Physics 334 Syllabus – Radiation and Optics

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Office Hours: See schedule on door or make appt (preferably by email).

Class Hours: T, Th 11:00-12:15, Workman 310
Texts: Griffiths, *Electrodynamics, 4th ed.* and Pedrotti[3], *Introduction to Optics, 3rd ed*

Pre-requisites: Phys 242 & 333 AND Math 335, *OR, consent of instructor*. No exceptions.

Course description and goals: This class is designed to help you learn the principles behind basic electro and magneto-dynamics extending from Maxwell's equation, to learn about the development of radiation, and to use EM theory to form a basic understanding of the broad field of optics - including geometrical optics/ray tracing, aberration theory, interference, diffraction, polarization, scattering, coherence and a few special topics (lasers, fiber optics, etc.). The objective of the course is to get good ground-work in some of the advanced E&M theory and the fundamentals of the optics that will you need for employment or to go on for graduate work. You will have a lot of practice solving problems, with an eye toward preparing you for graduate school or a research job in "the real world". Specific homework assignments and class announcements will be posted to the web, which you should consult regularly for updates (see above). (Anyone without web access should notify me immediately as it is a crucial form of communication for the class.)

Points and Grading: The total number of points for this course will be 1000. This will be comprised of 12 reading summaries of 10 points each totaling 120 points, about 50 homework problems of 5 points each totaling 210 points (at the end of the semester "extra" homework problems will not be counted in the total HW grade and will become extra credit if you have completed them), 1 capstone writing assignment of 75 points, 3 tests of 100 points each, one comprehensive final of 225 points and a class participation grade of 70 points. The grading scale is 92.5% and up: ***A***; 89.5-92.4%: ***A-***; 87.5-89.4%: ***B+***; 82.5-87.4%: ***B***; 79.5-82.4%: ***B-***, etc. All assignments are *absolutely due* by **4:30 pm** on the date they are scheduled to be turned in (see the website). Late homework, reading summaries and the writing assignment will not be accepted unless prior arrangements have been made or dispensation is granted to the class. Tests will **not** be reoffered, except in unusual and pre-approved circumstances. The date of the final will be announced toward the end of the semester. Grades will be available periodically for the students to check by speaking/visiting with me – please make an appointment or stop by during office hours if you are interested in your status in the course. For those students who get 89.5% or higher (i.e. an A- or higher) *on all 3 semester tests*, the final shall be *optional*. All others must take the final.

Assessment: I have written an assessment test in Optics for this course, much like the Physics Force-Concept-Inventory you took in the freshman year Physics class. This test, along with assessing your understanding of Optics, will help you track what you have learned over the semester. It will also help

you prepare a bit for the GRE, since the questions are based on those study exams. The test will be given at the beginning of the semester, and somewhere near the end, of class…details to follow later.

Tips for Success in this Class:

1) Attendance and classroom deportment: While not mandatory, it is highly recommended that you attend all lectures and the occasionally scheduled help sessions as you will learn and reinforce what you have read and studied by being present for these discussions and activities. Your class participation component of the grade will in part be determined by your attendance and by your activity and attentiveness in class discussions, and any work you are called to demonstrate at the board. (Acceptable excuses for missing class include: illness, personal or family emergencies, special research opportunities (e.g. field work, attendance at conferences). In cases of prolonged absences, corroboration for the absence may be required – e.g. letter from a physician or from the Dean of Students office.) Being on time to class shows respect for me and your classmates -- if you cannot be on time, please endeavor to cause as little disruption to the class as possible while finding your seat. Please silence cell phones in class (vibrate or visual notification is fine), focus on the lecture, and do not leave the classroom during the lecture unless arrangements have been made prior to class. Since class is over the "lunch hour" I am fine with you bringing lunch to class as long as it doesn't disrupt your neighbors.

