
University of Toronto at Mississauga

Optics (PHY347H5S)
Course Information

Winter 2023

Course Specifics

Course Instructor:

Prof. Claudiu Gradinaru
Phone: (905) 828-3833
E-mail: claudiu.gradinaru@utoronto.ca

Lectures: Tuesday, 1 – 3 pm in MN2130
Tutorials: Thursday, 1 – 3 pm in IB370 (alternating with labs)
Labs: Thursday, 1 – 4 pm in DV1109 (alternating with
tutorials)
Office Hours: Tuesday, 3 – 4 pm (instructor) in DV4051
30 min./week for each TA (exact time/place TBA)

Teaching Assistants:

Mr. Zhou – Section #1
Email: xh.zhou@mail.utoronto.ca
Office Hours: TBA

Mr. Mirsanaye – Section #2
Email: kamdin.mirsanaye@mail.utoronto.ca
Office Hours: TBA

Technical Staff:

Mr. Dan Reynolds
Email: dan.reynolds@utoronto.ca

Textbook:

Optics, 5th ed. (2016), Eugene Hecht, Pearson

Supplementary material:

Introduction to Optics, 3rd ed. (2006), Pedrotti et al, Pearson

Course Description

This course focuses mainly on providing a strong foundation of wave optics, while also presenting and an introduction to modern optics and the quantum nature of light. The topics in this course may vary but will include: electromagnetic waves and the propagation of light, basic coherence concepts and the interference of light, Fraunhofer and Fresnel diffraction, polarization, laser principles and the blackbody radiation. The students will have the opportunity to put to

practice the optical principles learned during the lectures by performing laboratory experiments on various optical devices and systems. [24L, 15P, 12T]

Prerequisite: PHY241H5 and PHY245H5 and MAT232H5 and MAT244H5

Exclusion: PHY385H1

Learning Outcomes

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

1. Describe the basic concepts of electromagnetic waves and the corpuscular nature of light.
2. Identify and illustrate physical concepts and terminology used in optics and explain them in appropriate detail.
3. Apply equations and laws pertaining to optics and the physics of light to obtain quantitative solutions to problems in optics.
4. Become familiar with optics laboratory experiments and procedures, perform a series of optics experiments and report their findings.
5. Assemble optical components on an optical bench
6. Use measuring methods based on interferometry and spectrometry
7. Analyze and interpret results of lab experiments
8. Understand the basics of coherence theory, and apply concepts such coherence time and length, and partial coherence.
9. Understand the origin of blackbody radiation, the spectrum of the Sun and of other light sources
10. Use lasers and explain their components, operation, properties, and applications

Marking Scheme

Type	Description	Due Date	Weight
Assignments	4 problems sets, submitted and graded on Crowdmark, each worth 5%	On-going	20%
Lab Reports	5 lab reports based on experimental data acquired in person, submitted and graded on Crowdmark, each worth 6%	On-going	30%
Term Test	Two-hour test consisting of problem sets	Feb. 16, 2023	20%
Final Exam	Two-hour test consisting of problem sets	TBD, Apr. 12-23, 2023	30%
Total			100%

Course Outline

The following list provides an overview of the topics covered in PHY347 during the 2023 winter term, with corresponding chapters from the textbook (Hecht). A more detailed lecture schedule will be posted on the course website at the beginning of the term. Students are responsible for all topics covered, even if they are unable to attend a lecture or a tutorial session. In such an event, students are encouraged to read through the materials posted on Quercus (lecture notes and recordings, tutorial materials, lab manuals), read the related chapters of the textbook, get in touch with a classmate and/or visit the Course Instructor and the Teaching Assistants during Office Hours to ensure that they are prepared for the assignments and tests that may include the topic in question.

