

**DEPARTMENT OF PHYSICS
UNIVERSITY OF TORONTO MISSISSAUGA**

**PHY332H5F LEC0101
Molecular Biophysics
Course Outline - Fall 2023**

Class Location & Time	Wed, 01:00 PM - 03:00 PM MN 2150
Instructor	Claudiu Gradinaru
Office Location	DV4051
Office Hours	M 12-1, F 12-1
Telephone	9058283833
E-mail Address	claudiu.gradinaru@utoronto.ca
Course Web Site	https://q.utoronto.ca

Course Description

A physicist's perspective on the building blocks of the living world. Topics may vary but will include: levels of structural complexity in biomolecules, molecular thermodynamics, molecular forces, the stability of biological structures, and the interaction of radiation with molecules. A rigorous treatment of commonly used biophysical techniques, such as calorimetry, optical spectroscopy, light/X-ray/neutron scattering, and single-molecule methods, will be accompanied by research applications.

Prerequisite:

PHY241H5 and PHY255H5 and JCP221H5

Corequisite:

JCP321H5

Exclusion: PHY331H1 (SCI)

Distribution Requirement: SCI

Course Learning Outcomes

On successful completion of the course, you will be able to:

1. Describe the molecular forces that determine biological structures
2. Explain how thermodynamics concepts, such as free energy, entropy, stability, apply to biological molecules and processes
3. Explain how radiation (light, X-rays) scatter off biomolecules and extract size and shape information
4. Describe how basic concepts in quantum mechanics apply to atoms and molecules
5. Use quantum mechanics to determine the energy levels of simple molecules and the transitions between them
6. Describe how molecules absorb light and explain the main physical properties associated with this process using quantum mechanics
7. Explain the basic principles of emission of light (fluorescence) and connect molecular structure and interactions to fluorescence properties such as lifetime, quantum yield, and polarization anisotropy.
8. Describe the process of resonance energy transfer (FRET) and its use to determine distances on the nanometer scale.

Textbooks and Other Materials

Textbook:

Walla, P.J., *Modern Biophysical Chemistry* (2nd ed., 2014), Wiley VCH

Recommended Reading(s):

Cantor C.R. & Schimmel P.R., *Biophysical Chemistry: Part II: Techniques for the Study of Biological Structure and Function* (1980), W.H. Freeman

Assessment and Grading

Type	Description	Due Date	Weight
Assignment	Problem set #1	2023-09-28	8%
Assignment	Problem set #2	2023-08-16	8%
Assignment	Problem set #3	2023-10-27	8%
Assignment	Problem set #4	2023-11-09	8%
Assignment	Problem set #5	2023-11-23	8%
Presentations	Oral presentation of a biophysics research article	2023-12-01	20%
Final Exam	Final exam - 2 hours consisting of problems covered in tutorials/assignments	TBA	40%
Total			100%

Procedures and Rules

Missed Term Work and Tests, Late Penalties, Absence Declarations, and Petitions for Special Consideration

Penalties for all term work missed or otherwise submitted late is as described in the text that follows unless valid and documented reasons exist for special consideration. Students may submit a petition for special consideration **within one week** of the due date of the missed item of term work or date of the missed test. Petitions for special consideration may be made by e-mail to the Course Instructor, from a valid University of Toronto (UofT) e-mail account. Students must also successfully complete an online absence declaration *via* [ACORN](#) and provide the Course Instructor with a confirmation of this declaration (*e.g.* a screenshot) in their petition for special consideration, which contains their student name, student number, absence dates, and confirmation number. Note that [ACORN](#) absence declarations must be recorded for each day that you are absent - as soon as it begins up until the day you return to your classes or other activities. The [ACORN](#) absence declaration tool lets you record absences for up to 14 consecutive days, one of which must be the day you access the tool (if you are still absent) or the day prior (if you have returned). If you need to record an absence outside of this range, please contact the Office of the Registrar. More information about Absence Declarations can be found [here](#).

