

# CHM327HF | EXPERIMENTAL PHYSICAL CHEMISTRY

## I CONTACTS

### Instructor



Name: Dr. Nicholas Kotoulas (he/him)  
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Dr. Nicholas Kotoulas is a postdoctoral fellow in the Department of Chemistry at the University of Toronto. He recently completed his Ph.D. in experimental physical chemistry in Prof. Cynthia Goh's lab with a focus on the development of two novel, rapid-capable techniques for bacterial detection: 1.) an adaptation of a diffraction-based technique for bacterial growth detection towards faster antibiotic susceptibility testing and 2.) the development of an original, rapid pathogen identification technique that harnesses the use of a novel fingerprint-like identifier. Throughout his (many) doctoral years, Nick has always had a passion for teaching and was awarded the Chemistry Teaching Fellowship Award in 2018, 2019, and 2021 to improve upon undergraduate lab curricula, which included the adaptation of the CHM327 laboratory to be completed entirely at home in the early years of the COVID-19 pandemic. Having recently submitted a patent, Nick's current focus beyond his research as a postdoctoral fellow is to develop a startup to produce a diagnostic device for rapid pathogen identification, in tackling the global challenge of antibiotic resistance. Outside teaching and research, Nick tries on a variety of hats (as he thinks his students should as well!) as a semi-professional vocal group co-director, photographer, avid gamer, and amateur gymnast.

### Teaching Assistants

Head TA:	Tomoyuki Sen	<a href="mailto:tomoyuki.sen@mail.utoronto.ca">tomoyuki.sen@mail.utoronto.ca</a>
TAs:	Jiaqi Gong	<a href="mailto:jiaqi.gong@mail.utoronto.ca">jiaqi.gong@mail.utoronto.ca</a>
	Rees Hughes	<a href="mailto:rees.hughes@mail.utoronto.ca">rees.hughes@mail.utoronto.ca</a>
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## II COURSE OVERVIEW

### Course Description:

In this course students are exposed to experiments that will help them experience modern physical chemistry. They will carry out labs designed to illustrate physicochemical principles as well as practical techniques while they explore experimental design and sharpen their skills in critical thinking.

At the end of the course, each student will be able to:

- Understand the basics of experimental design with regards to physical chemistry.
- Create a plan for designing an experiment to answer a question in physical chemistry.
- Design and construct a simple apparatus for measurement of a physical parameter, utilizing electronics components for data acquisition.
- Implement a project, including budgeting, sourcing, and scheduling.
- Analyze the results of an experiment and respond to unexpected results to make appropriate adjustments.
- Work individually and as part of a team to deliver on results.
- Have a mastery of a small aspect of physical chemistry by creating and implementing a project.

### **Prerequisite Courses:**

This course assumes that you have a basic understanding of concepts in physical chemistry at the second-year level, from thermodynamics to quantum mechanics.

Pre-requisites: CHM225Y/(CHM220H/222H, 221H/223H) with a minimum grade of 63%.  
Recommended co-requisites: CHM326H or CHM328H.

### **Classes:**

Weekly lectures will be held in person on Tuesdays from 1:10-2:00 pm at New College's Wilson Hall (WI) room 523 starting on September 12th.

### **Laboratories:**

The mandatory laboratories will be on Fridays weekly from 9:10 am- 1:00 pm and will be held in Lash Miller (LM) room 206 starting on September 22 (in-person Open Labs 2a).

### **Final Poster Presentations:**

The final ~~exam~~ poster presentations will be held on December 1st between 9:10 am and 1 pm.

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

This course is a single-semester (H) credit, with a weekly 1-hour lecture and a 4-hour lab. The first half of the course concentrates on providing you basic skills in experimental physical chemistry and guiding you towards design of your discovery lab project, while the second half is about implementing your project.

You are expected to participate in discussions during lectures, watch assigned videos, read the appropriate literature, meet with your teammates, and submit the required materials as needed.

