COURSE OUTLINE

[Physics 325: Optics, CRN 22636 A01), 1.5 Units]

Lectures: (1130-1230 We/Fr, In Person)

We acknowledge and respect the Lək^{w}əŋən (Songhees and Esquimalt) Peoples on whose territory the university stands, and the Lək^{w}əŋən and W̱SÁNEĆ Peoples whose historical relationships with the land continue to this day.

COURSE DESCRIPTION

In your introductory physics courses, you likely encountered ray diagrams showing how lenses form images, or how light reflects off surfaces and refracts through materials depending on their index of refraction. You may have even heard that light consists of photons. Yet many questions probably remained unanswered: Why is glass transparent and shiny, while plastic is opaque and dull? What exactly is an "image" anyhow? And why do we represent light as straight rays when, if you look around you right now, you don't see any rays at all?

In this course, we will explore these questions and develop a deep, rigorous, but intuitive understanding of light and optical phenomena. Using the fundamental physical laws and mathematical tools you have acquired as third-year physics students, you will gain the ability to explain the everyday visual world around you both quantitatively, and qualitatively.

PREREQUISITES & COREQUISITES

- Phys 216, ECE 216, or ELEC 216
- Math 204
- Math 110 or Math 211

Math 346 is not a prerequisite, but it is a *recommended* corequisite.

CONTACT INFORMATION

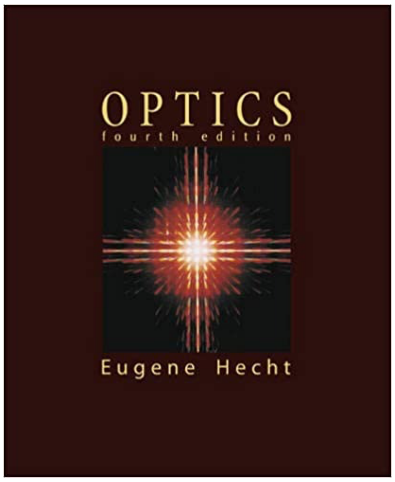
Instructor: Andrew MacRae
Email: macrae@uvic.ca
Office: Elliott 113
Office Hours: Wednesdays
Grader: TBA

LABS

There are 5 different labs in this course and **you will complete 3 of these**. You will be assigned a particular rotation, performing a lab roughly once every 3 weeks. Experiments are listed below:

Experiment 6: Michelson Interferometer
Use a Michelson interferometer to use the index of refraction of air.
Experiment 7: Measuring the Speed of Light
Use a classic method (A fast-rotating mirror) and a modern method (time of flight) to measure c.
Experiment 9: Far Field Diffraction
Explore the diffraction patterns of single and double slits.
Experiment 10: Polarization
Explore polarization by reflection, and the use of a liquid crystal to manipulate the polarization state.
Experiment 11: Holography
Create a transmission hologram and use it to measure minute displacements along a small cantilever.

COURSE MATERIALS



The main text will be Hecht's *Optics*, available in the bookstore.
Another great option is Pedrotti[3] and A free text by BYU:
https://optics.byu.edu/docs/opticsbook.pdf

LEARNING OUTCOMES

Upon completion of this course, students should be able to:

- Describe optical phenomena as a result of fundamental physical laws
- Decide on whether a photon, wave, or ray description of light is appropriate
- Calculate the diffraction limit to optical instrumentation
- Predict the amount of light reflected, transmitted, and lost through a material
- Publicly describe a scientific topic in a "poster session" setting

EVALUATION

Weekly quiz	5%
Assignments (11)	20%
Labs	15%
Poster Session	15%
Exams (3 x 15)	45%

COURSE DELIVERY

There will be 2 lectures in person on Wednesdays and Fridays. Aside from the very first lecture there will be no class help on Tuesday. Instead, there will be a companion video released for each

week going into detail about real world applications related to the week's material as well as a worked example. There will be a super-quick, low stakes quiz associated with each of these videos.

There will be 11 assignments, delivered roughly weekly. Each assignment will be worth 2% and the lowest mark will be thrown out. This provides a buffer against unexpected circumstances.

There will be 3 in-class exams throughout the semester, each worth 15% of your final mark. There will be no final exam for this course. The dates for the tests are:

Test I: Tuesday February 3rd
Test II: Tuesday March 3rd
Test III: Wednesday April 1st

POSTER SESSION

On Tuesday, March 24th, we will have the (in)famous Phys 325 poster session! Students will make and present a research poster on an optics topic of their choosing. A list of suggested topics will be provided, or you can suggest your own research topic for approval. A one-page outline of the poster worth 20% of the poster grade will be due early March.

COURSE POLICIES

Late/Missed Assignments or Exams

Assignments will be due on the stated deadline. Students may hand in late assignments for up to 4 days with a 10% penalty, after which the assignment solutions will be posted and the assignment will no longer be marked. Since there is a throw-away assignment, extensions will not be given barring extreme circumstances. If you must miss an exam due to an emergency, a make-up exam will be made available.

