Physics Department, California State Polytechnic University, Pomona

Physics 417

Spring 1999

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Course Description: Physics 417 is an upper division course in optics. Course topics include the design of optical systems using results from geometric optics, physical optics (interference, diffraction, polarization), spectroscopy, lasers, and holography.

Conditions of Enrollment: This course is open only to students who have satisfactorily completed physics 234. Physics 418 (Optics Laboratory) is a corequisite for physics majors.

Text: *Optics*, Third Edition, by Eugene Hecht.

How to get help: My formal office hours are Mondays 2-3, Wednesdays 2-3, and Fridays 11-12. In addition, I will be in the physics tutoring center (3-205) on Fridays from 2-3. You are also welcome to come see me during my lab on Monday afternoons from 3 to 5:30 as long as you understand that questions from my lab students will always take precedence. If you can't come during any of these hours, I will be *happy* to make an appointment with you for another time. For me, one of *the* most enjoyable aspects of teaching is working with students one-on-one and clearing up specific problems. *Please* come see me often.

Problem Sets: These will be your best indication of the material that I want to emphasize and the level of understanding that I expect you to attain. Working out solutions to these problems is probably about the bare minimum of practice on your part that is likely to yield that level of understanding. I will ask you to turn in some of these in problem sets that will be due approximately once a week.

As you surely know by now, the purpose of assigned problems in physics is *absolutely not* to see if you can get the right answer. Rather, it is for you to practice and then demonstrate that you have learned 1) how to determine the fundamental physical principles that are involved in each situation and 2) how to apply those principles in a disciplined and orderly fashion. Of course, if you have learned how to do these things, I fully expect that you will get the right answer too, but that is of *decidedly* secondary importance.

Accordingly, I am not interested in problem "solutions" that simply consist of series of mathematical manipulations leading to a numerical answer. Instead, the problem solutions you submit are to be "presented." By this I mean that they should be readable by someone who does not have access to the problem statement, should include written explanations and thoughtful comments, should use well-defined and consistent notation, should be accompanied by neatly drawn and carefully labeled diagrams, and should flow in a logical and orderly progression down the page. They should *not* include sequences of algebraic manipulations; *e.g.*, when three equations are to be solved for three unknowns, simply say something like, "Solving equations 1,2, and 3 for x, y, and z, we obtain ..." and give the result!

I will look over your work and assign a holistic score of 1 to 4 with 4 meaning that the problem set is *exceptional*—complete, *very* well presented, and at least mostly correct; 3, good – at least nearly complete, clearly presented, and mostly correct; 2 – incomplete or not very clearly presented; 1 – not a good faith effort. Unsubmitted problem sets will receive a 0. I do not accept late problem sets, but, in order to allow for extraordinary circumstances (*including* absence for *any* reason), I will throw out your two lowest problem set scores.

I *strongly* encourage you to form study groups and to discuss with others your readings, questions that come up in and out of class, and how to go about solving problems. The work *you* turn in, however, must be *yours*, based on the understanding *you* have acquired. When faced with two write-ups that show any signs of copying, I conclude that at least one person hasn't done the work. In such cases *both* papers *will* receive no credit.

Quizzes: There will often be brief (~3-5 minute), unannounced, closed-book quizzes usually given at the *beginning* of the class period. Quizzes will test only for a basic understanding of recent material and for a minimal level of comprehension of the day's assigned pre-class study. They will be scored on the same 4 point scale as the problem sets with the following meanings: 4 – no significant errors, you are clearly on top of things, 3 – minor errors, but basically O.K., 2 – substantive errors, this material needs immediate attention, 1 – no evident preparation or practice on material, serious trouble. Missed quizzes will receive a 0. In order to allow for extraordinary circumstances (*including* absence for *any* reason), I will throw out your two lowest quiz scores.

Course Involvement and Subjective Evaluation: Some of class time will be conducted in a participatory fashion that will require you to have completed daily reading assignments beforehand. A small portion of your grade, assigned on the same 4 point scale, will be determined by my own subjective impression of your involvement in the class as evidenced through attendance, preparation, class participation, and office visits. Most of you will likely receive a 3 (meaning O.K. to good) with other scores reserved for clearly "distinguished" levels of involvement.

Examinations: There will be an in-class midterm, an optional evening exam, and a final exam. The in-class midterm will by default count for 1/3 of your overall exam score and the final exam for the other 2/3. If you wish, however, you may take the optional midterm in a two hour evening session on Wednesday, 12 May. In that case—and only *if* it helps your overall grade—the midterm and the practice exam will count equally for 1/2 of your exam grade and the final for the other half.

