PHYS 425: Modern Optics and Photonics (Spring 2012)

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Course home page: http://atomoptics.uoregon.edu/~dsteck/teaching/12spring/phys425

Schedule: MWF 9:00-9:50, 318 Willamette
Course reference number: 37054
Credits: 4
Prerequisites: PHYS 424

Links: news, course notes, homework sets and keys.

Course overview

This course will provide a broad overview of Fourier optics, light-atom interactions, laser physics, and other topics in modern optics. See the tentative syllabus below for a preliminary list of topics we will cover.

Texts: There is no required textbook for this course. Course notes will be posted on this site as the term progresses; they may be downloaded all at once here, but this document may be updated during the course.

There are many other excellent standard optics texts that you may find useful for this course, such as:

- Pedrotti, Pedrotti, and Pedrotti, Introduction to Optics
- Fowles, Introduction to Modern Optics
- Saleh and Teich, Fundamentals of Photonics
- Hecht, Optics
- Verdeyen, Laser Electronics
- Siegman, Lasers

Grades

Grades for the course will be based on homework, two mid-term exams, and a final exam. The relative weights will be as follows:

- Homework: 40%
- Mid-term exam 1: 15%
- Mid-term exam 2: 15%
- Final exam: 30%

Homework: this is a homework-intensive course. Homework will be assigned weekly and each assignment will be due in class one week after it is assigned. Thereafter, late homework will be accepted, but at a 25% penalty for each 24 hour period it is turned in late. Partial assignments may be turned in, and only the late portion will be penalized. The relative contribution of each homework assignment to the final grade will depend on its difficulty.

Mid-term exam 1: in class, Wednesday, 25 April. If possible, I would like to reschedule this exam for an evening to reduce time pressure.

Mid-term exam 2: in class, Wednesday, 23 May. If possible, I would like to reschedule this exam for an evening to reduce time pressure.
Final exam: The final exam will be held Monday, 6 June, 10:15-12:15, in 318 Willamette.

Pass/fail grading option: a passing grade requires the equivalent of a C- grade on all coursework (homework and final).

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**Computer access**

Some of the homework will require access to a computer for basic calculations (in low-level languages such as C or Fortran, or any of several higher-level packages such as Mathematica, Maple, Matlab, Octave, Mathcad, etc.) and basic plotting (e.g., GNUplot, Excel, etc.). I will use Mathematica for examples because of its availability at UO, but it is not necessarily the best choice for any particular problem. Contact the instructor as soon as possible if you do not already have access to such resources.

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**Syllabus**

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<th>Monday</th>
<th>Wednesday</th>
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<tr>
<td>2 April Fresnel Relations: Internal Reflection</td>
<td>4 April Fresnel Relations: Conductors</td>
<td>6 April Thin Films: Reflection Model</td>
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<td>9 April Thin Films: Matrix Formalism</td>
<td>11 April Thin Films: Coating Design</td>
<td>13 April Fourier Analysis II: Convolution, Green's Functions</td>
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<td>16 April Fourier Analysis II: Convolution, Green's Functions</td>
<td>18 April Fourier Optics: Wave Propagation</td>
<td>20 April Fourier Optics: Fraunhofer Diffraction</td>
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<td>23 April Fourier Optics: Fresnel Diffraction</td>
<td>25 April Midterm Exam 1</td>
<td>27 April Fourier Optics: Spatial Filtering</td>
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<td>30 April Fourier Optics: Holography</td>
<td>2 May Statistical Optics: Coherence</td>
<td>4 May Statistical Optics: Interference and Visibility</td>
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<td>7 May Laser Physics: Overview</td>
<td>9 May Laser Physics: Gain Saturation</td>
<td>11 May Laser Physics: Light-Atom Interactions</td>
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<td>14 May Laser Physics: Optical Gain and Pumping Schemes</td>
<td>16 May Laser Physics: Output Characteristics travel to Exp. Chaos Conf., class to be rescheduled</td>
<td>18 May Atom Optics: Light Shifts and Optical Forces travel to Exp. Chaos Conf., class to be rescheduled</td>
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<td>21 May Atom Optics: Atom-Photon Interactions</td>
<td>23 May Midterm Exam 2</td>
<td>25 May Atom Optics: Laser Cooling and Trapping</td>
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<td>28 May No Class: Memorial Day</td>
<td>30 May Fiber Optics: Mode Analysis</td>
<td>1 June Fiber Optics: Loss and Dispersion</td>
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<td>4 June Photonic Bandgap Crystals: Kronig-Penney Model</td>
<td>6 June Photonic Bandgap Crystals: Fabrication and Performance</td>
<td>8 June Review</td>
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**Other important dates:**
Last day to drop without a 'W': 9 April
Last day to register: 11 April
Last day to withdraw: 20 May