GENERAL INFORMATION
Chemistry 331, Chemistry 332 and Chemistry 337 constitute the course sequence for pre-professional students (medicine, dentistry, optometry, pharmacy and other health professions), chemical engineering students and other students, not majoring in chemistry, who require a year of organic chemistry.

COURSE STRUCTURE
Online delivery

PREREQUISITES
One year of freshman chemistry
CH 121, CH 122, CH 123; or
CH 221, CH 222, CH 223

ACID-BASE CHEMISTRY IN ORGANIC CHEMISTRY
Bronsted-Lowry acids and bases
K_a values, pK_a values, equilibrium constants
Predicting the positions of acid-base equilibria
Predicting approximate pKa values
Ranking acids in order of acid strength; ranking bases in order of base strength
Acids and bases in organic chemistry
Lewis acids and bases
Nucleophiles and electrophiles
Mechanism of an acid-base reaction
-two-electron processes; the use of curved arrow notation

ALKANES
Nomenclature, structure and bonding, physical properties
Stereochemistry
-structural isomerism, stereoisomerism, conformational isomerism
Conformations of acyclic alkanes, cyclic alkanes including cyclohexane, monosubstituted cyclohexanes and disubstituted cyclohexanes
-torsional strain, steric strain, angle strain, ring strain
Conformational equilibria
-equilibrium constants, composition at equilibrium

ALKENES
Nomenclature, structure, bonding, physical properties
Stereochemistry
-configurational isomerism, chirality, optical activity
Conversion to Markovnikov alkyl halides
-hydrohalogenation, protonation, carbocations, carbocation rearrangements, regiochemistry/stereochemistry, mechanistic aspects
Conversion to Markovnikov alcohols
-hydration via the aqueous acid pathway, protonation, carbocations, carbocation rearrangements, regiochemistry/stereochemistry, mechanistic aspects
-hydration via the oxymercuration-demercuration pathway, mercurinium ions, organomercurial alcohols, regiochemistry/stereochemistry, mechanistic aspects
Conversion to anti-Markovnikov alcohols
-hydration via the hydroboration-oxidation pathway, alkylboranes, regiochemistry/stereochemistry, mechanistic aspects
Conversion to vicinal-dihalides and halohydrins
-cyclic halonium ions, anti-addition, regiochemistry/stereochemistry, mechanistic aspects
Conversion to alkanes
-catalytic hydrogenation, syn-addition, stereochemistry, mechanistic aspects
Conversion to epoxides
-syn-addition, stereochemistry, mechanistic aspects
Conversion to vicinal-diols
-using osmium tetroxide, using permanganate, stereochemistry, mechanistic aspects
Conversion to aldehydes, ketones &/or carboxylic acids
-oxidative cleavage using permanganate, ozonolysis

ALKYNYL HALIDES
Nomenclature, structure, bonding, physical properties
S_n1 and E_1 reactions
-rate laws, substituent effects, leaving group effects, solvent effects, rearrangements, stereochemistry, mechanistic aspects, competition
-applications to synthesis
S_n2 and E_2 reactions
-rate laws, nucleophilicity, steric effects, solvent effects, leaving group effects, stereochemistry, mechanistic aspects, competition
-applications to synthesis

ALKYNES
Nomenclature, structure and bonding, physical properties
Preparations of alkenes
-via the double dehydrohalogenation of alkyl dihalides, mechanistic aspects
Conversion to Markovnikov vinyl halides, dihalides
-protonation, vinyl cations, regiochemistry/stereochemistry, mechanistic aspects
Conversion to ketones
-hydration via the mercuric ion catalyzed pathway, regiochemistry/stereochemistry, keto-enol tautomerism, mechanistic aspects
Conversion to alkanes and cis alkenes
-via catalytic hydrogenation, stereochemistry
Conversion to trans alkenes
-via metal-ammonia reduction to trans alkenes, stereochemistry, mechanistic aspects
Conversion to geminal dihalides, tetrahalides
-stereochemistry, mechanistic aspects
Chemistry acetylide ions
-preparations/properties, applications to synthesis
GENERAL INFORMATION
Chemistry 331 (lecture), Chemistry 332 (lecture) and Chemistry 337 (lecture and laboratory) constitute the course sequence for pre-professional students (medicine, dentistry, optometry, pharmacy and other health professions), chemical engineering students and other students, not majoring in chemistry, who require a year of organic chemistry.

