SC/CHEM 3090 3.0 Introduction to Polymer Chemistry

Term	Winter 2023
Location and Time	M/W 13:30 – 14:20 (DB 0007) F 13:30 – 14:20 (R N203)
Prerequisite	SC/CHEM 2020 3.0 Organic Chemistry Students are strongly encouraged to review basic physical chemistry/thermodynamics principles

Contact Information

Course director: Prof. Gino G. Lavoie
E-mail: glavoie@yorku.ca
Phone: ext. 77728
Office: CB 408

Office Hours

Please send an email to schedule a meeting at a mutually-convenient time.
Please note that you will be required to wear a medical-grade mask to enter the office of the instructor. You must bring your own mask.

Course Description

This course serves as an introduction to polymer chemistry. The course deals with fundamental aspects with special focus on polymer synthesis, polymerization mechanisms, kinetics and key factors that governs molecular weight, polymer architecture and properties.

The following topics will be covered over the semester (subject to change):

- Introduction to polymers (types of polymers, polymerization mechanisms, nomenclature, physical states, amorphous vs. crystalline polymers, T_g, T_m and applications)
- Physical characterization of polymers (NMR, osmotic pressure, light scattering, viscometry, size exclusion chromatography)
- Step Polymerization (theoretical considerations, kinetics, molecular weight control, crosslinking, copolymerization, industrial process conditions)
- Radical Chain Polymerization (mechanism, kinetics, molecular weight control and molecular weight distribution, autoacceleration, living radical polymerization)
- Ionic Chain Polymerization (cationic and anionic polymerization, initiation and termination, block and other polymer architectures)
- Chain Copolymerization (kinetics, terminal and penultimate model, types of copolymerization behaviour, copolymer composition vs. feed composition)
- Ring-Opening Polymerization (cyclic esters and amides, ring-opening metathesis

polymerization)
- Stereochemistry of Polymerization (types of stereoisomerism, properties of stereoregular polymers, Ziegler-Natta initiators, metallocenes, post-metallocenes)

Purpose and Objectives of the Course

The purpose of the course is to introduce fundamental aspects of polymer chemistry and build upon knowledge gained in previous organic, inorganic, physical and analytical chemistry courses. Particular attention will be paid to the synthetic aspects of polymers, the understanding of reaction chemistry, of polymers physical properties and of the structure–property relationships. Students will also be introduced to the time-dependence behaviour of polymers.

At the end of the course, the students should be able to:

- communicate effectively with chemists in the field using proper nomenclature;
- propose means to prepare different types of polymers with control over the composition of the polymer, its microstructure and its molecular weight;
- determine and rationalize the properties of polymers;
- explain which and how analytical tools can be used to elucidate the chemical structure of polymers;
- read, understand and summarize important points from the polymer literature.

Organization of the Course

A number of pedagogical approaches will be used to meet the objectives of the course. Much of the lecture material will be delivered by the Course Instructors but will require active participation of the students. Polling exercises (either through iClicker or Zoom) will be part of the course. It is the responsibility of the student to install the iClicker Cloud application on their devices and join the course (link: https://join.iclicker.com/HSWL) to participate in those exercises.

Lecture notes will be posted ahead of the class on eClass. Problem sets will be assigned and posted on eClass on a regular basis to facilitate learning of concepts presented in class. Those problem sets will NOT be graded but are still part of the final grade (see **EVALUATION** below).

Evaluation

The level of proficiency in the material will be assessed through problems sets and exams. The final grade for the course will be based on the following items weighted as indicated.

Option 1 (default)

Problem sets	10%
Short quizzes (regularly held at the beginning of class)	10%
Midterm tests (see **IMPORTANT DATES** below)	45%
Final exam (3 h)	35%

Option 2 (opt-in option for those who will have written all 3 midterm tests)

Problem sets	10%
Short quizzes (regularly held at the beginning of class)	10%
Midterm tests (see **IMPORTANT DATES** below)	60%
Abbreviated final exam (3 h)	20%

As stated earlier, problem sets will NOT be graded. Every **fully completed** problem set turned in on time through Crowdmark is worth 100%, even if the answers to the questions are not right as

long as a reasonable effort was demonstrated. Assignments/problem sets received **later than 13:30 on the due date will result in no credit** (0%) at all.

