OPTICS FOR ENGINEERS

EECE7105 Fall 2012

INSTRUCTOR:

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Course Website:
http://www.ece.neu.edu/courses/eece7105/2012fa/
Faculty Website:
http://www.ece.neu.edu/faculty/dimarzio/
Research Lab Website:
http://www.ece.neu.edu/groups/osl

VIRTUAL OFFICE HOURS:

Students' questions don't always come at a time convenient for office hours. Please feel free to email me at any time for "virtual office hours." If you think the question will be of general interest, and you are willing, please give me permission to post your question (without your name) and my answer, for the benefit of other students. I will never do this without your explicit permission. If multiple students have similar questions, I may post a generic response, so look on the announcements page.

DISCUSSION GROUPS:

I am not a great fan of the "Blackboard" website, but I do think it is useful for some purposes, such as discussion groups. I will start discussion groups on Blackboard, particularly for questions about homework. Because you are encouraged to collaborate on homework, you are also encouraged to use this forum for wider collaboration. I will check the discussion groups and may contribute occasionally to keep the conversation going. I will more often post comments on the announcements page of the course website.

OFFICE HOURS:

Sometimes only real office hours will work. I will be available in the time–honored way.

Wednesdays 2:00PM–4:00PM (222 Egan) or by appointment

TEXT:

DiMarzio, Charles A., *Optics for Engineers*, CRC Press. 2011.
(http://www.crcpress.com/product/isbn/9781439807255)
After trying for many years to find a suitable text for this course, I decided to write one. We are using it this semester for the first time. Please report any errors, any areas that you find difficult or confusing, and any other comments you may have.

LOCATION:

209KA

TIME:

Tue 11:45 AM – 1:25 PM and Thu 2:50 – 4:30

GRADING:

Mid–Term	25%
Final	25%
Homework	25%
Project Final Report	25%

EXAMS: Take–home exams will be given at the middle and end of the course. You will have about one week to complete each. It is expected that your exam submission will be the result of your own effort, with the aid of your notes, the text, and other reference books. Please work independently. Do not collaborate or seek help from other experts.

Exams not received by the due date will receive a grade of "F."

PROJECTS: A list of suggested projects will be distributed. Each project must involve some research in the literature and some independent work. Reviews of the literature alone are not acceptable. If you have your own idea for a project, I would be happy to consider it. I will suggest other projects during class as they arise in the lectures.

HOMEWORK: Homework Assignments will be available on the course website. Collaboration among students on homework is acceptable and encouraged. Group submissions will be accepted from groups of up to four students, and a single grade assigned for all members of the group. Nevertheless, it is the responsibility of each student to have a good understanding of each problem.

TENTATIVE SCHEDULE

1 **6, 11 Sep**	**ADMINISTRIVIA. INTRODUCTION;** — History, The spectrum, Perception of Color, specular and diffuse reflection, Maxwell's Equations, the wave equation, Fermat's Principle. **Textbook Chapter:** 1.
2 **13, 18 Sep**	**BASIC GEOMETRIC OPTICS:** Imaging, ray optics, ray tracing. Refraction at a single surface, total internal reflection, simple optical elements, focal length. **Textbook Chapter:** 2. **Homework:** Problems from Ch. 1 & 2 Due 25 Sep..
3 **20, 25 Sep**	**MATRIX OPTICS:** Basic transformations, system matrix. Cascading matrices. CARDINAL POINTS: Application to representative systems. Thick lens, air–spaced doublet. **Textbook Chapter:** 3.
4 **27 Sep, 2,4 Oct**	**STOPS AND APERTURES:** Entrance and exit pupils. Entrance and exit windows. Object and image space. OPTICAL INSTRUMENTS: Microscope, magnifier, compound microscope, Heads–up display. **Textbook Chapter:** 4. **Homework:** Problems from Chapters 3, & 4 Due 11 Oct .
5 **9, 11 Oct**	**ABERRATIONS:** Spherical aberration, other third–order aberrations, matrix methods, exact ray tracing, wavefront methods. **Textbook Chapter:** 5. **Homework:** Problems from Chapter 5 Due 30 Oct.

Mid–Term Exam handed out 11 Oct, due 18 Oct

6 **11, 16, 18, 23, 25 Oct**	**POLARIZED LIGHT:** INTERFACE OPTICS: The wave equation, plane waves, Fresnel reflection and refraction at a dielectric interface. JONES CALCULUS: representations and transformations. Partial polarization, including coherency matrices and Mueller Calculus. Optical activity. Poincaré Sphere. **Textbook Chapter:** 6.
7 **30 Oct, 1, 6 Nov**	**INTERFERENCE:** The Mach–Zehnder and Michelson interferometers, The Fabry–Perot — laser line selection and tuning. Multi–layer coatings including matrix representation. **Textbook Chapter:** 7. **Homework:** Problems from Chapters 6 & 7 Due *** 13 Nov ***.

8 **8, 13 Nov**	**DIFFRACTION:** Interference, Multiple beams, slits and apertures, transmissive and reflective gratings. Littrow gratings. The Fresnel–Kirchoff integral. A/O Modulators. **Textbook Chapter:** 8.
9 **15 Nov**	**GAUSSIAN BEAMS:** Derivation and computational techniques. The complex radius of curvature. Graphical solutions. Higher–order modes. **Textbook Chapter:** 9. **Related Sections in Notes:** 8. **Homework:** Problems from Chapters 8 & 9 4 Due 20 Nov.
10 **20 Nov**	**COHERENCE:** Coherent and incoherent light, partial coherence, visibility. Coherent and incoherent imaging. Brief comments on quantum theory of coherence, and squeezed states. **Textbook Chapter:** 10.
11 **27 Nov**	**FOURIER OPTICS:** point spread function, modulation transfer function. Simple optical data processing. Holiday, 23 Nov. **Textbook Chapter:** 11.

Thanksgiving Holiday, 22 Nov

12 **29 Nov** **4, 6 Dec**	**INCOHERENT SOURCES:** The black body spectrum, coherent and incoherent sources. Polar bears. **RADIOMETRY:** Quantities and units, basic measurements, photometry. **Textbook Chapter:** 12. **Homework:** Problems from Chapters 10, 11, & 12 Due 8 Dec .
13 **6 Dec**	**OPEN:** Course summary. What we didn't cover.

***** Project Due 6 Dec *****

Final Exam handed out 6 Dec, due 13 Dec

Grades Due to Registrar on 17 Dec. Brades will be available on the Banner system.