PHYS 362: Optics and Lasers

Fall 2013
Lecture A01
M W F 11:00 - 11:50 am
CCIS L1-047

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Required Text:	Eugene Hecht, Optics, 4th edition (Addison-Wesley, 2002).		
Course website:	All course material will be made available online via eClass.		
Office Hours:	Tuesdays: 11:00 am - 12:30 pm Wednesdays: 4:00pm - 5:30 pm		or: email for appointment check eClass forum "Official forum"
Evaluation:	Assignments	30%	(approximately 6)
	Midterm examination	20%	(25 October 2013, 11:00 - 11:50 am)
	Final examination	50%	(12 December 2013, 9:00 - 11:00 am)

Prerequisites

PHYS 230 or 281 and MATH 209 or 215 or 317
If you do not have the necessary prerequisites, you must obtain written permission from the Department of Physics to take this course. It is important to prepare yourself for this course through a review of the prerequisite material. Students who do not have the required prerequisites at the time of taking this course should not expect supplementary professorial tutoring from the instructor.

Assignments

Assignments and solutions will be posted on eClass. Most assignment problems will involve calculation, but some may include small design projects or short (half- to one-page) written components. Students are encouraged to discuss their work with others and with me, but all submitted work must be produced independently. Late assignments will not be accepted.

Exams

Formula sheets (one page) will be provided for both the midterm and final examinations; they will be available in advance of the examinations via eClass. Students' photo I.D. is required at exams to verify identity. Students will not be allowed to begin an examination after it has been in progress for 30 minutes. Students must remain in the exam room until at least 30 minutes has elapsed. Electronic equipment other than calculators cannot be brought into examination rooms. Exams will consist of problems similar to those found on assignments.

Past/representative evaluative material: A sample examination from a previous year will be provided prior to both the midterm and final exams, and will be posted on eClass before each examination.

Midterm examination deferrals: A student who cannot write the midterm examination due to incapacitating illness, severe domestic affliction or other compelling reasons can apply for a deferred midterm examination. Students must obtain a statutory declaration explaining the absence from the Student Services Office in the Faculty of Science and submit this to the instructor, at whose sole discretion deferrals will be granted. Deferred examinations are a privilege and not a right; there is no guarantee that a deferred examination will be granted. Misrepresentation of Facts to gain a deferred examination is a serious breach

of the *Code of Student Behaviour*. Any deferred midterm exams will be held on 08 November 2013 at 12:00 - 12:50 pm.

Final examination deferrals: A student who cannot write the final examination due to incapacitating illness, severe domestic affliction or other compelling reasons can apply for a deferred final examination. Such an application must be made to the students Faculty office within 48 hours of the missed examination and must be supported by a Statutory Declaration or other appropriate documentation (Calendar §23.5.6). Deferred examinations are a privilege and not a right; there is no guarantee that a deferred examination will be granted. Misrepresentation of Facts to gain a deferred examination is a serious breach of the *Code of Student Behaviour*. Any deferred final examinations will be held on 17 January 2014 at 9:00 - 11:00 am.

Final reexaminations: A student who writes the final examination and fails the course may apply for a reexamination. Reexaminations are rarely granted in the Faculty of Science. These exams are governed by University (Calendar §23.5.5) and Faculty of Science Regulations (Calendar §192.5.9). Misrepresentation of Facts to gain a reexamination is a serious breach of the *Code of Student Behaviour*.

Final grades

Final grades will be determined based on a combination of absolute marks (according to the grade distribution given above) and the class distribution.

Student Responsibilities

Academic integrity: The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at http://www.governance.ualberta.ca/en/CodesofConductandResidenceCommunityStandards/CodeofStudentBehaviour.aspx) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All forms of dishonesty are unacceptable at the University. Any offence will be reported to the Senior Associate Dean of Science who will determine the disciplinary action to be taken. Cheating, plagiarism and misrepresentation of facts are serious offences. Anyone who engages in these practices will receive at minimum a grade of zero for the exam or paper in question and no opportunity will be given to replace the grade or redistribute the weights. As well, in the Faculty of Science the sanction for cheating on any examination will include a disciplinary failing grade (no exceptions) and senior students should expect a period of suspension or expulsion from the University of Alberta.

Mobile phones: Mobile devices are to be turned off during lectures, labs and seminars. Mobile phones are not to be brought to exams.

Students with disabilities: Students who require accommodation in this course due to a disability are advised to discuss their needs with Specialized Support & Disability Services (2-800 Students Union Building).

Academic support centre: Students who require additional help in developing strategies for better time management, study skills, or examination skills should contact the Student Success Centre (2-300 Students Union Building).

Disclaimer: Any typographical errors in this Course Outline are subject to change and will be announced in class. The date of the final examination is set by the Registrar and takes precedence over the final examination date reported in this syllabus.

Calendar description

Gaussian optics; optical instruments; matrix analysis of lens systems; aberrations; polarization; double- and multiple-beam interference; Fraunhofer and Fresnel diffraction; introduction to laser physics and applications; selected topics from contemporary optics.

Course objectives

- ◇ To understand the propagation of electromagnetic radiation through free space and through matter.
- ◇ To understand the basic mechanisms by which we can use light to probe matter; and how to use matter to control light
- ◇ To understand the differences between naturally generated and laser light, and how the latter is created
- ◇ To use Fourier series and transforms to describe wave phenomena in general and light in particular. To understand the mathematical roles of the wave vector and the position vector
- ◇ To understand the basic differences between classical and quantum theories of light, and when to use which description.

Content

General sections of the text are given; specific sections for recommended reading will be provided in advance of the relevant lectures. This table is a guideline; we may add or drop topics depending on time and interest.

Section	Topic	Text
1	Waves: a review *Simple harmonic oscillator, complex representation of waves, Fourier series*	Ch. 2
2	Electromagnetic waves *Maxwell's equations; wave equation; electromagnetic spectrum*	Ch. 3
3	Light-matter interactions *Classical oscillator model;polarizability; scattering; absorption; dispersion; Snell's law; Fresnel equations*	Chs. 3, 4
4	Propagation of light *Transmission, reflection and refraction; lenses, mirrors, and prisms; ABCD matrices; total internal reflection; fibre optics; evanescent waves*	Chs. 4, 5
5	Polarization *Electric field interactions with materials; birefringence; waveplates, optical activity*	Ch. 8
6	Lasers *Semiclassical light-matter interactions; spontaneous emission, stimulated absorption and emission; Einstein A, B coefficients; gain and loss; cavities*	Ch. 13
7	Superposition of waves and interference *Addition of waves with same and different frequencies; spatial and temporal coherence; Fourier analysis of waves (temporal); interferometry; thin films*	Chs. 7, 9
8	Diffraction *Fresnel vs. Fraunhofer diffraction; Fresnel integrals; Babinet's principle; Fraunhofer diffraction and relationship to Fourier optics*	Ch. 10
8	Fourier optics *Review Fourier transforms; spatial filtering; image analysis*	Ch. 11