2) Homework and Reading Assignments and Pace of the Class: Homework assignments will be posted on the website and will be due, in general, on **Thursdays by 4:30 pm** in my mailbox in Workman 333 or in my office (ONLY if I am there – please don't slip them under the door if I am not there) in Workman 357. I expect all students to take an active role in their own learning; students will *not* be "spoon fed" the answers they are expected to know and understand to complete homework problems and tests, but will instead be shown the important information/theory and some applications, and then need to take the next steps toward understanding and assimilating the material. It is my opinion that most people learn through practice, repetition and discussion with peers/instructor, and therefore reading the assignments ahead of class lectures will better prepare you to understand and absorb the material that is discussed. There is a great deal of material to cover here (4+ meaty chapters in *Griffiths* plus another 14+ thin chapters in *Pedrotti3* and any supplementary material I come up with), and I will concentrate on the parts that are most interesting to me, or that I believe to be the most important for your education as a physicist. You will best be able to ask meaningful questions and direct the discussions to your specific areas of interest if you have *prepared all the reading material* in advance of class. To assist you in staying current with your reading assignments, reading summaries will be due, in general, **every Tuesday** *at the beginning of the class period*. I am well-aware that the solutions manuals exist for these books, as well as many websites on-line. I cannot prevent you from consulting these materials, but I believe they are fundamentally harmful to your education as they leave you with a false sense of security that you know how to solve problems you may not actually understand how to solve using your own logical reasoning and understanding of physical principles. Explicit copying of these sources or the HW from other people will receive a 0 for the *entire assignment* in the first instance, and you will be reported to the Academic VP's office if it happens twice. Please consult the Student Code of Conduct/Honor Code policies if you are not clear on the procedures and academic responsibilities of students at NMT.

3) Getting Help and Your Responsibilities: Ultimately it is you who are responsible for learning the material, *whether or not I am able to cover all the material assigned in-depth in the classroom or in advance of a relevant homework assignment*. It is important that you understand that I am trying to insure that your physics education in this material prepares you to be competitive with other physics students graduating from any university in the US – so if my standards seem high, they probably are. If you are having trouble with the material, or falling behind in the homework, please make use of my office hours as soon as possible so that we may determine the best course of action to keep you on track and successful with the coursework. I will be able to do little to help you if you wait until a few hours before a test to tell me that you do not understand the material.

4) General Success Tips: I expect you will spend on average 8-10 hours a week on the reading assignments and homework assignments for this class. *For some people, particularly those struggling with the concepts or the mathematical applications, this may not be sufficient.* If you are not doing well with the material, and are spending substantially less time than 8 hours per week on your class work, then you should first find a way to spend more time on the assignments. If you are spending this amount of time on the assignments and still having trouble, please come see me to discuss it as soon as possible. Tutors are available through the OSL tutoring services on campus free of charge or I can help you find a tutor among the graduate students/upperclass students, and you should avail yourself of my time or a tutor's time whenever you are having trouble with the material. Also, finding study partners to review and work with will always help you concentrate on and absorb the material – this is called peer-instruction and has been demonstrated to be a successful way to learn physics in many published studies. One strong word of caution, do not wait until the night before a homework assignment is due to start working on it as many of these assignments are complex and require some time to think and determine the best path forward.

You will notice that the distribution of class points is 33% on HW and reading summaries, 52.5% on semester tests and the final, and 7.5% on the writing assignment, with the balance of 7% on your class participation/attendance. Each component is important to your grade if you plan to pass the class; all parts are integral if you strive for an ***A***. (By the way, if you get As on all 3 tests and therefore do not take the final, these percentages change to: 42.5% HW and reading summaries, 38.7% on the tests, 9.7% on the writing assignment and 9% on class participation.)

