**SC/CHEM 2020 6.0 – *Organic Chemistry***

**Calendar description:**
Structure including stereochemistry, physical and chemical properties of simple organic compounds; methods in structure determination; introductory concepts of reaction mechanisms and methods for determination of mechanisms. Prerequisites: SC/CHEM 1000 3.0 and SC/CHEM 1001 3.0.

**Structure of the Course:**

- Fall-Winter version:
  Two and one half lecture hours and one tutorial hour per week.
  Three laboratory hours every second week. Ten experiments with laboratory reports.
  Two terms. Twenty-four weeks.
  Totals: 60 lecture hours, 24 tutorial hours, 30 lab hours
- Summer version:
  Five lecture hours and one tutorial hour per week.
  Three laboratory hours every week. Ten experiments with laboratory reports.
  One term. Twelve weeks.
  Totals: 60 lecture hours, 24 tutorial hours, 30 lab hours
- Evaluation in both versions (may vary slightly from year to year):
  Two one-hour midterm tests: 10% each
  One two-hour mid-course test: 20%
  One three-hour final examination: 40%
  Laboratory (with lab reports): 20%

**Detail of topics covered:**

- Review of electronic structure and properties of main group elements with particular emphasis on the first two rows. Chemical bonding. Atomic molecular orbital theory, hybridization, resonance, conjugation. Bond moments, dipole moments. Intermolecular interactions and effects on solubility, mp, bp.
- Stereochemistry: conformations of acyclic and cycloalkanes, alkenes, alkynes, chiral carbon, and asymmetry of molecules. Optical activity, absolute configuration. Systems with more than one chiral center. Meso structures, Newman projections, Fischer projections. R/S, D/L, cis/trans and E/Z nomenclature. Stability considerations and measurement in alkenes and substituted cyclohexanes.
- Functionality: Alkanes, alkenes, alkynes, arenes, alcohols, amines, ethers, epoxides, ketones, aldehydes, acetals, imines, carboxylic acids (including a discussion of Bronsted acid-base theory), esters, amides, nitriles, anhydrides, cyclic analogues. Nomenclature of alkanes, alkenes, alkynes, alcohols. Aromaticity and Hückel rules. Characteristic reactions of each class. Applications to multistep synthesis. Acidity, basicity.
- Mechanisms of chemical reactions: free-radical halogenation, $S_N1$, $S_N2$, E1, E2, $S_EAr$, electrophilic additions to alkenes, nucleophilic additions to carbonyls, addition-elimination and addition-elimination-addition reactions. Acid catalysis. Base catalysis. Oxidation and reduction reactions. Combined reactions (e.g. hydroboration-oxidation, ozonolysis-reduction, reductive amination). Reaction intermediates and their stabilities, including radicals, cations, anions and $\sigma$ complexes. Organometallic and hydride reagents. Nucleophilicity, electrophilicity. Discussions of selectivity and reactivity. Kinetic and thermodynamic considerations. Solvent effects. Markovnikov rule, Saytzeff rule, Hammond Postulate.
- Structure determination: elemental analysis and mass spectroscopy (ionization, isotopic diversity, common fragmentation patterns), infrared (IR) absorption spectroscopy (including effects of H-bonding, strain and conjugation), $^1$H- and $^{13}$C-nuclear magnetic resonance (NMR) spectroscopy. Applications.
- Laboratory: Isolation, quantitation and identification of a natural product. Resolution of an amine. Chromatography. pH-controlled Extraction. Synthesis using a Grignard reaction. Kinetics of $S_N1$ and $S_N2$ reactions and Arrhenius plots. Typical reactions and chemical detection of functional groups. Preparation of derivatives. Identification of an unknown.

**Text:**
"Organic Chemistry", L. G. Wade, Jr., 6th or 7th edition (Prentice Hall) – Chapters 1-14 & 16-21
Solutions Manual to accompany the above, J. W. Simek (Prentice Hall)