The schedule is as follows:

DATES	WEEK	TOPIC/ACTIVITIES
Sept. 7 semester begins	1	<b>Complete initial course survey (on Quercus) by Sept. 12</b>
Sept. 12 lecture	2	Course introduction, physical parameters and basics of experimental design
Sept. 15 lab		<b>(online, not in-person)</b> Open Labs #1: introductions to microscopy (AFM, SEM), spectroscopy, and optics <b>Complete Quiz 1 (on Quercus) by Sept. 19</b>
Sept. 19 lecture	3	Paper critique (discussion - small groups in lecture)
Sept. 22 lab		Lab orientation and safety. Open Labs #2a: building a simple apparatus/sample preparation - measuring contact angle
Sept. 26 lecture	4	Building an instrument; experimental design and mini projects
Sept. 29 lab		Open Labs #2b: basic electronics, sensor set-up, data acquisition
Oct. 3 lecture	5	Designing discovery lab projects and the research proposal
Oct. 6 lab		Open Labs #2b (continued): complete your mini projects in lab. <b>Submit the Open Labs #2b report by Oct. 17</b> Discuss discovery lab project proposals
Oct. 10 lecture	6	Following through with your experiment goals, record keeping and troubleshooting
Oct. 13 lab		Presentation of initial discovery lab proposals (interactive, 5 minutes per team) Teams should have met with the course instructor for project discussion and approval in weeks 5 or 6 <b>Submit requests for materials by lab end</b>
Oct. 17 lecture	7	Special topic 1 (based off course survey/discovery lab projects)
Oct. 20 lab		Discovery Labs Week 1
Oct. 24 lecture	8	Special topic 2 (based off course survey/discovery lab projects)
Oct. 27 lab		Discovery Labs Week 2
Oct. 31 lecture	9	Group Meeting Round 1 (split lecture) <b>Submit the interim report by Nov. 3</b>
Nov. 3 lab		Discovery Labs Week 3
Nov. 6-10	10	Reading week - no classes, make-up lab (depending on absences)
Nov. 14 lecture	11	Group Meeting Round 2 (split lecture)
Nov. 17 lab		Discovery Labs Week 4
Nov. 21 lecture	12	Discovery Labs final week breakdown, data analysis, preparing an effective poster
Nov. 24 lab		Discovery Labs Week 5
Nov. 28 lecture	13	Applications of experimental physical chemistry: research at the cutting edge
Dec. 1 Final Poster Presentations		Final poster presentations (location TBD) during lab hours <b>Final report and lab notebooks due Dec. 6</b>

### Lecture Objectives:

While this is a lab course, the lectures are essential – it is where you will get introduced to the important background information in experimental physical chemistry, from considerations of the design of experiments all the way to data analysis and presentation. The lectures are meant to be interactive and thought provoking, with occasional breakout sessions into smaller groups for discussion.

## Laboratory Objectives:

The first objective of this course is to introduce you to the experimental aspects of physical chemistry, by carrying out experiments that you yourself have a hand in planning. Physical chemistry is a very broad field, and we do not expect you to master all of it, but we expect you to master a small aspect by creating and implementing a project. You are also expected to develop your ability to work with others and to plan and manage a project, including budgeting, dividing work, and making decisions. Attendance and participation are a must. You will be marked based on what you have learned scientifically, but also the development of critical thinking and problem-solving skills. Experiments do not always work, and we are less interested in your accumulating lots of data than in your developing an ability to analyze and to respond to the unexpected.

The TAs in the course are there to provide support and advice. They can make suggestions, but they are not supposed to tell you what to do unless you are way off base or are going to engage in unsafe activities. The TAs will conduct regular one-on-one interviews to be able to help you, as well as to assess your progress. The course instructor and the TAs have student hours you can use for consultation.

Your Discovery Lab project will be completed in teams of four. You may find that it is better to further subdivide the work, but that is your call; one of our objectives is for you to explore and learn how to work together efficiently as a team. The project planning will begin relatively early in the course so that when the Discovery Labs begin, you will hit the ground running. You can use our Discord server, or create your own, to facilitate discussion.

## IV EVALUATION/GRADING SCHEME

<b>Paper critique</b>		<b>5%</b>
<b>Open labs:</b>		<b>30%</b>
<i>Open lab 1 (quiz)</i>	3%	
<i>Open lab 2 (report, performance)</i>	27% (9, 6x3)	
<b>Discovery labs:</b>		<b>60%</b>
<i>Proposal</i>	5%	
<i>Lab performance (individual)</i>	25% (5x5)	
<i>Interim report (individual)</i>	8%	
<i>Final poster presentation (team)</i>	10%	
<i>Final report and lab notebook (individual)</i>	12% (10, 2)	
<b>Class participation / quizzes</b>		<b><u>5%</u></b>
	<b>TOTAL</b>	<b>100%</b>

