Organic Chemistry II

Winter term, 2022

Instructors:

Course topics:
Dr. John Carran (weeks 1-6)
Email: carranj@chem.queensu.ca
Dr. David Zechel (weeks 7-12)
Email: David.zechel@chem.queensu.ca

Labs: (12 weeks)
Dr. Jason Vlahakis
Email: jason.vlahakis@chem.queensu.ca

Please use forum discussion boards for all course topic related questions.

Office Hours (weeks 1-6): 4 h per week at scheduled times shown in ONQ. All sessions recorded.
Weeks 7-12 TBA

ONQ website

Students registered in the course can access the course ONQ site. The site includes the assignments, your grades, and other materials.

Intended Student Learning Outcomes

At the end of CHEM 282, students will be able to…

1	Identify functional groups and associated reactivity of conjugated systems (including aromatic systems)
2	Write complete mechanisms for common reactions involving these functional groups.
3	Identify functional groups and associated reactivity of alcohols, radicals, carbonyl group containing compounds and amines allowing to complete a reaction sequence towards total synthesis of multi functional group products.
4	Propose reagents for functional group interconversions of functional groups studied.
5	Connect chemical reactivity with real-life examples
6	Connect the chemical reactivity of isolated functional groups and apply towards the chemical synthesis and reactivity of lipids, amino acids and carbohydrates
7	Conduct virtual experiments in synthesis, extraction, reaction, purification and characterization of organic compounds, and critically analyze and communicate scientific results

Course Outline

Conjugated Systems

Required Reading – *Solomons* - Chapter 13

Conjugated Systems
Conjugated Systems - The Diels Alder Reaction - Part 1.
Conjugated Systems - The Diels Alder Reaction - Part 2.

Aromatic Molecules - 1
Required Reading – *Solomons* - Chapter 14/15

Aromatic Molecules - Aromaticity, Hückel Theory.
Aromatic Molecules - Resonance and Spectroscopy.
Aromatic Molecules - Reactivity - Electrophilic Aromatic Substitution (EAS), Friedel-Crafts Acylation and Alkylation.

Aromatic Molecules - 2
Required Reading – *Solomons* - Chapter 14/15

Aromatic Molecules - Reactivity - Directing Groups and Selectivity.
Aromatic Molecules - Reactivity
Aromatic Molecules - Reactivity - Synthetic Strategies - Protecting Groups, Functional Group Interconversion (FGI).

Alcohols and Ethers
Required Reading – *Solomons* - Chapter 11

Alcohols and Ethers - Nomenclature, Structure, Reactivity.
Alcohols and Ethers - Synthesis and Protection.
Alcohols and Ethers - Synthesis *via* Epoxidation.

Alcohols and the Carbonyl Group
Required Reading – *Solomons* - Chapter 12

Alcohols and the Carbonyl Group - Introduction to the Carbonyl Group.
Alcohols and the Carbonyl Group - Addition to the Carbonyl Group (Grignard Reagents, Organolithiums).
Alcohols and the Carbonyl Group - Reduction, Oxidation and Protection.

Organic Radicals
Required Reading – *Solomons* - Chapter 10

Radicals - Stability, Structure and Generation.
Radicals - Mechanism and Selectivity.
Radicals - Application, Examples, polymerisation

Aldehydes and ketones
Required Reading – *Solomons* - Chapter 16

Synthesis of and reactions of, including acetal formation, amine additions, HCN addition, Wittig reaction.

Carboxylic acids and their derivatives.
Required Reading – *Solomons* - Chapter 17

Nomenclature, physical properties, synthesis and reactions. Nucleophilic addition-elimination reaction at the acyl carbon. Step – Growth Polymers.

Aldehydes and ketones, reactions of α-C-H.
Required Reading – *Solomons* - Chapter 18.1-18.7

Keto and enol tautomers. Reactions via enols and enolate ions including racemization, halogenation, and aldol reaction. Malonic and acetoacetic ester synthesis. Lithium enolates.

Dicarbonyls, synthesis and reactions.
Required Reading – *Solomons* - Chapter 19.1 –19.6

Claisen condensation, crossed aldol condensation , cyclization via aldol condensation.

Amines.
Required Reading – *Solomons* - Chapter 20.1-20.5

Properties and synthesis.

Carbohydrates.
Required Reading – *Solomons* - Chapter 22

Monosaccharides, properties and reactions. Disaccharides and polysaccharides.

Lipids and fats, steroids.
Required Reading – *Solomons* - Chapter 23

Biosynthesis of terpenoids and steroids.