Academic Integrity

UVic's Policy on Academic Integrity is found at uvic.ca/calendar/future/undergrad/index.php#/home. It is every student's responsibility to be aware of this policy, including policies on cheating, plagiarism, unauthorized use of an editor, multiple submission, and aiding others to cheat. If you have any questions or doubts, please talk to me. For more information, see uvic.ca/learningandteaching/cac.

Use of AI

We live in a world where powerful AI tools like large language models (LLMs) are widely available. Like many tools, they are a double-edged blade, i.e. they can either accelerate or hinder your learning. You are in this class to understand physics. Not to memorize facts or perform computations (although this is a part of understanding) but to really understand it in your gut so you see not only how it works, but why it must be this way. You are free to use LLMs to gather information but you must at all times understand what you have written and be able to justify it. If you rely on AI to produce answers you don't understand, you're undermining your own education (and this won't help on an exam!)

COURSE CALENDAR AND OUTLINE

UVic Important Dates: uvic.ca/calendar/dates/
Last day to add courses: January 21, 2026
Last day to drop a course without penalty of failure: February 28, 2026

Week	Lecture Dates	Lecture Material (Approximate)
1	Jan 6,7,9	3 Pictures of Light, Vector Fields, Electromagnetic Waves
2	Jan 14,16	Properties of Plane Waves
3	Jan 21, 23	Light-Matter Interactions: Macroscopic pic. Fresnel Equations.
4	Jan 28, 30	Light-Matter Interactions: Microscopic. $n = n_R + in_I$, Beer's law
5	**Test1** Feb3, Lec Feb 4,6	Interferometry, Mach Zhender, Fabry Perot, Test 1
6	Feb 11,13	Fresnel Diffraction Integral, Diffraction gratings and slits
7	Feb 25, 27	Imaging systems, Ray Tracing and Matrix approaches
8	**Test2** Mar 3, Lec Mar 4,6	Fourier Optics, Airy Disc, Convolution theorem, Test 2
9	Mar 11,13	Microscopes and Telescopes, Birefringence
10	Mar 18, 20	Mathematical Description of Polarization. Jones Calculus
11	**PS** Mar24, Lec Mar25,27	Lasers, Fibers and Waveguides
12	Lec Mar31 **Test3** Apr1	Quantum Optics, Test 3

CHANGES DUE TO UNFORESEEN CIRCUMSTANCES

The above schedule, policies, procedures, and assignments in this course are subject to change in the event of extenuating circumstances. In the event of significant changes, a revised outline will be posted/circulated.

UVIC GRADING SYSTEM – UNDERGRADUATE

As per the Academic Calendar:

Grade	Grade Point Value	Grade Scale	Description
A+	9	90 – 100%	**Exceptional, outstanding** and **excellent** performance. Normally achieved by a minority of students. These grades indicate a student who is self-initiating, exceeds expectation and has an insightful grasp of the subject matter.
A	8	85 – 89%	
A-	7	80 – 84%	
B+	6	77 – 79%	**Very good, good** and **solid** performance. Normally achieved by the largest number of students. These grades indicate a good grasp of the subject matter or excellent grasp in one area balanced with satisfactory grasp in the other area.
B	5	73 – 76%	
B-	4	70 – 72%	
C+	3	65 – 69%	**Satisfactory**, or **minimally satisfactory**. These grades indicate a satisfactory performance and knowledge of the subject matter.
C	2	60 – 64%	

Grade	Grade Point Value	Grade Scale	Description
D	1	50 – 59%	**Marginal** Performance. A student receiving this grade demonstrated a superficial grasp of the subject matter.
F	0	0 – 49%	**Unsatisfactory** performance. Wrote final examination and completed course requirements; no supplemental.
N	0	0 – 49%	Did not write examination or complete course requirements by the end of term or session; no supplemental.

COURSE FEEDBACK

I value your feedback on this course. Towards the end of term, as in all other courses at UVic, you will have the opportunity to complete an anonymous **Course Evaluation Survey (CES)** regarding your learning experience. The survey is important for providing feedback to me regarding the course and my teaching, as well as to help the department improve the overall program for students in the future. The survey is accessed online and can be done on your laptop, tablet, or mobile device. I will remind you and provide you with more detailed information nearer the time, but please be thinking about this important activity during the course.

APPENDICES

DEPARTMENT OF PHYSICS AND ASTRONOMY INFORMATION

- **Department Website:** uvic.ca/science/physics/index.php
- **Department General Office:** physgen@uvic.ca
- **Department Undergraduate Advisor:** phast_advising@uvic.ca

---

UNIVERSITY STATEMENTS & POLICIES

- Academic Calendar: Information for All Students
- Creating a respectful, inclusive, and productive learning environment
- Accommodation of Religious Observance
- Accommodation and Access for Students with Disabilities
- Student Conduct
- Non-academic Student Misconduct
- Accessibility
- Diversity / EDI
- Equity Statement
- Sexualized Violence Prevention and Response
- Discrimination and Harassment Policy

STUDENT RESOURCES

POSITIVITY AND SAFETY

The University of Victoria is committed to promoting, providing, and protecting a positive and safe learning and working environment for all its members.