**Penalty for late submissions: 5% per day**

**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

- Each member of this course is expected to maintain a:
  - a) professional and respectful attitude during all course activities, including classes, laboratories, and online activity.
  - b) personal calendar/schedule/organizer to ensure that all course activities are completed, and due dates are met.
  - c) collection of notes recorded independently based on concepts covered in course activities (students registered with Accessibility Services requiring a class note-taker will have access to this accommodation)
  - d) familiarity with the university policy on Academic Integrity (overleaf)
  
- 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. As a Course Instructor, I will neither condone nor tolerate behaviour that undermines the dignity or self-esteem of any individual in this course and wish to be alerted to any attempt to create an intimidating or hostile environment. It is our collective responsibility to create a space that is inclusive and welcomes discussion. Discrimination, harassment and hate speech will not be tolerated. If you have any questions, comments, or concerns, we encourage you to reach out to the staff in our Equity Offices.
  
- 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.

- Students may use artificial intelligence tools, including generative AI, in this course as learning aids or to help produce assignments. However, students are ultimately accountable for the work they submit.
- The contents of the course website, including videos, manuals, presentations, etc. are to be viewed or downloaded only for your personal use in this course. Do not distribute.
- Communication with instructor: If you want to contact me, you can do so by email or by direct message on Discord. For email, make sure you include CHM327 in the subject line so I can easily notice it. I will respond to reasonable email questions within 24 hrs on weekdays. For simple questions and discussions that can be addressed by anyone (your peers, TAs), you are encouraged to use the discussion and text channels on Discord.
- My official office hours are Wednesdays from 2-3 pm, on Discord or in person (LM 504). However, if you see me in my Discord office (voice channel) at other times – that means my ‘door’ is ‘open’, and you can feel free to drop by and chat.
- Deadlines for assignment submissions and late policy: 5% will be deducted daily.
- Missing class: this is a lab course, and presence during the lab sessions is essential. The TAs and I will visit with you (online or in person) during the lab hours. If you miss a lab period due to a valid reason, talk to me about how to make it up. Otherwise, you will receive zero for that day.
- Submission methods: use Quercus to submit all written reports.
- Request for any re-grading of course work: put your arguments in writing. If a piece of work is submitted for regrading, the whole work will be re-graded.

## **VI TECHNOLOGY REQUIREMENTS**

- Specific guidance from the U of T Vice-Provost, Students regarding student technology requirements is available here: <https://www.vicprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/>
- Advice for students writing online assessments (quizzes etc.): <https://studentlife.utoronto.ca/task/online-exams-and-tests/>
- This course requires the use of computers, and technical issues are possible. When working on a piece of academic work, students are responsible for scheduling enough

time to allow for reasonable delays due to technical difficulties to be overcome, so such issues will not be acceptable grounds for deadline extension. Particularly, maintaining an up-to-date independent backup copy of your work is strongly recommended to guard against hard-drive failures, corrupted files, lost computers, etc.

## VII INSTITUTIONAL POLICIES & SUPPORT

### **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 ([governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019](http://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 reports:

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 report. **Please note that the use of websites (such as Chegg.com or the course discussion board) to post laboratory report material/questions or to post/access answers to questions is an academic offence under the University of Toronto's Code of Behaviour on Academic Matters. Alleged instances of this nature are forwarded to the Faculty of Arts & Science Student Academic Integrity office.**

On quizzes:

1. Using or possessing unauthorized aids.
2. Looking at someone else's answers or collaborating/discussing answers during a quiz unless explicitly allowed by the instructor (such as in group work).
3. Misrepresenting your identity.

In general 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 [www.academicintegrity.utoronto.ca/](http://www.academicintegrity.utoronto.ca/))

### **Use of Turnitin:**

Normally, students will be required to submit their written reports to 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.

### **Copyright:**

If a student wishes to copy or reproduce lecture presentations, course notes or other similar materials provided by instructors, he or she must obtain the instructor's written consent beforehand. Otherwise, all such reproduction is an infringement of copyright and is absolutely prohibited. More information regarding this is available here: <https://teaching.utoronto.ca/ed-tech/audio-video/copyright-considerations/>

### **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.

### **Accommodation 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.

### **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](#)

### **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 Mississaugas 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.