Grading: I do *not* grade on the curve so there is a tremendous advantage to be gained from working productively with your classmates.

I will combine your problem set, quiz, and subjective scores with relative weights of 3, 2, and 1 respectively into a single "effort" score on the same 4 point scale . Grades will then be assigned using the following grid:

	Exam Score				
	Excellent 80% - 90%	Good 66% - 80%	Satisfactory 52% - 66%	Substandard 40% - 52%	Unsatisfactory 25% - 40%
Effort Score 4	A	A-	B+	B-	C
3	A	A-	B	C+	C-
2	A-	B+	B-	C	D
1	B+	B	C+	D+	F
0	B+	B-	C	D	F

(All grades reflect the midrange and are ± roughly one step)

The grid is intended to insure 1) that solid effort in the course will *insure* a passing grade and 2) that demonstrated achievement (on exams) is the *only* pathway to superior grades. Because of the simple fact that physics *can not be learned* without substantial effort and practice, there is a strong correlation between effort and exam scores and most students end up in the unshaded area of this grid. It has overwhelmingly been my experience that good effort (>2.5) leads to good performance on exams and course grades of A or B. It has also been my experience that a lack of effort (<1.5) leads to extremely poor performance on exams and course grades of D or F.

Academic Integrity: Please be aware of the statement on academic integrity in the University catalog. My strongest desire is to act as facilitator for your studies in physics. Accordingly, I operate on the assumption that all of our interactions are based on honesty and good faith. I have no desire to act as policeman, just as *you* should not have to be concerned about being treated fairly and with respect. Because our trust in each other is crucial to the effectiveness of our relationship, I take an uncompromising, zero-tolerance stance on the necessity for sanctions when it is violated.

Course schedule:		Reading	Topics/Due Dates
Week 1	Mar 29	1.1-5	Introduction/History
	Mar 31	2.1-5	Wave equations
	Apr 2	2.6-10	Three dimensional waves
Week 2	Apr 5	(3.1-2),3.3	(EM waves) Energy and Momentum in EM radiation
	Apr 7	3.4-5, (3.6)	Radiation and Light in Matter (EM Spectrum)
	Apr 9	4.1-2	Scattering
Week 3	Apr 12	4.3-5,(4.6)	Reflection, Refraction, Fermat's Principle (EM approach)
	Apr 14	(5.1-2),5.3	(Geometrical Optics) Pupils and Stops
	Apr 16	5.7.1-5,(5.8)	Optical Systems (Wavefront Shaping)
Week 4	Apr 19		**Midterm Exam**
	Apr 21	7.1-3	Superposition of Periodic Waves
	Apr 23	7.4	Fourier treatment of nonperiodic waves
Week 5	Apr 26	8.1-3	Polarization
	Apr 28	8.4	Birefringence
	Apr 30	8.7-9	Retarders and Polarization of Polychromatic Light
Week 6	May 3	8.10-12	Optical Activity, Induced Effects, Polarization Vectors
	May 5	9.1-3	Interference and Wavefront Splitting Interferometers
	May 7	9.4-5	Amplitude Splitting Interferometers, Fringes
Week 7	May 10	9.6	Fabry-Perot Interferometer
	May 12	(10.1-2)	(Fraunhofer Diffraction) Review and/or Catch Up!
			Optional Evening Exam (6-8PM)
	May 14	10.3.1-3.5	Fresnel Diffraction, Circular Apertures and Obstacles
Week 8	May 17	10.3.6-3.7	Rectangular Apertures, The Cornu Spiral
	May 19		Fabry-Perot interferometer
	May 21	10.3.8-3.11	Diffraction by Other Obstacles, Babinet's Principle
Week 9	May 24	11.1-2	Fourier Transforms
	May 26	11.3-3.1,12.1	Fourier Optics, Coherence
	May 28	13.1-1.3	Radiation in Equilibrium, Stimulated Emission, the Laser
Week 10	May 31	*** No class meeting — Memorial Day ***	
	Jun 2	(13.1.4),13.2	(Laser Effects) Spatial Distribution of Optical Information
	Jun 4	13.3-3.1	Holography
Finals Week	Monday, June 7 (11:30 to 1:30)		**Final Exam**

AJM:3/31/99