In all cases, petitions for special consideration should be based on illness or other extenuating circumstances, which are beyond one's reasonable control. Note that reasons such as vacations, family events, wedding attendance, lack of preparation, technology failure, extra-curricular commitments, and academic work in other courses are not considered to constitute extenuating circumstances beyond a student's reasonable control. If not for reasons of illness, in addition to your [ACORN](#) absence declaration, your petition for special consideration must contain supporting documentation, which can include a [U of T Verification of Extenuating Circumstances](#) form, automobile collision or police reports, a death certificate, and supporting documentation from employers, lawyers and other professional persons. Supporting documents can be submitted electronically as an attachment in your e-mail to the Course Instructor. These attachments can include screenshots, photographs, and/or scans of physical documents. Please ensure the electronic documents are legible and also ensure that you retain the original copies of all documents submitted in case you are asked to present them later. The supporting documentation included in your petition must specify the exact period that you were unable to complete your term work or term test for it to be considered. The Course Instructor will inform the student by e-mail (as per the Communications Policy herein) whether special consideration is granted following due diligence on the documentation provided. Note that false statements and/or documentation will be treated as academic offences and handled accordingly.

The penalty for late submission of assignment work is a **10% deduction in the final mark per day** that the work is late. A late penalty may be waived provided that a request for special consideration is made and granted by the Course Instructor as described above.

If a student misses the oral presentation assignment, a mark of **zero (0%)** will be assigned unless a request for special consideration is made and granted by the Course Instructor as described above. In such a case, there will be no make-up assignments and the mark value of the oral presentation will be re-assigned equally to each assignment (*i.e.*, each assignment will be worth an additional 4% of the total mark for the course, *e.g.* 12 % from 8 %).

Re-evaluation Requests

Requests for re-evaluation of an article of term work (e.g. assignment, oral presentation) must be made in writing **within 1 month** of the return of the article of term work and include a brief explanation as to why the request is being made. Term work submissions can be written in pencil; however, re-marking of term work written in pencil is not permitted. Similarly, articles of term work on which correction media has been used will be exempt from re-evaluation. Re-evaluation requests must be made to the same person that did the initial grading of the article of term work. Note that the final mark assigned to a re-evaluated article of term-work may go up or down based on the outcomes of re-evaluation (in whole or in part, at the discretion of the marker). Disputes in grading subsequent to re-evaluation by the original marker may be brought forward to the Course Instructor for final adjudication. You, as a UTM student, have the right to appeal a mark beyond the Course Instructor only if the term work in question is worth at least 20% of the course mark.

Missed Final Exam

Students who cannot complete their final examination due to illness or other serious causes must file an [online petition](#) **within 72 hours of the missed examination**. Late petitions will **NOT** be considered. Upon approval of a deferred exam request, a non-refundable fee of \$72 is required for each examination approved.

Laboratory Safety Training

N/A

Laboratory Conduct: Expectations, Roles, and Responsibilities.

N/A

Communications Policy

Students are welcome and encouraged to meet with the Course Instructor during the posted office hour(s). Note that virtual office hour visits will not be recorded. Visits outside of the regularly scheduled office hour(s) can be made by appointment. Correspondence by e-mail is also acceptable. In all e-mail correspondence regarding this course, please note the following:

1. Please send e-mail only from your @utoronto.ca or @mail.utoronto.ca account.
2. In the Subject line of your message, please include the course code and a brief description of the topic, e.g. "[Course code] - Request for an appointment regarding potentiometry".
3. Please include your full name and student number in all correspondence.
4. Please consult the course syllabus and course website before sending questions by e-mail

I will endeavour to respond to e-mail within two workdays at the latest. Students are responsible for all information posted to the course [Quercus site](#) and e-mails sent by the Course Instructor.

Student Technology Requirements and Connection Tools

This is an in-person course, there is no online component.

Privacy and Use of Course Materials

All course materials belong to the Course Instructor, the University, and/or other sources (depending on the specific facts of each situation) and are protected by copyright. In this course, you are permitted to download 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 Course Instructor.

In the event of a mandated switch to remote course delivery, 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. 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. For questions about recording and use of videos in which you appear please contact your instructor.