Short quizzes will be held regularly during class but will only count towards the final grade as of Monday January 23rd. A third of 10% from the quizzes will come from participation, and two thirds will come from actual performance (i.e., for giving the correct answer). Thus, if ALL questions during a lecture are answered (with a reasonable answer), the minimum grade for those short quizzes would be 33%.

No make-up quizzes will be available. Any missed quizzes will result in **a grade of zero** for that specific quiz.

No make-up tests will be available. The weight of up to **two missed tests** will be added to the final exam. Any additional missed test will result in **a grade of zero** for that specific missed test. Students who will have written all 3 tests will be given the option to write an abbreviated final exam (Option 2 above).

Students who have a conflict with a religious holiday must contact the course director at least two weeks prior to the test/exam to learn how they will be accommodated. Late requests will likely not be accepted for consideration.

Important Dates

Dates are subject to change and will always align with the Registrar's Office. For a complete list of important dates, see https://registrar.yorku.ca/enrol/dates/2022-2023/fall-winter.

January 9	First class
February 6	**Midterm test 1**
February 18–24	Reading Week (no class)
March 3	**Midterm test 2**
March 17	Last day to drop course without receiving a grade
March 24	**Midterm test 3**
March 18–April 10	Course withdrawal period
April 7	Good Friday (no class; University closed)
April 10	Last class
April 12–7	**Final exam** (students MUST not make commitments that would prevent them from writing the final exam at the date determined by the Registrar's Office)

Textbooks/Course Kit

Much of the course will be based on the following **highly recommended** textbook:

> Painter, P. C., Coleman, M. M. (2009). *Essentials of Polymer Science and Engineering.* DEStech Publications. ISBN 978-1-932078-75-6
>
> or, the related earlier black-and-white version:
>
> Painter, P. C., Coleman, M. M. (1997). *Fundamentals of Polymer Science. An Introductory Text.* Second Ed. Technomic Publishing Co. ISBN 1-56676-559-5.

Synthesis aspects and control over molecular weight and structure are best covered in a separate **recommended** textbook, **available as an e-textbook** through the library:

Odian, G. (2004). *Principles of Polymerization.* Fourth Ed. Wiley-Interscience Publication. ISBN 0-471-27400-3.

These textbooks are on reserve at the Steacie Library and are available for a 2-hour loan. The following textbooks can also be used as supplementary and complementing readings:

Sperling, L. H. (2006). *Introduction to Physical Polymer Science.* 4th Ed. Wiley. ISBN 978 -0-471-70606-9.

Chanda, M. (2013). *Introduction to Polymer Science and Chemistry: a problem-solving approach*. 2nd Ed. CRC Press. ISBN 978-1-4665-5384-2

Young, R. J. (1991). *Introduction to Polymers*. 2nd Ed. Chapman and Hall. ISBN 041-2306-301

E-mail Communications

All course-related questions and issues will be addressed during class or during office hours. Any administrative questions and issues will best be addressed by the Undergraduate Program Assistant (chemasst@yorku.ca) in the Chemistry Building (CB 124). E-mail communications with the course instructor must have "CHEM 3090" as subject line.

All messages received without that subject line is likely to be overlooked and unanswered. Messages will be replied to within 48 hours, except during weekends or holidays. For a more rapid reply, students are encouraged to use the Forum in Moodle where peers can help answer questions. This Forum will be monitored by the Course Director on a regular basis.

Assignment Submissions and Lateness Penalties

Proper academic performance depends on students doing their work not only well, but on time. Accordingly, the assignments must be uploaded to Crowdmark by the set deadline. **Assignments/problem sets received later than 13:30 on the due date will result in no credit (0%) at all.** This will allow for the answers to the problem set to be posted promptly on eClass.

If a test/exam is administered through Crowdmark, students will be given 10 minutes from the official end time of the test/exam to upload their answer. Any late submission will be subject to a **5% penalty for every minute past the deadline**.