Essential Content of Various Assignments and Tests:

Reading summaries: Each reading summary will consist of ***two parts***. The first part is approximately one to two pages (handwritten (legibly please) or typed) discussing what key concepts and ideas you learned in the assigned sections. Each should be written in such a way to serve as excellent review material for a test. You may write this as a narrative, an outline with details, or multiple paragraphs – whichever you prefer. In any case, I expect to see *relevant equations included* and discussed. The second part shall consist of 1-5 outstanding questions or clarifications you would like to have about the material either via a personal dialog with me or in class. Please leave me some space to answer if possible. Each assignment will be worth 10 points. *You will only receive 5 points if you don't pose any questions.*

Homework assignments: Homework assignments should include your name, the assigned problems and date due, all steps necessary to show your work, labeled diagrams (especially when line/area/volume integrals are employed), full sentences to explain the steps/assumptions in your solutions, and source code for any computer generated graphs you produce. In the case where an integral or other complicated mathematics is done using a calculator or computer program, sufficient detail must be provided for me to understand what you put into the machine. Wrong answers derived due to putting mistaken input into a computer will be treated in the same way as any other mistakes. *You are encouraged to work together on the homework, but in that case you should list which students you worked with underneath your name.* Each assignment will vary in points depending upon how many problems are in it. Each problem shall be worth 5 points in general (though some long problems may be designated double). At the end of the semester, the total points for the homework will be calculated (all HW is worth 210 points) and any extra problems done beyond this will count as extra credit (for a total of up to 35 extra credit points maximum in this case).

Writing Assignment: A few weeks into the semester, a detailed capstone writing assignment will be handed out which will be due toward the end of the semester. The purpose of the writing assignment will be for you to work on your written communications skills in physics on a topic closely related to the course content. Several sample topics will be presented to you. An abstract of approximately ½ page will be due about 3 weeks after the assignment is handed out. As is to be expected, references, grammar and technical content will all count for this paper. Please plan to make use of writing resources available on campus at the Writing Center if you feel written communication is difficult.

Tests: You will take 3 tests during the semester, potentially hybridized with in-class and take-home components to them. The tests are each worth 100 points and will be strictly your own work. For the in-class portions of the tests, you may bring ½ page, one side, of equations/notes and a calculator with you for the test. For the take-home portion of the test, you will be given 1 week to complete the test *on your own* (open-book), and will be required to adhere to the academic honesty policies at NMT. Some number of questions from the take-home portion of the test will be chosen at random to be turned in with the in-class portion of the test. The final test is worth 225 points and will be both hybridized and comprehensive in nature. Tests usually consist of 3 portions: conceptual questions, short-answer calculations, and more complicated calculations. They also often include short-answer extra credit problems/concepts. The test problems will resemble homework assignments, textbook examples and in-class examples, but will often require you to synthesize new information in real-time.

Extra Credit: This will be announced sporadically throughout the semester and will most likely take the form of a report on a colloquium or other talk on campus, details to follow. The total for all extra credit assignments (including the extra credit portion of the homework discussed above) will not be more than 75 points total.

Overview for the semester: (exact sections TBD – will be announced on website – see above)

Week	**Starting date**	**Chapter**
1	Jan 15	(Griffiths) Brief review Maxwell's Eqns; *Optics Pretest*; Ch 8 – Maxwell's equations & Conservation Laws
2	Jan 22	Ch 9 – EM waves and applications
3	Jan 29	Ch 9 con't & Ch 10 – Pot'ls and Gauge Theory
4	Feb 5	Ch 10 & start Ch 11 – Radiation
5	Feb 12	Finish up Griffiths material and some review
6	Feb 19	***Test #1 – Ch 8-11 + Supp;*** start optics (Pedrotti) Ch 1 & 2
7	Feb 26	Ch 3 & 4 – Instruments and Wave Eqns., ***Writing abs due***
8	Mar 5	Ch 5 & 6 – Superposition and Laser theory
9	Mar 12	SPRING BREAK
10	Mar 19	Ch 5 & 6 – Laser theory and lasers
11	Mar 26	Ch 7 – Interference
12	Apr 2	Ch 8 & 9 Optical Interf. & coherence; ***Test #2- Ped 1-5***
13	Apr 9	Ch 10 & 11 – Fibers & Frauhofer diff.
14	Apr 16	Ch 12 & 13 – Gratings & Fresnel diffraction; ***Final paper due.***
15	Apr 23	Ch 14 & 15 – Polarization
16	Apr 30	2-3 special topics TBD; *Posttest*; ***Test #3- Ped 6-11***
17	May 7	**Finals week** – **Comprehensive Final including after test #3**