COURSE STRUCTURE
Online delivery

PREREQUISITES
One year of freshman chemistry
CH 121, CH 122, CH 123; or
CH 221, CH 222, CH 223
and
CH 331

ALCOHOLS AND ETHERS
Nomenclature, structure, bonding, physical properties
Conversion to alkyl halides and sulfonate esters
- mechanistic aspects, applications to synthesis
Conversion to alkenes
- via the acid-catalyzed dehydration of alcohols, E1 and E2 pathways, mechanistic aspects
Conversion to aldehydes and ketones
- oxidizing agents (Jones reagent, PCC)
- oxidation of primary alcohols to aldehydes and carboxylic acids, mechanistic aspects
- oxidation of secondary alcohols to ketones, mechanistic aspects
Chemistry of ethers
- epoxide ring opening, mechanistic aspects
- Williamson ether synthesis, mechanistic aspects
- acid-catalyzed cleavage of ethers, mechanistic aspects

ALDEHYDES AND KETONES
Nomenclature, structure, bonding, physical properties
Relative reactivities of aldehydes and ketones
Conversion to alcohols
- via the addition of hydride and organometallic reagents (preparations/properties of sodium borohydride, lithium aluminum hydride, Grignard reagents, acetylide ions, organolithium compounds), mechanistic aspects
Conversion to hydrates, hemiacetals, acetals
- via the addition of water and alcohols, acetals as protecting groups in synthesis, mechanistic aspects
Conversion to imines
- via the addition of ammonia and its derivatives, mechanistic aspects

AROMATICITY AND CHEMISTRY OF BENZENE
Nomenclature, structure, bonding, physical properties
Aromaticity
Electrophilic aromatic substitutions
- halogenation, nitration, sulfonation, Friedel-Crafts alkylation,
  Friedel-Crafts acylation, mechanistic aspects
Clemmensen reduction
Wolff-Kishner reduction

CARBOHYDRATES
Nomenclature, structure, bonding, physical properties
Aldoses, ketoses
D sugars, L sugars
Furanoses, furanosides, pyranoses, pyranosides
Alpha and beta anomers
Oxidations
- conversion to aldaric acids
- conversion to aldonic acids
Reductions
- conversion to alditols
Reducing sugars, nonreducing sugars
Alpha-glycosidic linkages, beta-glycosidic linkage
the constituent sugar(s) of a disaccharide; a trisaccharide; a polysaccharide

CARBOXYLIC ACIDS AND ESTERS
Nomenclature, structure, bonding, physical properties
Chemistry of carboxylic acids
- esterification, metal hydride reduction, mechanistic aspects
Chemistry of esters
- acid-catalyzed hydrolysis, saponification, metal hydride reduction, conversion to alcohols, mechanistic aspects
Fatty acids
Waxes, triglycerides, fats, oils
Soaps

STRUCTURE DETERMINATION
Degrees of unsaturation
Energy, wavelength, frequency
Infrared spectroscopy
- typical vibrational modes
- predicting/interpreting spectral features
- compound identification
Proton NMR spectroscopy
- shielding, deshielding
- chemically equivalent protons, non-chemically equivalent protons
- splitting, pitchfork diagrams
- predicting/interpreting spectral features
- compound identification
CHEMISTRY 337 ◆ ORGANIC CHEMISTRY LABORATORY

GENERAL INFORMATION
Chemistry 331 (lecture), Chemistry 332 (lecture) and Chemistry 337 (lecture and laboratory) constitute the course sequence for pre-professional students (medicine, dentistry, optometry, pharmacy and other health professions), chemical engineering students and other students, not majoring in chemistry, who require a year of organic chemistry.

COURSE STRUCTURE
Both online and on-campus delivery

PREREQUISITES
One year of freshman chemistry
CH 121, CH 122, CH 123; or
CH 221, CH 222, CH 223; and
CH 331, CH 332 or
CH 334, CH 335, CH 336

LABORATORY EXPERIMENTS
- Melting point determinations
  Techniques Melting point determination

- Isolation/characterization of trimyristin from nutmeg
  Techniques Solid-liquid extraction, simple distillation, melting point determination

- Isolation/characterization of green-leaf pigments from spinach
  Techniques Solid-liquid extraction, liquid-liquid extraction, column chromatography, TLC

- Isolation/characterization of lactose
  Chemistry Benedict’s test

- Isolation/characterization of essential oils from spices
  Techniques Steam distillation, liquid-liquid extraction

- Synthesis of 1-butene, cis-2-butene and trans-2-butene via E1 dehydrohalogenation of 2-bromobutane
  Chemistry Dehydration alcohols
  Techniques GC

- Synthesis of 1-butene, cis-2-butene and trans-2-butene via E2 dehydrohalogenation of 2-bromobutane
  Chemistry Dehydrohalogenation of alkyl halides
  Techniques GC

- Synthesis of salicylic acid via saponification
  Chemistry Ester saponification
  Techniques Heating under reflux, recrystallization, melting point determination, IR, NMR

- Synthesis of dibenzalacetone via an aldol condensation
  Chemistry Aldol condensation
  Techniques Recrystallization, melting point determination, IR, NMR

- Synthesis of benzoic acid via a Grignard reaction
  Chemistry Grignard chemistry
  Techniques Prep/handling of moisture-sensitive reagents, liquid-liquid extraction, recrystallization, melting point determination, IR, NMR

- Synthesis of 9,10-dihydroanthracene-9,10-α,β-succinic acid anhydride via a Diels-Alder reaction
  Chemistry Diels-Alder reaction
  Techniques Vacuum filtration, recrystallization, IR, NMR

- Asymmetric reduction of 1-phenyl-1,2-propanedione
  Chemistry Asymmetric reduction
  Techniques TLC, liquid-liquid extraction, IR and NMR