

# Department of Chemistry Online Course Syllabus

CHM 455-1206H: Advanced Materials Chemistry, Fall 2023

## I CONTACTS

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### INSTRUCTOR

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### BIOGRAPHICAL

Geoffrey A. Ozin is a distinguished University Professor at the University of Toronto. He currently spearheads the Solar Fuels Team at the University of Toronto, [www.solarfuels.utoronto.ca](http://www.solarfuels.utoronto.ca). He has held positions as Honorary Professor at The Royal Institution of Great Britain and University College London, External Adviser for the London Centre for Nanotechnology, Alexander von Humboldt Senior Scientist at the Max Planck Institute for Surface and Colloid Science and the Center for Functional Nanostructures at the Karlsruhe Institute of Technology, Global Chair at Bath University, and Leverhulme Professor at Imperial College London. He is the author of five books: *Cryochemistry* (1976), *Nanochemistry: A Chemical Approach to Nanomaterials* (2006), *Concepts of Nanochemistry* (2009), *The Story of CO<sub>2</sub>: Big Ideas for a Small Molecule* (2020), and *Energy Materials Discovery Enables a Sustainable Future* (2022). Co-founder of several Canadian spinoff companies Torrovap, Opalux, Solistra, and Co2Rail, and recipient of numerous prestigious awards most recently the Killam Prize in Natural Science, World Cultural Council Albert Einstein Award in Science, Royal Society of Chemistry Centenary Prize in Nanochemistry, and World Technology Award in Energy. He lives with his wife in Toronto, Canada.

## II COURSE OVERVIEW

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### COURSE DESCRIPTION:

This online cross-listed undergraduate-graduate course is designed as a follow-up to CHM 255Y (Introduction to Inorganic Chemistry) with lectures on solid state chemistry basics and CHM 355H (Polymer and Materials Chemistry), with lectures on synthesis-structure-property-function relations of selected classes of low dimensional polymeric and inorganic materials.

In CHM 455H/CHM 1206H we will be concerned with a comprehensive investigation of a wide range of synthetic methods for preparing diverse classes of inorganic materials and nanomaterials with properties and function that are intentionally tailored for a particular use. Several contemporary issues in materials research are critically evaluated to introduce the student to recent highlights in the field of materials chemistry and nanochemistry – now a well-established sub-discipline of chemistry.

### STUDENT LEARNING OUTCOMES:

1. The aim of this course is to provide a cohesive introduction into the materials world and “**how materials chemists think.**” We will begin with a primer on solid-state materials and connections between structure, bonding and molecular orbitals in molecule chemistry, and crystal lattices, cohesive energy, and electronic bands in solid-state materials chemistry. Following that, a survey of archetypical inorganic solids that have had a dramatic influence on the materials world, along with an overview of strategies for synthesizing and understanding the formation of many different classes of materials and nanomaterials with intentionally designed compositions and structures, dopants, defects and non-stoichiometry, textures and morphologies over multiple length scales and dimensionalities, with an emphasis on how to control the relations between structure, property, function and utility, in a wide range of technologies.
2. Practice science with integrity and sensitivity to ethical, environmental, and social concerns, by committing to promoting diversity, equitable behaviour, academic rigour, and responsible leadership.
3. Gain knowledge through new ideas and hypothesis-driven methods of inquiry aimed at answering scientific questions through the design and implementation of experimental and theoretical methods used in the field of solid-state materials chemistry.
4. Apply quantitative and qualitative methods used in the instrumental analysis, evaluation, and interpretation of scientific data in the field of solid-state chemistry.
5. Access, select and critically evaluate scientific information and literature to conceive and solve a wide range of problems both within and outside of the field of solid-state materials chemistry.
6. Consider limitations, assumptions, and uncertainties when imagining, making decisions, or solving scientific problems in the field of solid-state materials chemistry, and justify the approach(es) taken.

