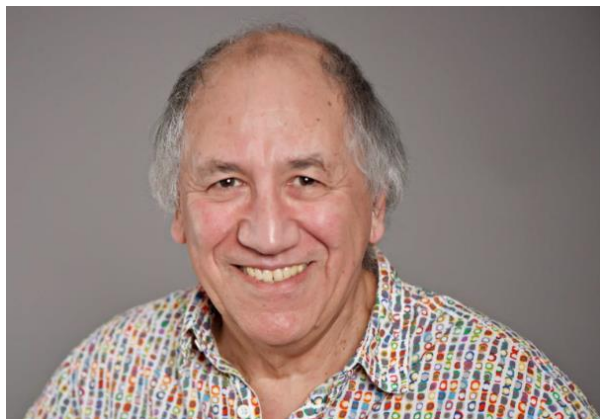


University of Toronto: Department of Chemistry

Course Syllabus

CHM 1206H: Advanced Materials Chemistry, Fall 2024

I CONTACTS



INSTRUCTOR

Geoffrey Ozin

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Website: www.nanowizard.info

Office: Room LM 326

Classes: In-Person WI Room 523 Thursday 4-6 pm

Office hour: Online Zoom Tuesday 4-5 pm

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. 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 six books: *Cryochemistry* (1976), *Nanochemistry: A Chemical Approach to Nanomaterials* (2006), *Concepts of Nanochemistry* (2009), *The Story of CO₂: Big Ideas for a Small Molecule* (2020), *Energy Materials Discovery Enables a Sustainable Future* (2022), *The Story of CH₄: Five Atoms that Changed the World* (2024). Co-founder of several Canadian spinoff companies Torrovap, Opalux, Solistra, and recipient of numerous prestigious national and international 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.

II COURSE OVERVIEW

COURSE DESCRIPTION:

This in-person cross-listed undergraduate-graduate course is designed as a follow-up to CHM 237H1 (Introduction to Inorganic Chemistry) with lectures on solid-state materials chemistry basics, CHM 338H1 (Intermediate Inorganic Chemistry) and CHM 355H1 (Polymer and Materials Chemistry), with lectures on synthesis-structure-property-function relations of selected classes of 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 and thriving sub-discipline of chemistry.

STUDENT LEARNING OUTCOMES:

The overarching 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 bulk and surface compositions and structures, dopants, defects and non-stoichiometry, textures and morphologies, tailored over multiple length scales and dimensionalities, with an emphasis on how to control the relations between structure, property, function and utility, geared towards a wide range of technologies. Specifically, a successful student will be able to:

1. Practice materials science with integrity and sensitivity to ethical, environmental, and social concerns, by committing to promoting diversity, equitable behaviour, academic rigour, and responsible leadership.
2. 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.
3. Apply quantitative and qualitative methods used in the instrumental analysis, evaluation, and interpretation of scientific data in the field of solid-state chemistry.
4. 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.
5. 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.

6. 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.

7. Work independently and collaboratively while exercising initiative, responsibility, and accountability in both personal and group contexts.

8. 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 338H1 which builds upon CHM 237H1, and CHM 355H1).

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

COURSE PLAN:

We will begin with a strongly recommended meet n' greet online, getting to know each other session, a look at the course content, assignments, tests and exams, mutual expectations, and learning outcomes.

This course involves 2-hour in person weekly classes, scheduled Thursday 4-6 pm throughout the Fall semester with online office hours on Tuesdays 4-5 pm, to discuss, clarify, and solve any problems that may arise with the course material and assignments. Over the course of each week throughout the semester, you are expected to attend the in-person 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 oral presentations and submit assignments according to the due dates. **Note that the classes will not be recorded plus your in-person attendance is extremely important in securing successful completion of the course.**