Amino acids and peptides.
Required Reading – *Solomons* - Chapter 24

Protecting groups. Peptide bond synthesis. Solid phase synthesis of peptides.

Friendly Advice:
1) All of you have taken CHEM281, which is a required pre-requisite for CHEM282. Do not forget the information in that course because you will need it to understand the material being given in CHEM282.
In CHEM282 the great bulk of the material will focus on functional group transformations. We make the assumption that you are familiar with the material taught in CHEM281 and will not review this unless it is necessary to introduce an additional concept. There will be a lot of new material covered in the course: the majority of this will be easier if you try to understand the chemical principles behind the topic. Homework will be assigned, and will be graded (WileyPlus). **Do not fall behind, be sure to attend and/or review office hours and tutorials.** One of the surest ways to fail this course is to fall too far behind, thinking that you can catch up. Students who are most successful at this course are those who keep up with the material and understand it as the course proceeds (use all resources available to you to solve issues with course material as it is presented).
2) The **module notes take precedent** over the textbook for content coverage unless specified otherwise (assigned readings that are not in notes etc). You are also responsible for the material covered in module notes which may not be covered in the textbook, unless specified. Reading

around a subject puts topics into context however and you are encouraged to do this. You SHOULD be using the textbook in addition to your module notes to ensure you have a full understanding of topics.

Textbooks/Readings

Organic Chemistry, Solomons and Fryhle 12th edition.

Grading Scheme

Grading as below:

Online Assignments (WileyPlus):	20%
Midterm Examination:	30% (online, Saturday March 5th)
Final Examination:	30% (in-person unless advised otherwise, April exam period)
Laboratory Grade:	20%

* Students must pass the combined lecture component (Wiley assignments, Midterm, Final exam) and the lab component to pass the course

Grading Method

All components of this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to Queen's Official Grade Conversion Scale:

Queen's Official Grade Conversion Scale

Grade	Numerical Course Average (Range)
A+	90-100
A	85-89
A-	80-84
B+	77-79
B	73-76
B-	70-72
C+	67-69
C	63-66
C-	60-62
D+	57-59
D	53-56
D-	50-52
F	49 and below

Late Policy

(Online portion of course) **Wiley assignments have expected due dates at the end of the week associated with the work topics as indicated in the course timeline. All online assignments also have hard and fixed electronic due dates that students can see in their assignment area that will not be extended as answers are set to be viewable for learning purposes after these electronic due dates have passed. All**

accommodations are included in the hard electronic due dates. There is ample warning of those due dates and generous time accommodations to complete the items have been built in. It is your responsibility to complete these items at the end of the week as outlined in the timeline, but no later than the hard electronic due dates. I strongly suggest that you not leave **any** component of the course that has a due date until the last moment to either complete or submit it. Server issues, wi-fi outages and other issues may prevent you completing the submission/completion otherwise.

Department of Chemistry Policy on Missed Quizzes, Tests, Midterms, Presentations, and Assignments

The Chemistry Department requires that students submit a 'declaration of extenuating circumstances' form before being considered for accommodation. The form, and related information, is available at http://www.chem.queensu.ca/undergraduate/undergraduate-resources/missed-exam-policy. Note that this departmental policy does NOT apply to final exams.

Laboratory: The laboratory portion of this course is supervised by Dr. Jason Vlahakis (vlahakis@queensu.ca) and will consist of **5 Virtual Laboratory Experiments** (and possibly an additional **3 In-Person Laboratory Experiments** if permitted after Feb 28, 2022). Students will watch a training video and **individually** write and submit a laboratory report for each virtual experiment. These can be completed at any time convenient for the student before the submission deadline, but it is highly recommended that you adhere to the suggested time frames. The prelab/lab report is submitted together as **one** Word document (as an assignment named Lab 1, Lab 2, Lab 3, Lab 4, and Lab 5) within onQ, and will be marked electronically by TAs. Watching each video will take about 1 hour and writing each laboratory report will probably take about 3 – 5 hours. More information about specific labs will be posted on onQ – follow closely the posted information/marking schemes. **WEIGHT for LABS:** If we are NOT permitted to return to in-person labs after Feb 28, 2022, the lab reports for Virtual Experiments 1, 2, 3, 4, and 5, will be worth 4% each, giving a total weight of 20% to the laboratory portion of the course. If we ARE permitted to return to in-person labs after Feb 28, 2022, the lab reports for Virtual Experiments 1, 2, 3, 4, and 5, will be worth 2.8% each, and in-person Experiments 6, 7, and 8 will be worth 2% each, giving a total weight of 20% to the laboratory portion of the course. The in-person labs will be mainly performance-based and will not require a full lab report. More detailed Lab Info/Schedule/Due Dates will be posted within the CHEM 282 onQ site. The lab reports have strict due dates. You can watch the Virtual Lab videos at the suggested times in the schedule, or at any other convenient time for your schedule, but **reports are all due at strict exact times, always plan ahead, no extensions will be given. Normally lab reports are due within one week, we have extended this due date now to 2 weeks after the recommended start time.**