1. **Waves Refresher:** different waves, superposition/summation, phase/group velocity
Chapter 2: 2.1 – 2.9
Chapter 7: 7.1, 7.2
2. **Basic Electromagnetic Theory:** Maxwell Equations, Energy, Irradiance, Radiation Spectrum
Chapter 3: 3.1 – 3.3 (except 3.3.4), 3.5 (up to Scattering), 3.6
3. **Propagation of Light:** Fermat principle, Fresnel equations, Total Internal Reflection
Chapter 4: 4.5 – 4.7
4. **Polarization of Light:** birefringence, optical activity, Jones vectors, applications
Chapter 8: 8.1(except 8.1.5), 8.2 – 8.7, 8.10, 8.11
5. **Interference of Light:** wavefront- & amplitude-splitting, thin films, multi-beam, Michelson
Chapter 9: 9.1 – 9.4, 9.6 (up to 9.6.1)
6. **Basic Coherence Theory:** temporal, spatial, partial/degree of coherence, applications
Chapter 12
7. **Diffraction of Light:** Fraunhofer, Fresnel, circular/rectangular apertures, gratings, Cornu spiral
Chapter 10: 10.1 – 10.3 (except 10.3.6, 10.3.11)
8. **Photons, Blackbody, Lasers:** Planck/Wien/SB, Einstein coefficients, Laser concepts/operation
Chapter 13: 13.1 and Ch. 26 (26.1 – 26.4) from Pedrotti

Tutorials and Labs

Regarding tutorials and labs, the course will have two sections, each managed by a different TA. Labs and tutorials will be offered in person each week except the first week of classes, when a lecture will be offered instead. The two sections will have alternating labs and tutorials each week, starting with the second week. A detailed schedule of the labs and tutorials will be posted on the course website on Quercus. Team selection and lab assignments for each team will be finalized during the first week of classes by the Laboratory Coordinator.

Midterm Test

The in-person midterm test will be 2 hours in length and will take place during regularly scheduled TUT/PRA periods, starting at precisely 1:00 pm on Thu. Feb. 16th 2023. There may be a switch to online test writing in the event that a switch to online course delivery is mandated. Detailed instructions on how to access and complete online term tests will follow *via* the course Quercus site should such an event manifest.

Final Exam

The in-person final exam will be 2 hours in length, cumulative, and be scheduled during the final examination period of the winter term. All final exam policies and regulations will be those set by the Office of the Registrar.

Important Course Dates (Winter 2023)

<i>First lecture:</i>	Tue. Jan. 10
<i>First lab or tutorial:</i>	Thu. Jan. 19
<i>First assignment:</i>	Thu. Jan. 26
<i>Midterm test:</i>	Thu. Mar. 2
<i>Last assignment:</i>	Thu. Mar. 30
<i>Last lecture:</i>	Tue. Apr. 4
<i>Last lab/tutorial:</i>	Thu. Apr. 6

Additional Dates of Significance (Winter 2023):

<i>January 22:</i>	Last day to drop an S course on ACORN and receive 100% course fee refund, as long as you are still registered in other courses for this session.
<i>February 20–24:</i>	Reading Week
<i>March 19:</i>	Last day to drop a S course from your academic record and GPA.
<i>April 6:</i>	Classes end for Y and S courses. Last day to request Late Withdrawal After the Drop Date (LWD) or to request/cancel Credit/No Credit for Y and S courses.
<i>April 12-23:</i>	Final exam period.

Missed Term Work, Late Penalties and 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.

If a student misses the midterm test, a mark of **zero (0%)** will be assigned, unless a request for special consideration is made and granted by the Course Instructor. In the case that special consideration is granted, the mark value of the missed test will be re-assigned equally to each assignment (*i.e.*, each assignment will be worth an additional 5% of the total mark for the course, *e.g.* 10 % from 5%).

The penalty for late submission of term work (lab reports, assignments) 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 as described above.

If a student misses a laboratory session, a mark of **zero (0%)** will be assigned for that experiment and associated term work, unless a request for special consideration is made and granted as described above. In the case where special consideration is granted, the mark value of the laboratory or discussion will be re-assigned to a make-up laboratory session. Two make-up laboratory sessions will be held in person during the term, under the supervision of the lab coordinator at dates TBD.