7. Communicate scientific knowledge in the field of solid-state materials chemistry to diverse audiences clearly and concisely in written, oral, and visual forms, both in-person and online.
8. Work independently and collaboratively while exercising initiative, responsibility, and accountability in both personal and group contexts.
9. Understand, practice, and promote safe behaviour in a laboratory environment, including responsible management of chemical resources.
10. Reflect upon the dynamic nature of solid-state materials chemistry and value opportunities for updating knowledge, understanding, and technical and professional skills as practitioners of the discipline on a continuing basis.

#### **PREREQUISITE COURSES:**

This course assumes you have a basic understanding of inorganic chemistry, including topics covered by the prerequisites for the course (CHM 238Y and CHM 325H).

#### **REQUIRED TEXT:**

Hard Copy: L. Smart and E. Moore, *Solid State Chemistry, An Introduction*, Chapman and Hall, London, Fifth Edition.

Electronic Edition: [Solid State Chemistry 5th edition | 9780367135720, 9780429648663 | University of Toronto \(vitalsource.com\)](#).

### **III HOW THE COURSE IS ORGANIZED**

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#### **COURSE PLAN:**

We will begin with a recommended meet n' greet on-line, getting to know each other session, a look at the course content, mutual expectations, and learning outcomes.

This course involves 2-hour weekly classes, scheduled Thursday 4-6 pm throughout the fall semester with office style tutorials on Tuesdays 4-6 pm, to discuss, clarify, and solve any problems that may arise with the course material and assignments. As a **fully online zoom course**, there is no in-person scheduled classroom time. Over the course of each week throughout the term, you are expected to attend the online zoom classes, read the PowerPoint class notes and relevant parts of the required text, supplement this reading with useful material in the recommended texts, participate in tutorial and oral presentations and submit assignments according to the due dates.

## ONLINE ZOOM COURSE SCHEDULE & RELEVANT SESSIONAL DATES:

DATES	TOPICS
September 5 <sup>th</sup>	Pre-Class Meet n' Greet Online
September 7 <sup>th</sup>	Class 1
September 14 <sup>th</sup>	Class 2 (Assignment 1 due)
September 21 <sup>st</sup>	Class 3 (Assignment 2 due)
September 28 <sup>th</sup>	Class 4
October 5 <sup>th</sup>	Class 5 (Assignment 3 due)
October 12 <sup>th</sup>	Class 6
October 19 <sup>th</sup>	Class 7
October 26 <sup>th</sup>	Class 8 (Assignment 4 due)
November 2 <sup>nd</sup>	Class 9
November 6 <sup>th</sup>	Last day to cancel the course without academic penalty
November 6-10 <sup>th</sup>	Reading Week (No Class)
November 16 <sup>th</sup>	Class 10 (Assignment 5 due)
November 23 <sup>rd</sup>	Class 11 (Assignment 6 due)
November 30 <sup>th</sup>	Class 12 (Last Lecture)
December 9-20 <sup>th</sup>	Final Assessment Period

## IV EVALUATION/GRADING SCHEME

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Assignment 1 – Due September 14 <sup>th</sup> Structure, Bonding, Properties in Materials Written Presentation	5%
Assignment 2 – Due September 21 <sup>st</sup> Materials that Changed the World and Why Written Presentation	10%
Assignment 3 – Due October 5 <sup>th</sup> Materials Chemistry Topics Video Oral Slide Presentation	13%
Assignment 4 – Due October 26 <sup>th</sup> Materials Innovation Research Project Video Oral Slide Presentation	12%
Assignment 5 – Due November 16 <sup>th</sup> Materials Art-Science Video Oral Slide Presentation	5%
Assignment 6 – Due November 23 <sup>rd</sup> Materials Project Written Presentation	25 or 30%*
Final Assessment – December Final Assessment Period	25 or 30%*
Total	100%

\*The assignment with the highest grade will be given the larger weight.

\*\*Graduate student performance on tests and assignments will be evaluated at a higher level than undergraduate students enrolled in this cross-listed course.