Grading Scheme

- Laboratory (5 Virtual experiments + 3 In-person experiments, if permitted) 20%

Department of Chemistry Policy on Missed Labs

Laboratory work is an integral part of this course. All labs must be completed to pass the course. It is the responsibility of the student to notify the lab coordinator when a lab cannot be completed at the scheduled time. In exceptional circumstances, the following considerations will be given if a scheduled lab cannot be completed at the assigned time: Whenever possible, provisions will be made for a make-up lab preferably shortly before or after the missed experiment; the lab may be completed during the following academic year and a course mark of IN will be assigned until the missing work is completed; In rare circumstances, other accommodations may be made. For further information consult the lab coordinator.

Calculator Policy

Calculators acceptable for use during quizzes, tests and examinations are intended to support the basic calculating functions required by most Arts and Science courses. For this purpose, the use of the **Casio 991** series calculator is permitted and is the **only approved calculator for Arts and Science students**. This calculator sells for around $25 at the Queen's Campus Bookstore, Staples and other popular suppliers of school and office supplies.

Academic Integrity

Academic Integrity is constituted by the five core fundamental values of honesty, trust, fairness, respect and responsibility (see www.academicintegrity.org). These values are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University (see the Senate Report on Principles and Priorities http://www.queensu.ca/secretariat/policies/senate/report-principles-and-priorities).

Students are responsible for familiarizing themselves with the regulations concerning academic integrity and for ensuring that their assignments conform to the principles of academic integrity. Information on academic integrity is available in the Arts and Science Calendar (see Academic Regulation 1 http://www.queensu.ca/artsci/academic-calendars/regulations/academic-regulations/regulation-1), on the Arts and Science website (see http://www.queensu.ca/artsci/academics/undergraduate/academic-integrity), and from the instructor of this course. Departures from academic integrity include plagiarism, use of unauthorized materials, facilitation, forgery and falsification, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the university.

Copyright of Course Materials

All materials associated with this course are copyrighted. This includes in-class handouts, Emailed information, and all documents and information provided on the course Moodle site. These course materials are for the sole use of students registered in the course. These materials shall not be distributed or disseminated to anyone other than students registered in this course. Failure to abide by these conditions is a breach of copyright, and may also constitute a breach of academic integrity under the University Senate's Academic Integrity policy statement.

Accessibility Statement

Queen's is committed to an inclusive campus community with accessible goods, services, and facilities that respect the dignity and independence of persons with disabilities. Course materials are available in an accessible format or with appropriate communication supports upon request.

Please contact **Meredith Richards in the Department of Chemistry** in one of the following ways:

Email: ugadm@chem.queensu.ca

Accommodations Statement

Queen's University is committed to achieving full accessibility for persons with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. If you are a student with a disability and think you may need accommodations, you are strongly encouraged to contact Student Wellness Services (SWS) and register as early as possible. For more information, including important deadlines, please visit the

Student Wellness website at: **http://www.queensu.ca/studentwellness/accessibility-services/ YOU MUST ALSO USE THE WIDGET ON THE HOME PAGE OF THE COURSE TO REGISTER YOUR ACCOMMODATIONS.**

Statement of the Location and Timing of Final Examinations (note that online exam arrangements as in this course are different in terms of the location of exam writing)

As noted in Academic Regulation 8.2.1, "the final examination in any class offered in a term or session (including Summer Term) must be written on the campus on which it was taken, at the end of the appropriate term or session at the time scheduled by the Examinations Office." The exam period is listed in the key dates prior to the start of the academic year in the Faculty of Arts and Science Academic Calendar and on the Office of the University Registrar's webpage. A detailed exam schedule for the Fall Term is posted before the Thanksgiving holiday; for the Winter Term it is posted the Friday before Reading Week, and for the Summer Term the window of dates is noted on the Arts and Science Online syllabus prior to the start of the course. Students should delay finalizing any travel plans until after the examination schedule has been posted. Exams will not be moved or deferred to accommodate employment, travel /holiday plans or flight reservations.