Information Security Risks

If you are a citizen of another country, and/or accessing your courses at the University of Toronto from a jurisdiction outside of Canada, please note that you may be subject to the laws of the country in which you are residing, or any country of which you have citizenship. The University of Toronto has a long-established commitment to freedom of expression, with this right enabled by an environment valuing respect, diversity, and inclusion. In your classes, you may be assigned readings, or discuss topics that are against the law in other jurisdictions. I encourage you to become familiar with any local laws that may apply to you and any potential impact on you if course content and information could be considered illegal, controversial, or politically sensitive. If you

have any concerns about these issues, please contact your instructor directly to discuss with them

Academic Integrity

UTM wishes to remind students that they are expected to adhere to the [Code of Behaviour on Academic Matters](#) regardless of the course delivery method (*i.e.* in-person or online). Potential academic offences include, but are not limited to:

- Using or possessing an unauthorized aid or aids or to obtain unauthorized assistance in any academic examination or term test or in connection with any other form of academic work. Use of unauthorized aid(s) and unauthorized assistance includes working collaboratively, in-person or online, with others on assessments that are expected to be completed individually, in addition to accessing unauthorized resources (search engines, chat rooms, Reddit, *etc.*) for assessments completed online.
- Representing as one's own, any idea or expression of an idea or work of another in any academic examination or term test or in connection with any other form of academic work, *i.e.* to commit plagiarism.
- Submitting, without the knowledge and approval of the instructor to whom it is submitted, any academic work for which credit has previously been obtained or is being sought in another course or program of study in the University or elsewhere.
- Submitting any academic work containing a purported statement of fact or reference to a source which has been concocted.

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](#).

Normally, students will be required to submit their course essays to the University's plagiarism detection tool 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 tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (<https://uoft.me/pdt-faq>).

Students are permitted opt-out of using the University's plagiarism detection tool and notice of this decision must be delivered to the Course Instructor no later than the end of day on which the first class meeting occurs. This notice should be provided *via* email, as per the communication policy specified herein. In such a case, you may be asked to submit all of your rough work for an assignment and you may be required to have a short meeting with the Course Instructor to discuss your research methodology.

Academic Rights

You, as a student at UTM, have the right to:

- Receive a syllabus by the first day of class.
- Rely upon a syllabus once a course is started. An instructor may only change marks' assignments by following the University Assessment and Grading Practices Policy provision 1.3.
- Refuse to use the University's plagiarism detection tool (you must be offered an alternative form of submission).
- Have access to your Instructor for consultation during a course or follow up with the Department Chair if the Instructor is unavailable.
- Receive at least one significant mark (15% for H courses, 25% for Y courses) before the last day you can drop a course for H courses, and the last day of classes in the first week of January for Y courses taught in the Fall/Winter terms.
- Submit handwritten essays so long as they are neatly written.
- Have no assignment worth 100% of your final grade.
- Not have a term test worth 25% or more in the last two weeks of class.
- Retain intellectual property rights to your research.
- Receive all your assignments once graded.
- View your final exams. To see a final exam, you must submit an online Exam Reproduction Request within 6 months of the exam. There is a small non-refundable fee.
- Privacy of your final grades.
- Arrange for representation from Downtown Legal Services (DLS), a representative from the UTM Students' Union (UTMSU), and/or other forms of support if you are charged with an academic offence.

Inclusivity Statement

You belong [here](#). The University of Toronto commits to all students, faculty, and staff that you can learn, work, and create in a welcoming, respectful, and inclusive environment. In this class, we embrace the broadest range of people and encourage their diverse perspectives. This team environment is how we will innovate and improve our collective academic success. You can read the evidence for this approach [here](#).

We expect each of us to take responsibility for the impact that our language, actions and interactions have on others. The

Department of Chemical and Physical Sciences (CPS) denounces discrimination, harassment and unwelcoming behaviour in all its forms. You have rights under the [Ontario Human Rights Code](#). If you experience or witness any form of harassment or discrimination, including but not limited to, acts of racism, sexism, Islamophobia, anti-Semitism, homophobia, transphobia, ableism and ageism, please tell someone so that we can intervene. CPS takes these reports extremely seriously. You can talk to anyone you feel comfortable approaching, including your professor, teaching assistant, technician, an [academic advisor](#), our [Chairs](#), members of our [Equity, Diversity and Inclusivity Committee](#), or any staff member at our [Equity, Diversity & Inclusion Office](#).

You are not alone. Working together, we can all achieve our full potential.