Re-evaluation Requests

Requests for re-evaluation of an article of term work (*e.g.*, test, assignment, laboratory report, *etc.*) 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 applied 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 (normally, this is a Teaching Assistant). 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.

Laboratory Conduct: Expectations, Roles, and Responsibilities.

Students and all members of the teaching team (*i.e.* the Teaching Assistant(s) and Laboratory Coordinator(s)) have specific roles and responsibilities in the effective and efficient operation of the laboratory. Students are expected to adhere to all safety rules and to come to the lab prepared. Preparation includes a thorough review of the laboratory manual and associated theory related to the laboratory work to be conducted (notes and flowcharts in your laboratory notebook are highly recommended), review of all required standard operating protocols (SOPs) for use of instrumentation, completing calculations beforehand (*e.g.* reagent masses and solution volumes), and completion of all assigned pre-laboratory exercises. Students who fail to come to the laboratory prepared, show a lack of preparedness during the laboratory, and/or violate laboratory safety protocols will be asked to leave the laboratory and a mark of **zero (0%)** will be assigned for that experiment and associated term work (*e.g.* the associated laboratory report).

A laboratory skill and preparation grade will be assigned for each laboratory session and will be based on an evaluation of the organization and completeness of each student's laboratory notebook, their conduct in the laboratory (including the overall condition of their workspace throughout the laboratory and clean-up beginning with enough time remaining to finish prior to the end of the laboratory session, which is generally at least 15 minutes), submission of pre-laboratory assignments and signed Standard Operating Protocols (SOPs), and their ability to answer questions based on the laboratory work. Note that there will be an immediate mark deduction of **10%** in the grade of a laboratory assignment in which a student fails to clean-up their workspace and leave it in the same condition as found at the beginning of the laboratory before the laboratory period ends.

Questions will inevitably arise during laboratory sessions and knowing whom to ask for assistance with specific matters will help resolve issues expediently. Questions related to teaching (*e.g.* grading, theory, experiment difficulties, *etc.*) should be directed to your Teaching Assistant. Any questions related to the availability and locations of reagents/supplies and proper waste disposal should be directed to the Laboratory Coordinator. The Laboratory Coordinator is also the person that can provide assistance in cases where equipment/instrumentation is not working correctly and should be the first person to contact for all matters related to health and safety in the laboratory (*e.g.* injuries, accidents, *etc.*).

Policy

Technology and Communications

Communications Policy

Students are welcome and encouraged to meet with the Course Instructor during the posted office hour(s). Office hours will be held in person unless online course delivery is mandated. In this event, details for connecting to office hours *via* Zoom will be posted on the course Quercus site. 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, Laboratory Technicians and Teaching Assistants.

Student Technology Requirements and Connection Tools

During times when a switch from in-person to online course delivery is mandated, Zoom will be used for remote course delivery (*i.e.* lectures, tutorials, and practicals) and office hours. Students are therefore expected to review and be in compliance with the University of Toronto's requirements for [online learning](#) and to register for a [UTM Zoom account](#) prior to the first course meeting. Students are also strongly encouraged to familiarize themselves with the resources available on the UTM Library's [Learn Anywhere](#) website.

The assignment problem sets and the laboratory reports will be submitted and graded on Crowdmark. To submit documents and access grades on Crowdmark students will need to sign in on Crowdmark. They should use the tab "sign in through your school", by choosing "University of Toronto" from the drop-down menu, which will direct them to "Sign with

Quercus" page: <https://app.crowdmark.com/sign-in/utoronto>. For more information about this online grading platform please check: <https://crowdmark.com/help/categories/support-for-students/> and <https://www.uleth.ca/teachingcentre/crowdmark-advice-give-your-students>

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. 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.

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.

Integrity

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.

Inclusion

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.
- Personal calendar/schedule/organizer to ensure that all course activities are completed and due dates are met.
- 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 vpequity@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