

Industrial and Green Chemistry

Syllabus

Course Number	SC/CHEM 3070 3.0 Section A
Term	Fall
Session	2015-2016
Prerequisites	CHEM 2020 3.00 and CHEM 2021 3.00, or with permission
Meetings	TR 2:30 – 4:00 pm in CLH J

Course Director and Instructors

Dr. Derek Jackson (Module 1 and Course Director)

Office: CB 452

Office Hours: TBD

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Prof. Pierre Potvin (Module 2)

Office: CB 406

Office Hours: TR 1:00 – 2:00 PM

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Prof. Gerald Audette (Module 3)

Office: LSB 327C

Office Hours: MW 1:00 – 2:00 PM IN LSB 213

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Course Description

The chemical industry has become a huge complex of operations that range from large multinational corporations to small, locally owned factories. Collectively, they manufacture materials and products that compose at least some part of almost every item used in our society today.

This course serves as an introduction to industrial and green chemistry. Various aspects related to the production of chemicals on a large scale will be presented, ranging from a general introduction of the chemical industry to specific manufacturing and legal issues.

The following topics will tentatively be covered over the semester.

1. Introduction (Jackson)

- a) Brief history of the chemical industry
- b) Top chemical companies and countries
- c) Top manufactured chemicals
- d) Brief economics of chemical processes

2. Chemical Reactors (Jackson)

- a) Scaling up issues (laboratory to pilot-plant to industrial scale)
- b) Reactor types: batch vs. continuous
- c) Product isolation
- d) Atom economy

3. Fine chemistry (Jackson)

- a) Pharmaceuticals
- b) Halogenated compounds

4. Large-scale chemistry (Potvin)

- a) Large-scale sources of raw materials (coal, natural gas, petroleum, N₂, O₂, sulfur) and their processing into products of importance to chemical industry
- b) Specific processes of importance: Claus, Haber, Oxo, Monsanto, Oswald and many others
- c) Elaboration of end products from two main feedstocks (ethylene and aromatics), including many polymers and consumer goods
- d) Energy considerations, energy management, green chemistry principles and examples

5. Legal and Regulatory Affairs (Audette)

- a) Standards: quality management, good manufacturing/laboratory practice, standard operating procedures, with particular emphasis on the ISO 17025 laboratory accreditation standard
- b) Intellectual property issues (patents and trade secrets)
- c) Regulatory issues and corporate responsibility

Purpose and Objectives of the Course

The purpose of the course is to introduce fundamental aspects of industrial and green chemistry. At the end of the course, students should be able to:

1. Communicate effectively with industrial chemists using proper nomenclature;
2. Speak to how the chemical industry developed and who are the major chemical manufacturers, as well as what the top produced chemicals are;
3. Elaborate on scale-up issues and other issues faced by large-scale manufacturers;
4. Describe various types of processes and reactor types;
5. Expand on the various types of catalysts and their role in the production of chemicals;
6. Explain the economics of a large-scale chemical process;
7. Describe some new trends in chemical industry;
8. Analyze processes in terms of green chemistry principles and quantitatively evaluate them;
9. Expand on legal issues related to the production and sale of chemicals;
10. Read, understand and summarize important points from trade journals.

Course Organization

The course will be taught by three lecturers (Derek Jackson, Pierre Potvin and Gerald Audette). 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. Selected lecture notes will be posted on Moodle (moodle.yorku.ca).

Evaluation

Grading scheme for the course

Short paper (500-600 words) – 10%

Long paper (2500-3000 words) – 20%

Midterm 1 (Jackson) – 20%

Midterm 2 (Potvin) – 20%

Final exam (comprehensive) – 30%

NOTE: There will be no makeup midterm exams. If a student misses a midterm for a legitimate reason, they must provide suitable documentation within 2 business days of the missed midterm. In the case of illness, please provide an official York University Attending Physician Statement, available at http://www.registrar.yorku.ca/pdf.php?pdf=attend_physician_statement.pdf

Misrepresentation in such documentation will constitute academic dishonesty and will be sanctioned in accordance with university and Faculty policies.

For these students, the weight of the missed midterm(s) will be shifted to the final exam and apply to the portion of material not tested.

The policy for a missed final exam will be made available in advance of the final exam date.

NOTE: The final exam schedule will not be known until October. However, all students are expected to be available for the **complete** final exam period and no travel or other arrangements should be made to start before the end of the exam period. This is to allow for weather emergencies and other reasons for rescheduling. A conflict with previously made travel arrangements is **not** an acceptable reason for missed final exams.

Learning Tools

There is no mandatory textbook for this course. However, three textbooks have been placed on reserve at the Steacie Library should you wish to consult them:

Chenier, Philip J. Survey of Industrial Chemistry (2002)

White, Howard L. Introduction to Industrial Chemistry (1986)

Wiseman, Peter. An Introduction to Industrial Organic Chemistry (1979)

There is also another textbook available online through York University Libraries e-resources:

Wittcoff, Harold A. Industrial Organic Chemicals, 3rd Edition (2013)

Assignment Submissions, Lateness Penalties, Academic Integrity

Proper academic performance depends on students doing their work not only well, but on time. Accordingly, the term papers must be received on the due date specified. Papers are to be submitted in electronic format through turnitin.com as well as in hard copy format to the instructor. The hard copy must be submitted by the due date and no mark will be recorded before the electronic copy is submitted. Students can only submit once

and the two formats must be *identical* in content; submitting a different hard-copy version constitutes academic dishonesty. Students who opt out of using turnitin.com must submit an electronic copy of their papers to their instructor by the same deadline. Supporting documentation may be requested and other means of plagiarism detection may be used.

Papers must be submitted on stapled, letter-sized, single-sided sheets with margins of no more than 1" on each side, using double lined spacing and containing 500-600 words (short paper) or 2500-3000 words (long paper), exclusive of title, tabular material, captions and references. Students will be expected to adhere to high standards of professionalism in their submitted papers. Spelling and grammar should be checked. All data, figures and other source materials must be duly attributed. Plagiarism will be sanctioned to the fullest extent in accordance with university and Faculty policies.

Term papers received later than 4 PM on the due date will be penalized by taking 20% off the maximum mark per 24 hour period of lateness (including Saturdays and Sundays). To reduce the penalty on weekends, students may submit electronically to turnitin.com over the weekend, followed by an identical hard copy to their instructor on Monday. The penalty will only apply to when the electronic copy was submitted. Exceptions to the lateness penalty resulting from illness will be entertained by the instructors only when supported by official written documentation.

Students are required to make themselves aware of school policies relating to Academic Honesty and Integrity, Access, Religious Accommodation, Student Conduct and other matters. A summary of these policies can be accessed at

<http://www.yorku.ca/secretariat/senate/committees/ascp/documents/CourseInformationForStudentsAugust2012.pdf>