Physics 327: Optics Spring 2018

Course Information

- Instructor: Dr. David A. Macaluso
- Office: C.H. Clapp Building, room 119
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- Email: david.macaluso@umontana.edu
- Lectures: MWF 2:00 – 2:50 PM, CHCB 230/231
- Office Hours: M,W 3:00 PM – 4:30 PM
- Course Website: Moodle

Overview

From Wikipedia: *Optics is the branch of physics which involves the behavior and properties of light, including its interactions with matter and the construction of instruments that use or detect it.*

This is a one-semester course in Optics. The selection of material is based on a traditional optics course, with additional material to be added at the end of the semester - time permitting.

Learning Outcomes

Upon completing this course, students should have:

1. A qualitative and quantitative understanding of:
    a) geometric optics
    b) optical instruments
    c) the mathematical formalism of the wave equation
    d) interference and coherence
    e) diffraction
    f) polarization
    g) applications: lasers, fiber optics, spectrometers, and interferometers

2. Improved problem solving and study skills in preparation for advanced physics coursework.

Textbook

Required
Introduction to Optics, 3rd Edition, By Pedrotti × 3
ISBN-13: 9781108428262

Suggested
Optics, 5th Edition, By Hecht
ISBN-10: 0133977226 | ISBN-13: 978-0133977226

Add/Drop/Withdraw

Please refer to the University policy on adding, dropping, and withdrawing from the course at http://www.umt.edu/registrar/students/dropadd.php.

From the 16th through the 45th instructional day, all classes must be dropped using Drop forms (instructor signature required, advisor signature required for undergraduates). **$10 fee applies.**

From the 46th to the last instructional day prior to finals week, classes must be dropped using the Drop form (instructor and Dean signatures required, advisor signature required for undergraduates). **$10 fee applies.**

Course Expectations

This is an upper division course intended for physics majors. The expectations are appropriate for advanced undergraduate students who are familiar with the concepts of personal responsibility, accountability, and academic honesty.

Prerequisites/Co-requisites: I expect all students to have completed the prerequisite course, Oscillations & Waves (PHSX 311). It is also expected that students be fluent in mathematics, with specific experience in matrix analysis and calculus.

Attendance: Exams will be based on homework assignments, readings, lectures, in-class discussions, and in-class assignments. In addition, quizzes represent a significant percentage of the course grade. Thus regular attendance, while not compulsory, is vital to student success.

Reading Assignments: Students are expected to read the assigned material *before class*. Intermittent quizzes will be given usually at the beginning of class that will be based at least partially on the assigned reading.

Please do not use electronics in class, including phones and laptops.

Grading Policy

Midterm Exams (three at 15% each)	**45%**
Cumulative Final Exam	**25%**
Homework	**15%**
Quizzes	**15%**

Midterm exams will take place in the regular classroom during normal class time. If you are unable to attend an exam, arrangements must be made *beforehand* so your exam can be rescheduled.

Missed exams will be scored as a zero.

Homework will be due at the beginning of class unless prior arrangements are made with me. A subset of the problems in each assignment will be selected "at random" to be graded.

Late assignments will be accepted with a maximum grade of 50%.

Students with Disabilities:

Whenever possible, and in accordance with civil rights laws, The University of Montana will attempt to provide reasonable modifications to students with disabilities who request and require them. Please feel free to setup a time with me to discuss any modifications that may be necessary for this course. For more information, visit the Disability Services for Students website at http://life.umt.edu/dss/.

Final Exam

The Final Exam will take place in the normal classroom from 3:20 – 5:20 PM, Monday, May 7th.

Tentative Course Schedule (dates, topics, and readings subject to change)

	Date	Topic	Reading Assignment
M	Jan 22	syllabus, course intro, mathematics review	
W	Jan 24	light, photons, EM spectrum, radiometry	Ch. 1 (all)
F	Jan 26	geometrical optics	Ch. 2 up to 2-4
M	Jan 29	geometrical optics	2-5 to 2-8
W	Jan 31	geometrical optics	2-9 to 2-12
F	Feb 02	apertures, aberrations, prisms	Ch.3 up to 3-3
M	Feb 05	cameras, microscopes, telescopes	3-4 to 3-7
W	Feb 07	1D wave equation, harmonic waves, *i*, plane waves	Ch. 4 up to 4-5
F	Feb 09	spherical cylindrical & EM waves, polarization, Doppler effect	4-6 to 4-10
M	Feb 12	superposition, coherence	Ch. 5 up to 5-3
W	Feb 14	standing waves, beats, phase & group velocities	5-4 to 5-6
F	Feb 16	quantization, blackbody and non-laser sources, exam review	Ch. 6 up to 6-3
M	Feb 19	*Presidents Day – no class*	
W	Feb 21	**Exam I, Chapters 1 – 5**	
F	Feb 23	Return exams, Einstein, laser basics	6-4 to 6-6
M	Feb 26	laser light and types of lasers	6-7 to 6-8
W	Feb 28	interference, double slit, films	Ch. 7 up to 7-4
F	Mar 02	fringes, Newton's rings, Stokes, multi-beam interference	7-5 to 7-9
M	Mar 05	Michelson interferometer	Ch. 8 up to 8-3
W	Mar 07	Fabry-Perot interferometer	8-4 to 8-6
F	Mar 09	Fabry-Perot interferometer & gravitational waves	8-7 to 8-10
M	Mar 12	Fourier analysis, coherence	Ch. 9 up to 9-3
W	Mar 14	coherence	9-4 to 9-6
F	Mar 16	fiber optics and applications	Ch. 10 up to 10-4
M	Mar 19	modes, attenuation, distortion	10-5 to 10-8
W	Mar 21	diffraction, exam review	Ch. 11 up to 11-3
F	Mar 23	**Exam II, Chapters 6 - 10**	
M	Mar 26	*Spring Break – no class*	
W	Mar 28	*Spring Break – no class*	
F	Mar 30	*Spring Break – no class*	
M	Apr 02	return exams, resolution, double slit, many slits	11-4 to 11-6
W	Apr 04	grating basics	Ch. 12 up to 12-4
F	Apr 06	gratings continued	12-5 to 12-9
M	Apr 09	Fresnel diffraction, phase shifts	Ch. 13 up to 13-5
W	Apr 11	Fresnel diffraction, Cornu spiral	13-6 to 13-9
F	Apr 13	matrices and polarization	Ch. 14 (all)
M	Apr 16	matrices and polarization	Ch. 14 (all)
W	Apr 18	polarization	Ch. 15 up to 15-3
F	Apr 20	polarization, double refraction	15-4 to 15-5
M	Apr 23	optical cavities, photoelasticity	15-6 to 15-7
W	Apr 25	laser operation, exam review	Ch. 26 up to 26-4
F	Apr 27	**Exam III, Chapters 11 - 15**	
M	Apr 30	broadening, pulsed lasers	26-5 to 26-10
W	May 02	laser characteristics	Ch. 27 (all)
F	May 04	final exam review and course evaluations	
M	May 07	**Final Exam, 3:20 – 5:20 PM**	*everything*