Academic Integrity

Assessments, whether in person or online, are intended to be individual pieces of work. Collaborating with other students is not permitted. Please note the instructors have full access to Chegg and other similar websites and will be used if needed to prosecute academic misconduct. Please also note that online proctoring software could be used (should the part of the course need to be delivered remotely/online). Any decision on this matter will be clearly communicated to all students before an assessment.

Numerous students in Faculty of Science courses have been charged with academic misconduct when materials they uploaded to third-party repository sites (e.g. Course Hero, One Class, Chegg, etc.) were taken and used by unknown students in later offerings of the course. The Faculty's Committee on Examinations and Academic Standards (CEAS) found in these cases that the burden of proof in a charge of aiding and abetting had been met, since the uploading students had been found in all cases to be wilfully blind to the reasonable likelihood of supporting plagiarism in this manner. Accordingly, to avoid this risk, **students are urged not to upload their work to these sites**. Whenever a student submits work obtained through Course Hero, Chegg or

One Class, the submitting student will be charged with plagiarism and the uploading student will be charged with aiding and abetting.

Note also that exams, tests and other assignments are the copyrighted works of the professor assigning them, whether copyright is overtly claimed or not (i.e. whether the © is used or not). Scanning these documents constitutes copying, which is a breach of Canadian copyright law, and the breach is aggravated when scans are shared or uploaded to third party repository sites.

Students are required to make themselves aware of school policies relating to Academic Integrity, Accessibility, Religious Accommodation, Student Conduct and other matters. Plagiarism and other academic offenses will be sanctioned to the fullest extent in accordance with University and Faculty policies.

You MUST digitally sign on the agreements below on eClass

- **Academic Honesty Agreement:** I understand York University's *Senate Policy on Academic Honesty* and will abide by this policy. The full policy can be found at: https://secretariat-policies.info.yorku.ca/policies/academic- honesty-senate-policy-on/.
- The following website (https://spark.library.yorku.ca/academic-integrity-what-is-academic-integrity/) is a good resource to learn about "academic integrity". Students are strongly encouraged to go through the self-guided website.
- Note that ignorance of these policies and of academic integrity is not an acceptable excuse for academic misconduct.
- I acknowledge that academic honesty requires that I do not cheat (attempt to gain an improper advantage in an academic evaluation), plagiarize, aid and abet others in academic dishonesty, nor attempt or actually alter, suppress, falsify or fabricate documents.
- Suspected breaches of academic honesty will be investigated and charges shall be laid if reasonable and probable grounds exist and lead to the range of penalties described in the guidelines of the policy.

Online Delivery of the Course

Due to the ever-evolving nature of the COVID-19 pandemic, the course **might** need to shift from in person to online. In this scenario, the following is a list of requirements of what students will need to complete the course.

- A **working and stable internet connection** (high speed greatly preferred***)*** to attend remotely lectures delivered through Zoom. eClass and Crowdmark also require stable internet connections. The instructors cannot accommodate if students run into technical problems relating to your internet connections.
- **Access to the email account linked to the eClass profile** as *o*nline assessments through Crowdmark will only be sent to the email address linked to that specific account (where course announcements are also sent). The actual email account is listed on eClass, under Profile (pull-down menu on the top right page).
- **A document scanning app capable of producing PDF files** as exams need to be submitted in PDF format only. This will require you to write your answers on paper, then digitally capture your work in PDF using a document scanning app. Both Apple and Android phones contain native scanning apps that should be used. The instructors will NOT accept camera photos as they tend to be too large in file size, rotated incorrectly, taken at an improper angle and suffer from many image artifacts. Failure to submit your work properly may result in it not being graded.

A sample assessment will be given (if needed) to allow you to practice a submission and to become familiar with our expectations.

For students who may be using a tablet computer with a stylus to annotate provided PDF files:

- Tablet computers such as the Microsoft Surface are able to annotate PDF files using a stylus. Unfortunately, the instructors have run into issues with eClass and Crowdmark whereby the annotations is lost when uploaded for grading, depending on the program used to annotate the PDF files.
- If a tablet computer is used to annotate files, it is the student's responsibility to make sure the annotations show up after the file is uploaded. Otherwise, it will be treated as a missed assessment or as late submission, with penalty as per the course syllabus.