Course Code of Conduct and Expectations

Each member of this course is expected to maintain:

- A professional and respectful attitude during all course activities, including lectures, labs, and online activity.
- A personal calendar/schedule/organizer to ensure that all course activities are completed and due dates are met.
- Backup copies of all work. Electronic backups should be maintained (ideally in real time) to circumvent technology failures that would otherwise prevent completion of assignments on time. Note that all UofT students are provided with 1 TB of cloud-based storage on the Office365 OneDrive platform (hosted by Microsoft Canada). All students are encouraged to maintain a live backup copy of their work using this secure, cloud-based platform.
- A collection of class notes recorded independently based on concepts covered in lectures and labs (students registered with Accessibility Services requiring a class note-taker will have access to this accommodation).
- Familiarity with the University's policy on Academic Integrity (see: the section entitled Academic Integrity, above, and the [Code of Behaviour on Academic Matters](#)).
- Familiarity with the [University policy on Conflict of Interest and Close Personal Relationships](#). Note that a conflict of interest arises when your personal interests conflict with your responsibilities as a student of the University. For example, if you have, or have had, a familial, sexual, or otherwise close relationship with a member of the teaching staff, you will almost inevitably be in a conflict-of-interest situation, which may affect your academic performance. Please disclose any potential conflicts-of-interest to the Course Instructor and/or Department Chair as soon as possible.
- Familiarity with the [University policy on Sexual Violence and Sexual Harassment](#). Note that sexual violence is any sexual act or act targeting a person's sexuality, gender identity or gender expression, whether the act is physical or psychological in nature, that is committed, threatened or attempted against a person without the person's consent. All members of the University community should have the ability to study, work, and live in an environment free from sexual violence and sexual harassment.

Equity Statement

The University of Toronto is committed to equity and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect. 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, you may contact the UTM Equity and Diversity officer at edo.utm@utoronto.ca or the University of Toronto Mississauga Students' Union Vice President Equity at ypequity@utmsu.ca.

Accommodations for Learning Needs

The University of Toronto Mississauga supports accommodations for students with diverse learning needs, which may be associated with mental health conditions, learning disabilities, autism spectrum, ADHD, mobility impairments, functional/fine motor impairments, concussion or head injury, blindness and low vision, chronic health conditions, addictions, deafness and hearing loss, communication disorders and/or temporary disabilities, such as fractures and severe sprains, or recovery from an operation.

If you have a learning need requiring an accommodation, we recommend that students register as soon as possible with [Accessibility Services](#).

Phone: (905) 569-4699

Email: access.utm@utoronto.ca

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, lab session, or lecture. Students must inform the instructor **before** the session/assignment date to arrange accommodations.

Mental Health

As a university student, you may experience a range of health and/or mental health challenges that could result in significant barriers to achieving your personal and academic goals. Please note, the University of Toronto (St. George and Mississauga campuses) offer a wide range of free and confidential services that could assist you during these times.

As a CPS student, you have an [Academic Advisor](#) who can support you by advising on personal matters that impact your academics. Other resources include:

- [Accessibility Services](#)
- [Health & Wellness](#) (St. George)
- [Health & Counselling Centre](#) (UTM)
- [My Student Support Program \(MySSP\)](#)
- [Good2Talk Student Helpline](#)
- [Navi](#)

If you find yourself feeling distressed and in need of more immediate support resources, consider reaching out to the counsellors at [My Student Support Program \(MySSP\)](#) or visiting the [Feeling Distressed webpage](#).

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 the Mississaugas of the Credit. 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.

Final Exam Information

Duration: 2 hours

Other Information

Lecture Topics

The following table provides a **tentative list** of the topics to be covered during the various lecture and tutorial sessions throughout the term. Students are responsible for all topics covered, even if they are unable to attend a lecture or tutorial session. In such an event, students are encouraged to read through the materials posted on Quercus, read the related chapters of the textbook, get in touch with a classmate and/or visit the Course Instructor during Office Hours to ensure that you are prepared for any test, discussion or exam questions related to the topic in question.

1. Biological Macromolecules: conformations, configurations, and levels of structural complexity
2. Molecular Thermodynamics: molecular forces, energy, entropy and the stability of biological structures.
3. Biophysical Methods - theory and experiment:
 - - interaction of light with molecules, a quantum mechanical framework
 - absorption and fluorescence spectroscopy
 - polarized light - linear and circular dichroism
 - scattering techniques (light, X-ray, neutron)
 - single-molecule methods

Last Date to drop course from Academic Record and GPA is November 6, 2023.