IN PERSON COURSE SCHEDULE, RELEVANT SESSIONAL DATES, ASSIGNMENT DUE DATES

DATES	TOPICS
September 3 rd	Pre-Class Meet n' Greet Online 4-6 pm
September 5 th	Class 1
September 12 th	Class 2 (Oral Assignment 1 due)
September 19 th	Class 3 (Oral Assignment 2 due)
September 26 th	Class 4
October 3 rd	Class 5 (Oral Assignment 3 due)
October 10 th	Class 6
October 17 th	Class 7
October 24 th	Class 8 (Oral Assignment 4 due)
November 4 th	Last day to cancel the course without academic penalty
November 7 th	Class 9
November 14 th	Class 10 (Oral Assignment 5 due)
November 21 st	Class 11 (Written Assignment 6 due)
November 28 th	Class 12 (Last Class)
December 4 th – 5 th	Study Break
December 6 th – 21 st	Final Exam Period

IV COURSE CONTENT LECTURE SCHEDULE

How does a solid-state chemist think – 1 hour

Synthesis, structure, property, function, utility relations – 1 hour

How and why solids react and why do we care – 2 hours

Classification of solid-state reactions – 4 hours

Portfolio of solid-state synthetic methods – 4 hours

Defect state, perfecting imperfection, functionality and use – 4 hours

Solid-state ionic conductivity, concepts, principles, applications – 4 hours

Non-stoichiometric materials, concepts, principles, applications – 4 hours

V EVALUATION/GRADING SCHEME

Assignment 1 – Due September 12 th	
Structure, Bonding, Properties in Materials Oral Poster Style Presentation	5%
Assignment 2 – Due September 19 th	
Materials that Changed the World and Why Oral Poster Style Presentation	10%
Assignment 3 – Due October 3 rd	
Materials Chemistry Topics Video Oral Slide Presentation	13%
Assignment 4 – Due October 24 th	
Materials Innovation Research Project Video Oral Slide Presentation	12%

Assignment 5 – Due November 14 th	
Materials Art-Science Video Oral Slide Presentation	5%
Assignment 6 – Due November 21 st	
Materials Project Written Assignment	25 or 30%*
Final Examination – December Final Exam Period	25 or 30%*
Total	100%

*The higher grade on Assignment 6 and the Final Examination will be given the larger weight.

**Oral and written assignments to be submitted on Quercus.

***Graduate student performance on tests and assignments will be evaluated following the University of Toronto, Governing Council University Assessment and Grading Practices Policy.

****Any use of AI in assignments is not permitted

*****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.

VI COURSE POLICIES

- Students are highly encouraged to attend a pre-class "**Meet n' Greet**" scheduled for **Tuesday September 3rd, 4 - 6 PM, on Zoom**. We will go over course content, etiquette and expectations.
- **Students are expected to attend in class the in-person lectures delivered in WI Room 523. Lectures will not be recorded.**
- **Getting in touch:** please contact the course instructor with any questions about the course by email, Geoffrey Ozin: 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.**
- Submission for all assignments on the dates stated in the course schedule table will take place on Quercus, with a penalty of 10% deducted for each day late.
- If you are absent from your studies due to illness or other reasons and unable to complete course work (e.g., a term test or an assignment) then a piece of written documentation is required. The following four items are the recognized forms of documentation:
 1. Absence Declaration via ACORN (please note the circumstances under which an absence declaration can and cannot be submitted)
 2. U of T Verification of Illness or Injury Form
 3. College Registrar's letter
 4. Letter of Academic Accommodation from Accessibility Services

Students who complete the ACORN Absence Declaration form must additionally contact me/the course coordinator/the course administrator to discuss their situation within five business days of the missed piece of work. This is essential action for any consideration to be granted.

For extended absences and for absences due to non-medical reasons, make sure to contact your College Registrar's Office. They can help you decide between a request for an extension or other types of academic consideration.

If you suspect or know that you have a disability that is affecting your studies, learn about the services and supports available through Accessibility Services. A disability can be physical disability, sensory disability, a learning disability, mental health disorder or a short-term disability like an injury. If you are not sure whether you have a disability, you can confidentially contact Accessibility Services with your questions.

VII TECHNOLOGY REQUIREMENTS

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.

VIII INSTITUTIONAL POLICIES AND SUPPORT

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 materials belong to your instructor, the University, and/or other source depending on the specific facts of each situation and are protected by copyright.

ACCOMMODATIONS FOR RELIGIOUS OBSERVANCES

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

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.