Note: if an unexpected technical issue occurs with a university system (e.g., Quercus services, network outage) that affects availability or functionality, it may be necessary to revise the timing or weighting of the assessments.

## V COURSE POLICIES

- Students are highly encouraged to attend a pre-class "**Meet n' Greet**" scheduled for **September 5<sup>th</sup>, 4 - 6 PM, on Zoom**. We will go over course content, etiquette and expectations.
- **Getting in touch:** please contact the course instructor with any questions about the course by email, Geoffrey Ozin: [g.ozin@utoronto.ca](mailto:g.ozin@utoronto.ca)
- The University of Toronto is committed to equity, human rights, and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. **We have the highest expectations from you all to act in a respectful manner towards your peers and colleagues.**
- This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session. Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. **Do not download, copy, or share any course or student materials or videos without the explicit permission of the instructor.** For questions about recording and use of videos in which you appear please contact your instructor.
- Submission for all assignments will take place on Quercus, with a penalty of 10% deducted for each day late.
- Students are responsible for informing the instructor and TA about any expected absences. In case of emergency it is vital to notify us as soon as possible so accommodations can be made.

## VI TECHNOLOGY REQUIREMENTS

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Specific guidance from the U of T Vice-Provost, Students regarding student technology requirements is available here: <https://www.viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/>

This course requires the use of computers, and of course sometimes things can go wrong when using them. You are responsible for ensuring that you maintain regular backup copies of your files, use antivirus software (if using your own computer), and schedule enough time when completing an assignment to allow for delays due to technical difficulties. Computer viruses, damaged hard drives, lost or corrupted files, incompatible file formats, and similar mishaps are common issues when using technology, and are not acceptable grounds for a deadline extension.

## VII INSTITUTIONAL POLICIES AND SUPPORT

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### ACADEMIC INTEGRITY

#### On Academic Integrity:

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (<https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019>) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In papers and assignments:

1. Using someone else's ideas or words without appropriate acknowledgement.
2. Submitting your own work in more than one course without the permission of the instructor.
3. Making up sources or facts.
4. Obtaining or providing unauthorized assistance on any assignment.

On tests and exams:

1. Using or possessing unauthorized aids.
2. Looking at someone else's answers during an exam or test.
3. Misrepresenting your identity.

In academic work:

1. Falsifying institutional documents or grades.
2. Falsifying or altering any documentation required by the University.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see <https://www.academicintegrity.utoronto.ca/>).

#### Use of Turnitin

Students will be required to submit their work to Quercus, which makes use of Turnitin.com for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site.

### ACCESSIBILITY NEEDS

Students with diverse learning styles and needs are welcome in this course. The University

of Toronto is committed to accessibility: if you require accommodations for a disability, or have any other accessibility concerns about the course, please contact [Accessibility Services](#) as soon as possible.

### **ADDITIONAL SERVICES and SUPPORT**

The following are some important links to help you with academic and/or technical service and support.

- General student services and resources at [Student Life](#)
- Full library service through [University of Toronto Libraries](#)
- Resources on conducting online research through [University Libraries Research](#)
- Resources on academic support from the [Academic Success Centre](#)
- Learner support at the [Writing Centre](#)
- Information for [Technical Support/Quercus Support](#)

### **COPYRIGHT**

Course videos and materials belong to your instructor, the University, and/or other source depending on the specific facts of each situation and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor. More information regarding this is available here: <https://teaching.utoronto.ca/ed-tech/audio-video/copyrightconsiderations>

### **ACCOMMODATIONS FOR RELIGIOUS OBSERVANCES**

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Following the University's policies, reasonable accommodations will be made for students who observe religious holy days that coincide with the due date/time of an assignment, tutorial, class or laboratory session. Students must inform the instructor before the session/assignment date to arrange accommodations.

### **ACKNOWLEDGEMENT OF TRADITIONAL LANDS**

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We wish to acknowledge this land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca and, most recently, the Mississauga's of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.