEM 160S (with CHEM M07B)	Approved

Equivalent Courses at 4 year institutions

University	Course ID	Course Title	Units
CSU Los Angeles	CHEM 2200 & 2201	Organic Chemistry I & Lab	4+1
CSU Chico	CHEM 270	Organic Chemistry I	4
San Francisco State Univ.	CHEM 233 & 234	Organic Chemistry I & Lab	3+2
UC Irvine	CHEM 51A & 52LA	Majors Organic Chemistry I & Lab	4+2

Comparable Courses within the VCCCD

CHEM V12A - General Organic Chemistry I
CHEM V12AL - General Organic Chemistry I Laboratory
CHEM R130 - Organic Chemistry I

Equivalent Courses at other CCCs

College	Course ID	Course Title	Units
Los Angeles Pierce College	CHEM 211	Organic Chemistry I	5

Attach Syllabus

syllabus (1).pdf

District General Education

A. Natural Sciences

A2. Physical Science

Approved

B. Social and Behavioral Sciences

C. Humanities

D. Language and Rationality

E. Health and Physical Education/Kinesiology

F. Ethnic Studies/Gender Studies

Course is CSU transferable

Yes

CSU Baccalaureate List effective term:

F1995

CSU GE-Breadth

Area A: English Language Communication and Critical Thinking

Area B: Scientific Inquiry and Quantitative Reasoning

B1 Physical Science

Approved

B3 Laboratory Activity

Approved

Area C: Arts and Humanities

Area D: Social Sciences

Area E: Lifelong Learning and Self-Development

Area F: Ethnic Studies

CSU Graduation Requirement in U.S. History, Constitution and American Ideals:

UC TCA

UC TCA
Approved

IGETC

Area 1: English Communication

Area 2A: Mathematical Concepts & Quantitative Reasoning

Area 3: Arts and Humanities

Area 4: Social and Behavioral Sciences

Area 5: Physical and Biological Sciences

Area 5A: Physical Science
Approved

Area 5C: Laboratory Science
Approved

Area 6: Languages Other than English (LOTE)

Textbooks and Lab Manuals

Resource Type
Textbook

Description
Smith, Janice Gorzynski. *Student Study Guide/Solutions Manual to Accompany Organic Chemistry.* 6th ed., McGraw-Hill, 2020.

Resource Type
Textbook

Description
Klein, David. *Organic Chemistry.* 4th ed., Wiley, 2020.

Resource Type
Textbook

Description
Joiner, C. Steven. *Chemistry 7A Course Guide and Lab Manual.* V. 4.2, Xanedu, 2021.

Resource Type
Textbook

Description
Smith, Janice Gorzynski. *Organic Chemistry.* 6th ed., McGraw-Hill, 2020.

Resource Type
Other Resource Type

Description
Molecular Model Set for Organic Chemistry. 2nd ed., Pearson, 1983.

Library Resources

Assignments requiring library resources
Research using the library's print and online resources.

Sufficient Library Resources exist
Yes

Example of Assignments Requiring Library Resources
Use the Library's print and online resources to research and report on the chemistry and background material in the introduction section of a written laboratory report about, for example, nucleophilic substitution.

Distance Education Addendum

Definitions

Distance Education Modalities
Hybrid (1%–50% online)

Faculty Certifications

Faculty assigned to teach Hybrid or Fully Online sections of this course will receive training in how to satisfy the Federal and state regulations governing regular effective/substantive contact for distance education. The training will include common elements in the district-supported learning management system (LMS), online teaching methods, regular effective/substantive contact, and best practices.
Yes

Faculty assigned to teach Hybrid or Fully Online sections of this course will meet with the EAC Alternate Media Specialist to ensure that the course content meets the required Federal and state accessibility standards for access by students with disabilities. Common areas for discussion include accessibility of PDF files, images, captioning of videos, Power Point presentations, math and scientific notation, and ensuring the use of style mark-up in Word documents.
Yes

Regular Effective/Substantive Contact

Hybrid (1%–50% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Asynchronous Dialog (e.g., discussion board)	Students may be required to post their ideas or solutions for class-related material on the course discussion boards. Students may also be required to comment on the posts of other students, including constructive criticism.
E-mail	The instructor may email students with announcements about the course or other college events and opportunities and answer student questions. Students may email questions and possibly assignments or projects, depending on the nature of the class, directly to the instructor.
Face to Face (by student request; cannot be required)	Students may have the option to visit the instructor in their office on campus for office hours or to discuss other class-related items.

Other DE (e.g., recorded lectures)	The instructor may use other instruction methods appropriate to the subject matter. For example, pre-recorded lectures may be posted perhaps leading to a class discussion on the discussion boards.
Synchronous Dialog (e.g., online chat)	The instructor may hold class in a regular schedule but in an online format using a program such as ConferZoom. Office hours may also be held in this manner or with an online chat tool.
Telephone	Students may have the option to call the instructor and/or the instructor may call students to facilitate office hours or to discuss other class-related items.
Video Conferencing	The Instructor may hold class in a regular schedule but in an online format using a program such as ConferZoom. Office hours may also be held in this manner.

Examinations

Hybrid (1%–50% online) Modality
On campus
Online

Primary Minimum Qualification
CHEMISTRY

Review and Approval Dates

Department Chair
03/25/2022

Dean
03/25/2022

Technical Review
04/21/2022

Curriculum Committee
5/4/2022

DTRW-I
MM/DD/YYYY

Curriculum Committee
MM/DD/YYYY

Board
MM/DD/YYYY

CCCCO
MM/DD/YYYY

Control Number
CCC000434825

DOE/accreditation approval date
MM/DD/YYYY