

**CONCORDIA UNIVERSITY  
DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY**

**CHEM 498/640 (section 01)  
SELECTED TOPICS IN INORGANIC CHEMISTRY**

**GREEN CHEMISTRY**

**SYLLABUS – Fall 2019**

**GENERAL INFORMATION**

Green Chemistry (CHEM 498/640) is a one-term course open to all degree programs. This course requires CHEM 222 (Introductory Organic Chemistry II), CHEM 241 (Inorganic Chemistry I: Introduction to Periodicity and Valence Theory), and CHEM 217 (Introductory Analytical Chemistry I). This course will give an overview of the 12 principles of green chemistry and how they are applied in a laboratory and industrial setting.

INSTRUCTOR	Professor Ashlee J. Howarth Office L-SP 275-23 ashlee.howarth@concordia.ca Ph. 848-2424 ext. 5324
COURSE FORMAT	Lectures
LECTURE HOURS	Tues & Thurs 10:15am - 11:30am
LOCATION	LOY CC-425
Recommended TEXTBOOKS	<i>Green Chemistry, Theory and Practice.</i> Paul T. Anastas, John C. Warner, Oxford University Press, 1998.  <i>Green Chemistry, An Inclusive Approach.</i> Béla Török, Timothy Dransfield (Eds). Elsevier, 2018.
COURSE WEBSITE	Moodle, CHEM-498-01. CHEM 640-01-2192
OFFICE HOURS	Tues 2:00pm – 3:00pm; email any time

**COURSE WITHDRAWAL**

**Monday September 16, 2019** is the last day for withdrawal with tuition refund (DNE) from fall-term courses.

**Monday November 4, 2019** is the last day for academic withdrawal (DISC) from fall-term courses.

**LECTURES and READING**

Classroom time is divided between lectures and discussions on recent scientific literature relevant to the material covered. The lectures will cover fundamental and applied material. This is an advanced topics course which is built on a foundation of important fundamental chemistry principles while providing a survey of the philosophy and implementation of green chemistry. The course is divided roughly into two parts, taught in parallel: (i) a general overview of the history and development of green chemistry - focusing on the 12 principles of green chemistry established by Paul Anastas and John Warner, and (ii) examples of chemical processes that have been developed following principles of green chemistry, including fundamental literature examples, and those which have been scaled-up and commercialized.

**COURSE OBJECTIVES**

- To understand the history of the field of green chemistry, why it was created, why it is necessary, and the responsibility that chemists have with regards to the sustainability of our planet
- To describe the 12 principles of green chemistry, including the theory behind each principle, and approaches for applying the principles in all fields of chemical research
- To gain insight into current green chemistry literature, progress that has been made on both fundamental and commercial levels, and the future challenges of the field

**COURSE OUTLINE**

1. Overview of the 12 principles of green chemistry including: (1) Prevention, (2) Atom Economy, (3) Less Hazardous Chemical Syntheses, (4) Designing Safer Chemicals, (5) Safer Solvents and Auxiliaries, (6) Design for Energy Efficient, (7) Use of Renewable Feedstocks, (8) Reduce Derivatives, (9) Catalysis, (10) Design for Degradation, (11) Real-time analysis for Pollution Prevention, (12) Inherently Safer Chemistry for Accident Prevention
2. Green chemistry in practice including: literature examples, commercial examples, and a brief overview of the periodic table of the elements of green and sustainable chemistry

**EXAMINATIONS**

There will be two (2) formal examinations:

1. Midterm Exam I (in class) on **Thursday October 3, 2019**.
2. Midterm Exam II (in class) on **Tuesday November 12, 2019**.

In addition to the Midterm Exams, there will be two projects required for completion of this course.

1. A midterm oral presentation where students will explain a recent advance in the field of green chemistry. Students (in groups of 2) will select a recently published paper (or papers), and present the highlights of the work to the class. Presentations will be 10 or 15 minutes for undergraduate and graduate students, respectively, followed by 5 minutes of questions from the audience. Beginning **Thursday November 14, 2019**.
2. A final paper where students will write a mini-review article on recent scientific contributions from a prominent researcher in the field of green chemistry (the researcher will be assigned). Due **Thursday December 5, 2019**.

**MANDATORY QUIZ AND SEMINAR**

As part of this course, you are **required** to i) attend a Chemistry and Biochemistry Departmental Seminar on the academic conduct code and the appropriate use of information sources and ii) pass the online quiz associated with this seminar (the passing grade for the quiz is 100%). (**Note:** This is **not** the University's quiz you may have been asked to take when you first registered and logged into the myConcordia portal; the one you must take is similar, but graded by the Department of Chemistry and Biochemistry, and you do not have access to it until after you have attended the seminar.) The aim of this seminar is to clarify the academic conduct code in terms of what practices will be considered unacceptable with regards to work submitted for grading in Chemistry and Biochemistry courses. **You are only exempt from repeating the seminar and the quiz if you have done both in Fall 2014 or more recently,\*** otherwise you are required to repeat both this term. This short seminar (1 hour) will be held at the following times (note that late-comers will **not** be admitted):

Date (Fall 2019)	Time	Room
Monday, Sept. 16	16:45-17:45	CC 111
Tuesday, Sept. 17	16:45-17:45	CC 308
Tuesday, Sept. 17	20:45-21:45	HB 130

Wednesday, Sept. 18	16:45-17:45	CC 308
Wednesday, Sept. 18	20:45-21:45	HB 130
Thursday, Sept. 19	16:45-17:45	HC 155
Friday, Sept. 20	16:45-17:45	HC 157

As space for each of the seminars is limited by the room size, please **sign up** to your preferred time as soon as possible (slots fill up quickly). Sign-up sheets are available two weeks in advance of the seminars outside SP 201.01 (Departmental office). Only sign up in **available slots**: rooms must not be filled over capacity!

**If you do not complete this course requirement, your final grade for the course may be lowered by one full letter grade with an incomplete (INC) notation until such time as this requirement is completed. Please refer to the undergraduate calendar (section 16.3.5) for details on removal of an incomplete notation.**

\* You are exempt if you can locate your ID in the pdf file located on the Departmental web site (<http://www.concordia.ca/content/dam/artsci/chemistry/docs/Compliance-list.pdf>).

### **PLAGIARISM AND OTHER FORMS OF ACADEMIC DISHONESTY**

The Academic Code of Conduct can be found in section 17.10 of the academic calendar (<http://www.concordia.ca/academics/undergraduate/calendar/current/17-10.html>). Any form of unauthorized collaboration, cheating, copying or plagiarism found in this course will be reported and the appropriate sanctions applied. The mandatory seminar is a clear and fair opportunity to learn what our faculty regards as academic misconduct. Failure to take part in this learning opportunity and thus ignorance of these regulations is no excuse and will not result in a reduced sanction in any case where academic misconduct is observed.

### **COURSE GRADE**

Your final grade in the course is based on marks obtained for lecture participation, midterm exams, midterm presentation, and final paper. The composition of the final course grade is as follows:

Participation	10 %
Midterm exam I	15 %
Midterm exam II	15 %
Midterm presentation	20 %
Final paper	40 %

#### Passing Grades:

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-
100-93	92-86	85-80	79-77	76-73	72-70	69-67	66-63	62-60	59-57	56-53	52-50

In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change.

A. J. Howarth  
September 2019