

The University of Western Ontario  
Chemistry 9525A, Fall 2025  
Corrosion

**1. Course Information:**

Thursdays 1430-1700, ChB 9

Start date: 4 September, 2025

End date (written exam): 27 November, 2025

**Enrollment:**

To be capped at 30 students

**2. Instructor Information:**

Dr. Yolanda Hedberg

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**3. Course Description:**

The primary objective of the course is to develop a fundamental and in-depth understanding of the theory of material degradation and corrosion in various environments. The course is designed for students who want to gain a deeper understanding of corrosion mechanisms, design corrosion studies, and mitigate or predict corrosion processes. Basics in thermodynamics, kinetics, and electrochemical reactions, which determine the corrosion mechanism of metals and alloys in aqueous systems, will be covered. However, for fundamental knowledge in electrochemistry, students are referred to the course CHEM9452 (Electrochemistry). This course will specifically focus on recognizing and understanding different types of corrosion, which are specific to certain metals, material designs, and environments. High temperature oxidation, atmospheric corrosion, and corrosion of non-metallic materials, such as polymers and textiles, will also be covered shortly. Basic knowledge in corrosion protection will also be covered.

**Course content:**

1. Thermodynamics of importance for the corrosion of metals in aqueous systems. Consideration and calculation of standard potentials, chemical dissociation constants, Nernst equation, and equilibrium potential-pH diagrams (Pourbaix diagrams).
2. Electrochemical reactions of metals in aqueous systems.
3. Corrosion kinetics. Activation polarization, concentration polarization, and resistance polarization.
4. Prerequisites, initiation, propagation, and failure for specific corrosion types:
  - a. Uniform corrosion
  - b. Localized corrosion types: crevice and pitting corrosion
  - c. Microstructure involved, and localized types: selective corrosion, intergranular corrosion, dealloying
  - d. Galvanic corrosion

- e. Mechanically induced corrosion types: Stress corrosion cracking, fatigue corrosion, fretting corrosion, erosion corrosion
  - f. Microbiologically influenced corrosion and protein-induced corrosion
  - g. Atmospheric corrosion
  - h. High temperature corrosion
  - i. Degradation of polymers
5. Recognizing the most probable corrosion causes for a given material and environment. Analysis of corrosion cases, and special corrosion susceptibilities for different metallic materials.
  6. Different tools to analyze corrosion: electrochemical methods, surface analytical tools, solution analytical tools, simple predictions, and chemical speciation models.
  7. The most common corrosion protection methods and their individual advantages and risks.

**Learning objectives:**

1. Describe, identify, analyze, and compare different corrosion types on metals and alloys in different environments.
2. Explain why corrosion takes place using knowledge of the surrounding environment and the properties of the metallic materials.
3. Explain electrochemical reactions governing corrosion of metals and alloys, and make simple calculations and estimations on corrosion rates in solution.
4. Suggest a strategy for corrosion testing and prediction for a given metallic material and its surroundings.

**Lectures / tutorials:**

3 h/week; in person, Thursdays, 1330-1600 h

**4. Course Materials:**

An electronic copy of the course notes will be provided. Much useful information can also be found in:

- L.L. Shreir, Jarman, R.A., Burstein, G.T. (Eds.) Corrosion Metal/Environment Reactions, Butterworth Heinemann, 1994. [Link to e-book](#)
- E. McCafferty, Introduction to corrosion science, Springer Science & Business Media, 2010. [Link to e-book](#)
- Z. Ahmad, Principles of Corrosion Engineering and Corrosion Control, 1st ed., Elsevier Ltd, Oxford, 2006. [Link to e-book](#)
- D.E.J. Talbot, J.D.R. Talbot, Corrosion Science and Technology, 2nd ed. ed., CRC Press, Boca Raton, FL, 2007. [Link to e-book](#)
- N. Birks, G.H. Meier, F.S. Pettit, Introduction to the High Temperature Oxidation of Metals, 2 ed., Cambridge University Press, Cambridge, 2006. [Link to e-book](#)
- C. Leygraf, I.Odnevall Wallinder, J. Tidblad, T. Graedel, Atmospheric corrosion, John Wiley & Sons, 2016. [Link to e-book](#)

- D.W. Van Krevelen, K. Te Nijenhuis, Chapter 22 - Chemical Degradation, in: D.W. Van Krevelen, K. Te Nijenhuis (Eds.) Properties of Polymers (Fourth Edition), Elsevier, Amsterdam, 2009, pp. 779-786. [Link to chapter](#)

## **5. Methods of Evaluation:**

This course will be evaluated by a written exam on 27 November, 2025, 1:30 – 4 pm. In the case of a valid excuse, an alternative exam will be provided on 4 December, 2025, 1:30 – 4 pm. This written exam will represent 100% of the course grade. In order to pass the exam and the course, at least 60% of the written exam must be correct.

Students who wish to audit the course must have at least 25% of the written exam correct.

### **Course attendance and missed/late assignments**

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed.

### **Statement on Use of Electronic Devices**

During the written exam, you are allowed to bring a calculator. You are not allowed to use a cell phone, laptop, or any course materials.

### **Statement on the Use of Generative Artificial Intelligence (AI)**

The use of generative artificial intelligence (AI) tools/software/apps is not acceptable during the written exam.

## **6. Statement on Academic Offences:**

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following website:

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_offences.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_offences.pdf).

## **7. Statement on Gender-Based and Sexual Violence:**

Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who is going through or has gone through these traumatic events. If you are experiencing or have experienced GBSV (either recently or in the past), you will find information about support services for survivors, including emergency contacts at the following website:

[https://www.uwo.ca/health/student\\_support/survivor\\_support/get-help.html](https://www.uwo.ca/health/student_support/survivor_support/get-help.html) To connect with a case manager or set up an appointment, please contact [support@uwo.ca](mailto:support@uwo.ca).