Physics 344
Applied Optics
Fall 2014

Instructor: Alex Small, Room 8-227, 909-869-5202, arsmall@csupomona.edu

Course web page: Homeworks and solutions will be posted in Blackboard.

Lectures: 9:15am-10:20pm, Monday, Wednesday, and Friday, Building 8 room 210.

Office Hours: Tuesday 10am-11am, Thursday 3pm-5pm, Friday 2pm-3pm

Readings:
1) For homework problems we will mostly use Optics by Pedrotti, Pedrotti, and Pedrotti. (It's a family thing.)

2) We will make use of a number of online resources, in particular the ones at these sites: http://www.microscopyu.com/ and http://zeiss-campus.magnet.fsu.edu/index.html

3) We will have some readings from the Melles-Griot Optics Guide. The .pdf is posted under "Course Documents" in Blackboard.

4) Our goal is to be able, by the end of the quarter, to understand a paper on nanoscale imaging of a live mouse brain: Berning et. al., "Nanoscopy in a Living Mouse Brain", ***Science***, volume 335, page 551, February 3, 2012.

Grading: The grade is based on a midterm, homework (due mostly on Fridays or Mondays starting in the second week of class), and a final exam. For the midterms and final you are allowed one page of notes, 8.5"x11", both sides.

20% Midterm (October 20)
25% Final (December 8)
25% Weekly homeworks (8 assignments, due most weeks, I drop the worst.)
20% Computer assignments
10% Short assignments, given at the end of some classes, due at start of next class. I drop the 2 worst. (So if you miss some classes you should still be fine.)

Grading scale: 85-100 A, 75-84 B, 65-74 C, 55-64 D

The weekly homeworks will typically be about 6 problems. You are welcome to discuss them with classmates, but you must turn in your own work. The shorter assignments are generally either follow-ups to points raised in class, or warm-up activities for the next class. They will be short and will be assigned sporadically.

Computer assignments will require you to use ray-tracing software available at http://lambdares.com/education/oslo_edu/. If you cannot use it on a machine outside of class, let me know as soon as possible and I will work on alternative arrangements.

Deadlines and Exceptions: Late homework is not normally accepted, and missed tests cannot normally be made up, except in cases of SEVERE AND DOCUMENTED emergencies. It is in

your best interests to **contact me in advance**. Once the homework solutions are posted online, I cannot accept a late assignment.

Ways to get help and meet interesting people: If you are looking for a place to get help on homework, the Physics Club is full of helpful people. They are usually found in 8-209. If you want to meet people who do optics research, in 3-2005 you'll find my research group, which works on image processing for microscopy, as well as Dr. Salik's group, which works on fiber-optic sensors. Dr. Abramzon's group does optical spectroscopy in 3-2614.

If you want to meet people who work on optics in industry, come to the Optical Society of Southern California meetings (www.ossc.org). The meetings are once a month, and feature dinner and a presentation on optics research. ADMISSION AND DINNER ARE FREE FOR STUDENT MEMBERS! You just have to join the OSSC ($15/year) and register in advance. **A lot of people advertise jobs and internships at these meetings! The first meeting is Wednesday, October 8, and if you wish to go you should register ASAP.**

Finally, most Thursdays at 11am the department has a seminar in 4-2-314, where people talk about physics research.

Academic Integrity: Studying together is encouraged, but you must submit your own homework solutions, and your own writing assignments. Cheating on homeworks, tests, and writing assignments will result in an automatic F for the course and referral to Judicial Affairs for additional sanctions.

Schedule: Order of topics is tentative. Tests dates are firm. If necessary, I will reschedule homeworks, giving you prior notice.

