



Chemistry 2400: Introductory Organic Chemistry I

Winter 2021

Instructor: Dr. Sunil V. Pansare (spansare@mun.ca)

Text: "Organic Chemistry", 8th Ed. by P. Y. Bruice.

You are advised not to use previous editions due to significant changes in the newest edition.

The course will cover:

- Chapters 1-12 from the Bruice text. Selected sections from chapters 8, 10 and 11 will not be covered and a list of these sections will be provided when we start that chapter.

Other course materials:

- Study Guide & Solutions Manual for 'Organic Chemistry' 8th Ed., by P. Bruice (optional).
- Molecular Models
Darling molecular models are very helpful in understanding the course material and may be used in all exams.
- Suggested Readings and Resources
Pearson, Mastering Chemistry – an ideal source for extra practice problems and practice assignments. The use of Mastering is not mandatory and it will not be used as an assessment tool.

Learning Goals:

The goal of Chem 2400 is to develop a fundamental understanding of organic chemistry. In this course, you will study the contents introduced in Chapters 1 through 12 of the textbook. Detailed topics include fundamentals of molecular structures and bonding, acid/base theory, electron delocalization, organic nomenclature, organic functional groups, stereochemistry, mechanisms of organic reactions, organic synthesis, reactive intermediates and organometallic compounds.

Evaluation:

Two class tests (75 min. each):	30% (lower mark worth 10%, higher mark worth 20%)
Laboratory:	20%
Final examination (3 hours):	50%

The tests will be held on February 11 and March 23, 2021. *Make-up tests will not be offered.* If you are unable to write a test due to acceptable cause, as described under 'Exemptions from Parts of the Evaluation (University Regulation 6.7.5)', the value of the test will be added to the value of your final examination.

Lectures:

- Will be conducted via asynchronous instruction.
- 2 x 75 min pre-recorded lecture videos will be posted every Monday morning.
- Lecture notes and videos will be posted directly in the course shell on Brightspace.

Tutorial Sessions:

- WEEKLY OPTIONAL PRACTICE SESSIONS (practice problems will be released on Sundays)
- Pre-recorded “solution” videos will be posted on Wednesday’s at 4 pm (NL time)
- Virtual office hours with Tutorial Instructor will occur Wednesday’s from 5pm - 6pm (NL time)
- Virtual room information and practice questions will be available on Brightspace before the session

Resources:

If you have questions about Course Evaluation or Course Materials contact:

Course Instructor: Dr. Sunil V. Pansare

- Email: spansare@mun.ca
- Office Hours: by appointment (email above) and will be conducted virtually

If you have questions about the Laboratory Experiments or Laboratory Materials contact:

Laboratory Instructors:

- Anne Sheppard (h72amm@mun.ca)
- Renee Halliday (rrandell@mun.ca)

If you have questions about Course Content (lecture material, practice problem help, etc.) contact:

Course Tutor:

- Sourav Biswas (sbiswas@mun.ca)

The normal practice will involve Sourav answering questions by email. If necessary, he will schedule Brightspace sessions as and when required. He will provide details for such sessions in advance.

If you have questions about Tutorial Sessions or Content contact:

Tutorial Instructor:

- Sima Alavi (salavi@mun.ca)

Laboratories:

The laboratory component consists of 6 virtual experiments that have been developed for the remote version of the course. Detailed information for the labs is available in the ‘Chem-2400-Lab’ Brightspace shell. Please note that your first point of contact for anything related to the Virtual Labs is your assigned Lab Instructor (either Anne Sheppard, anne.sheppard@mun.ca or Renee Halliday, rrandell@mun.ca).

Accommodations for students with disabilities: “Memorial University is committed to ensuring an environment of understanding and respect for the dignity and worth of each student and also to supporting inclusive education based on the principles of equity, accessibility, and collaboration” (<http://www.mun.ca/policy/site/policy.php?id=239>)

Academic Misconduct: Students are expected to maintain a high level of scholarly integrity and to adhere to principals which constitute proper academic conduct. Cheating is not permitted. University regulations pertaining to academic misconduct and the consequences of an academic offence are found in the university calendar in section 6.12 (see: <https://www.mun.ca/regoff/calendar/sectionNo=REGS-0748>).