Important Information Regarding Platforms Used for the Course

Several platforms will be used in this course (e.g., eClass, Zoom, etc.) through which students will interact with the course materials, the course director / TA, as well as with one another. Students shall note that:

- **eClass** (also known as Moodle) will be used extensively throughout the course. More information about the platform, its technology requirements and FAQs can be found online at https://lthelp.yorku.ca/moodle.
- **Zoom** is hosted on servers in the U.S. This includes recordings done through Zoom. If you have privacy concerns about your data, provide only your first name or a nickname when you join a session. The system is configured in a way that all participants are automatically notified when a session is being recorded. In other words, a session cannot be recorded without you knowing about it.
- This course might require the use of online proctoring (e.g., **Proctortrack**) for examinations. In this scenario, students will need to have access to common IT technology (computer with a camera and mic with stable internet connection). Further details will be shared in due course if needed. Students will be required to share any IT accommodation needs with the instructor as soon as possible.

Accessibility

York University is committed to principles of respect, inclusion, and equality of all persons with accessibility needs across campus. The University provides services for students with accessibility needs (including physical, medical, learning, and psychiatric needs) needing accommodation related to teaching and evaluation methods/materials. These services are made available to students in all Faculties and programs at York University.

Students in need of these services are asked to register with accessibility services as early as possible to ensure that appropriate academic accommodation can be provided with advance notice. You are encouraged to schedule a time early in the term to meet with each professor to discuss your accommodation needs. Please note that registering with accessibility services and discussing your needs with your professors is necessary to avoid any impediment to receiving the necessary academic accommodations to meet your needs. Additional information is available at the following websites:

- **Student Accessibility Services**: https://accessibility.students.yorku.ca

- **York Accessibility Hub**: http://accessibilityhub.info.yorku.ca/

Assistance

Attending university and coping with all the expectations, over and above other responsibilities you may have outside school, can be very challenging. A number of options are available to students, on and off campus, to assist you in your learnings and to help deal and cope with difficult situations. As always, in case of an emergency, students should **call 911**.

- **Academic Advising**: https://www.yorku.ca/science/academic-advising/ Departments also offer program-specific advising. Check with your Department's Undergraduate Office.
- **Centre for Human Rights, Equity, and Inclusion:** https://rights.info.yorku.ca
- **Centre for Indigenous Students Services:** https://aboriginal.info.yorku.ca/
- **Good2Talk 24-hour Ontario Student Helpline:** 1-866-925-5454 /Text: GOOD2TALKON to 686868
- **Keep.meSAFE:** https://myssp.app/keepmesafe/ca/home
- **Learning Commons** (general academic learning supports including library research, time management, study skills, career planning, etc.): https://learningcommons.yorku.ca/
- **Peer Assisted Study Sessions (PASS):** https://www.yorku.ca/colleges/bethune/get-help/pass/
- **Peer Tutoring**: https://www.yorku.ca/colleges/bethune/get-help/peer-tutoring/
- **Sexual Violence Response and Support:** https://thecentre.yorku.ca
- **Student Counselling, Health & Well-being:** https://counselling.students.yorku.ca/
- **Support Services for International Students:** https://yorkinternational.yorku.ca/international-student-support/
- **Writing Services**: https://www.yorku.ca/colleges/bethune/get-help/writing/
- **York University Student Services:** https://family.yorku.ca/student-services/#SCD
- **York University Student Well-being Resources:** https://www.yorku.ca/well-being/resources/students/

Religious Accommodation

York University is committed to respecting the religious beliefs and practices of all members of the community and making accommodations for observances of special significance to adherents. Should any of the dates specified in this syllabus for an in-class test or examination pose such a conflict for you, contact the Course Director within the first three weeks of class. Similarly, should an assignment to be completed in a lab, practicum placement, workshop, etc., scheduled later in the term pose such a conflict, contact the Course Director immediately. To arrange an alternative date or time for an examination scheduled in the formal examination periods (December and April/May), students must complete and submit an accommodation request form at least 3 weeks before the exam period begins.

https://secure.students.yorku.ca/pdf/religious-accommodation-agreement-final-examinations.pdf

(updated on January 9th, 2023)