Student Groups & Resources

ACADEMIC RESOURCES

UVic Library - *UVic Library offers many services and resources for undergraduate and graduate students*.

uvic.ca/students/academics/library-services

Learning Resources - *UVic Learn Anywhere is the primary learning resource for students that offers many learning workshops and resources to help students with academics and learning strategies*.

onlineacademiccommunity.uvic.ca/uviclearn/

Centre for Academic Communication - *Offers online and in-person one-on-one tutorials, workshops, and more.*

uvic.ca/learningandteaching/cac

Physics Aid Service – *Addresses problems with conceptual understanding, difficulties encountered with homework assignments, preparation for mid-term and final exams, and occasionally even preparation for external exams such as the MCAT. Instruction may be one-to-one or in small groups, with emphasis placed on engaged interaction between the students and the instructor.*

https://www.uvic.ca/science/physics/current/undergraduate/pas/index.php

MENTAL HEALTH & WELLNESS

A note to remind you to take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, getting enough sleep, and taking some time to relax. This will help you achieve your goals and cope with stress. All of us benefit from support during times of struggle. You are not alone.

Student Wellness Centre - *Our team of practitioners offers a variety of services to support students' mental, physical, and spiritual health.*

uvic.ca/student-wellness

Counselling Services - *Counselling Services can help you make the most of your university experience. They offer free professional, confidential, inclusive support to currently registered UVic students.*

uvic.ca/student-wellness

Health Services - *University Health Services (UHS) provides a full-service primary health clinic for students and coordinates healthy student and campus initiatives.*

uvic.ca/student-wellness

ACCESSIBILITY

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a documented disability or health consideration that may require accommodations, please feel free to approach me and/or the Centre for Accessible Learning (CAL) as soon as possible.

Centre for Accessible Learning - *The CAL staff are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.*

uvic.ca/accessible-learning

ADVISING

For academic advising-related questions, students in the Department of Physics & Astronomy are also encouraged to meet with the Undergraduate Advisor (phast_advising@uvic.ca) as well as an academic advisor in the Academic Advising Centre early in their studies to help map out a plan to declare a major and complete university program requirements.

Academic Advising Centre - *Academic advice and support is currently available by phone, email and virtual or in-person appointments*. uvic.ca/services/advising

Ombudsperson - *The ombuds office is an independent, impartial, and confidential resource for undergraduate and graduate students and other members of the University of Victoria community. The ombudsperson helps resolve student problems or disputes fairly.* uvicombudsperson.ca

ACADEMIC CONCESSION

You can request an academic concession if your course requirements are affected by unexpected and unavoidable circumstances, or conflicting responsibilities. Concession requests can be for an in-course extension, deferral, withdrawal under extenuating circumstances, or an aegrotat. Please speak to an advisor at the Academic Advising Centre if you have questions on how requesting a concession will affect your academic program.

Undergraduate Academic Concessions - uvic.ca/students/academics/academic-concessions-accommodations

EQUITY AND HUMAN RIGHTS AT UVIC

EQHR is a resource for students, staff, and faculty who have experienced sexualized violence, discrimination, and/or harassment and are looking for informal and/or formal resolution options as well as advice, coaching, and/or education. We are available for confidential consultations so that you can ask questions and learn your options.

EQHR – By email at eqhr01@uvic.ca or in-person (Sedgewick C115). uvic.ca/equity

Sexualized Violence Resource Office – *If you have been directly or indirectly impacted by sexualized violence, reach out to the SVRO for information, advice, and resolution options (restorative and disciplinary) as well as support options and referrals. The SVRO is both survivor-centred and trauma-informed in their approach. You can reach us by phone at 250-721-8021 or by email at eqhr01@uvic.ca to book either an in-person (Sedgewick C119) or online appointment.* uvic.ca/sexualizedviolence

RESOURCES FOR INTERNATIONAL STUDENTS

International Centre for Students - *The primary office supporting international students on campus at the university-wide level*. uvic.ca/international-experiences

UVic Global Community Initiative - *Provides various supportive programming, including a Mentorship Program and Conversation Partner Program*. uvic.ca/international-experiences/get-involved/uvic-global-community

RESOURCES FOR INDIGENOUS STUDENTS

Indigenous Student Support - *UVic offers holistic services to Indigenous students throughout their academic journey.* uvic.ca/students/info-for/indigenous-students

Elders in Residence - *The Office of Indigenous Academic and Community Engagement (IACE) has the privilege of assembling a group of Elders from local communities to guide students, staff, faculty, and administration in Indigenous ways of knowing and being.* uvic.ca/iace/