Week		Date	Topic	Reading	Due
1	Fri.	9/26/2014	Snell's Law. Principle of Least time.		
2	Mon.	9/29/2014	Least Time and lenses. Focal length.	Pedrotti, Chp. 2, sec. 1-5 and 9-10, Feynman, vol. 1, chp. 26 and 27	**Short HW 1-Refraction**
2	Weds.	10/1/2014	Ray tracing. Magnification. Objects at infinity.	Pedrotti Chp. 2 sec 9-10 and Melles Griot chp. 1 pg. 3-7	**Short HW 2-TIR**
2	Fri.	10/3/2014	Ray tracing. Magnification. Objects at infinity.	Pedrotti Chp. 2 sec 9-10 and Melles Griot chp. 1 pg. 3-7	**HW 1: Refraction, simple lens problems**
3	Mon.	10/6/2014	Lens combination problems. Effective focal length. Simple idea of a telescope or microscope.	Pedrotti Chp. 3 sec. 5-7 and Melles Griot chp. 1 pg. 8-10 and 18-19	**Short HW 3-Defocus**
3	Weds.	10/8/2014	Numerical aperture and F/#	Pedrotti Chp. 3 sec. 4 and Melles-Griot Chp. 1 pg. 6-7	
3	Fri.	10/10/2014	Focal length of a spherical lens	Pedrotti Chp. 2 section11	**HW 2: More lens problems**

4	Mon.	10/13/2014	Why perfect imaging is impossible	Walther article	**Short HW 4-Power and intensity**
4	Weds.	10/15/2014	Aberrations: A largely qualitative view	Pedrotti, Chp. 20	
4	Fri.	10/17/2014	Midterm review		**HW 3: And still more lens problems**
5	**Mon.**	**10/20/2014**	**Midterm: Topics from HW 1-3**		
5	**Weds.**	**10/22/2014**	**Computer lab (3-2029)**		**Short HW 5-Aberrations**
5	**Fri.**	**10/24/2014**	**Computer lab (3-2029)**		
6	Mon.	10/27/2014	Matrix optics	Handout on matrix multiplication (on Blackboard), Pedrotti Chp. 18 sec. 1-5	**Short HW 6-Matrices**
6	Weds.	10/29/2014	Matrix optics	Pedrotti Chp. 18 sec. 6-11	**Computer assignment 1**
6	Fri.	10/31/2014	A crash course in wave optics	Pedrotti Chapter 4	**Short HW 7-waves**
7	Mon.	11/3/2014	Diffraction gratings (just the essentials)	Pedrotti Chp. 11 sec. 1, 2, 5, 6	**HW 4: Matrix optics and aberrations**
7	Weds.	11/5/2014	Diffraction gratings and resolution	Pedrotti Chp. 12 sec. 1-4	**Short HW 8-Gratings**
7	Fri.	11/7/2014	Optical coatings	Melles-Griot, Chapter 5, and Pedrotti Chp. 7 sections 4-5	**Short HW 9-Coatings**
8	Mon.	11/10/2014	Photons and fluorescence: The essentials	UCSF Fluorescence notes, Microscopy U article	**HW 5: Waves, gratings**
8	Weds.	11/12/2014	Point spread functions: Where do they come from? Interference, scattering, aberrations	See "course documents" on Blackboard	

8	**Fri.**	11/14/2014	Point spread functions: Using them for practical calculations. Power, defocus in 3D, overlap, etc.	See "course documents" on Blackboard	**Computer assignment 2**
9	Mon.	11/17/2014	Crash course in scattering	See "course documents" on Blackboard	**HW 6: Coatings, photons**
9	Weds.	11/19/2014	Skin optics	See "course documents" on Blackboard	**Short HW 10-Skin optics article**
9	Fri.	11/21/2014	Confocal microscopy	See "course documents" on Blackboard	
10	Mon.	11/24/2014	2-photon microscopy: A very clever way to image deep in tissue	See "course documents" on Blackboard	**HW 7: PSF, beam spread**
10	Weds.	11/26/2014	Detecting light: CCD, CMOS, Shot Noise	See "course documents" on Blackboard	**Short HW 11: Two-photon microscopy**
10	**Fri.**	**11/28/2014**	**Let us give thanks for no class**		
11	Mon.	12/1/2014	Stimulated emission	Pedrotti, Chp. 6, sections 1-6	**Short HW 12: Light detection**
11	Weds.	12/3/2014	Stimulated emission depletion: How they imaged a mouse brain at nanometer resolution	See "course documents" on Blackboard	**Computer assignment 3**
11	Fri.	12/5/2014	Review, and a special lecture on information paradoxes in optics		**HW 8: Scattering, confocal, light detection**
Finals	Mon.	12/8/2014	**Final exam, 9:10am-11:10am**		