Chemistry 2400 Syllabus

Review of Structure and Bonding

- The structure of an atom
- How electrons are distributed
- Ionic vs covalent bonds
- Representing structures
- Atomic orbitals
- Molecular orbital theory
- Single/double/triple bonds in organic compounds
- Methyl cation, radical, and anion
- Bonds in ammonia and the ammonium ion
- Bonds in water
- Bonds in hydrogen halides
- Hybridization and molecular geometry

Acids and Bases

- pK_a and pH
- Organic acids and bases
- Predicting the outcomes of rxns
- Equilibrium of acid and base rxns
- Structural effects on acidity
- Substituent effects on acidity
- Delocalized Electrons
- Buffers
- Lewis acids and bases
- Resonance contributors (Ch. 8)

Nomenclature, Physical Properties and Representations of Organic Compounds

- Nomenclature and introduction of all functional groups relevant to this course (various chapters)
- Structures of organic compounds
- Rotation about C-C single bond
- Angle strain
- Conformers of cyclohexane
- Conformers of monosubstituted cyclohexanes
- Conformers of disubstituted cyclohexanes
- Conformers of fused cyclohexane

Isomers and the Arrangement of Atoms in Space

- *cis-trans* isomerism
- Chirality
- Asymmetric centres
- Isomers with 1 stereocenter
- Drawing enantiomers
- R and S configurations
- Optical activity
- Specific rotation
- Enantiomeric excess
- Isomers with > 1 asymmetric centre
- Stereoisomers of cyclic compounds
- *Meso* compounds
- Separation of enantiomers
- *N*- and *P*-chiral compounds

Introduction to Alkenes, Thermodynamics and Kinetics of Organic Reactions

- Degree of unsaturation
- Structure of alkenes
- Functional group reactivity
- How alkenes react
- Intro to curved arrows
- Thermodynamic & kinetic considerations
- Reaction rates and rate constants
- Reaction coordinate diagrams

Reaction of Alkenes and Stereochemistry of Addition Reactions

- Addition of HX to an alkene
- Stability of carbocations
- Transition state structure
- Regioselectivity
- Addition of H_2O to an alkene
- Addition of ROH to an alkene
- Carbocation rearrangement
- Hydroboration/oxidation
- Addition of X_2 to an alkene
- Epoxidation
- Ozonolysis
- Addition of H_2 to an alkene
- Relative stabilities of alkenes
- Stereoselective and stereospecific reactions
- Stereochem. of electrophilic additions to alkenes
- Intro. to synthesis and retrosynthetic analysis



Reactions of Alkynes

- Functional groups
- Physical properties
- Structure of alkynes
- Reactivity of alkynes
- Addition of HX and X₂
- Addition of H₂O to an alkyne
- Hydroboration/oxidation
- Addition of H₂ to an alkyne
- Acidity of terminal alkyne
- Alkynes in synthesis

Substitution Reactions and Alkyl Halides

- S_N2 reaction
- Factors that affect the S_N2 rxn
- S_N1 reaction
- Factors that affect the S_N1 rxn
- Types of organic halides
- Competition between S_N2 & S_N1
- Role of solvent in S_N2 & S_N1
- Intermolecular and intramolecular reactions

Elimination Reactions of Alkyl Halides

- E2 reaction
- Regioselectivity in the E2 rxn
- E1 reaction
- Benzylic and allylic halides
- E2 vs E1
- Stereoselectivity in E2 and E1
- Elimination of substituted cyclohexanes
- Kinetic isotope effects
- Competition between sub. vs elimin.
- Sub. and elimin. in synthesis

Reactions of Alcohols, Ethers, Epoxides, Amines, and Thiols

- Formation of alkyl halides
- ROH into sulfonate ester
- Dehydration of alcohols
- Oxidation of alcohols
- Sub. reactions of ethers
- Sub. reactions of epoxides
- Elimin. reactions of quat. Ammonium hydroxides
- Thiols, sulfides and sulfonium salts
- Reaction in synthesis

Organometallic Compounds

- Organolithium compounds
- Organomagnesium compounds
- transmetallation
- Organocuprate reactions
- Organometallic reactions in synthesis

Radicals

- Low reactivity of alkanes
- Radical halogenation of alkenes
- Order of stability of radicals
- Product distributions
- Reactivity-selectivity principle
- Hazards of peroxides
- Addition of radicals to an alkene
- Stereochemistry of radical reactions
- Radical subs. Of benzylic and allylic hydrogens
- Radical reactions in synthesis

Delocalized Electrons and Their Effect on Stability, pK_a, and Outcome of a Reaction

- Benzene
- Estimating relative stability
- Delocalization energy
- Aromaticity
- Heteroaromatic compounds
- Antiaromaticity
- Effects of delocalization on
 - stability
 - pK_a
 - Reaction outcomes
- Reactions of dienes
- Thermodynamic and kinetic control