PHO 102 Applied Optics
4 credits (3 hour lecture, 2 hour lab)

J. Donnelly
Office: C238
Office Hours: MTW 11-12

Prerequisites: MAT 137 and PHO 101; or permission of the instructor
Corequisites: MAT 186 (Precalculus)

This course is the second semester in a sequence to introduce optics and its applications. Building on the foundations of PHO 101 Introduction to Photonics, you will study more involved systems of lenses, including stops, pupils and windows and aberrations. Matrix methods will be introduced. Topics from wave optics include coherence, types of interferometers and their applications, thin films, Fresnel and Fraunhofer diffraction, scattering, production and modification of polarized light. Natural and technical applications of optical phenomena will be emphasized.

The laboratory parallels the classroom lectures. You will construct and evaluate multiple lens systems and various interferometers using both rail and breadboard systems. Classroom demonstrations, Internet web sites, and in-class mini labs and team projects will be used extensively.

References:
The course will be taught mainly from instructor notes. You need to have a binder for organizing them. We will also use the text from PHO 101, LIGHT-Introduction to Photonics. Other useful books are:

J.R. Meyer-Arendt, *Introduction to Classical and Modern Optics, Fourth Edition*; Prentice Hall. This book is out of print, copies are available in the lab and from used book sellers.

Pedrotti and Pedrotti, *Introduction to Optics, Ed 4*, Prentice Hall 1993
This is an advanced text, available in the TV campus library.

Hecht*, Optics, Ed 4*, Addision Wesley, 2002.
This is also an advanced text, with beautiful photos of optical phenomena.

Attendance Policy
Students are expected to attend all classes, to be on time and to be prepared. Since the course is based on instructor notes, you need to be in class!

Homework
Homework will be assigned for every class. You are expected to make a good effort to solve the homework problems- if you get stuck, send me an email or talk with other students. You learn by trying. Be sure you understand each problem that is assigned- if you don't, ask in class to see the solution or come to office hours for help.

Course Topics with Approximate Hours

LENSES

Review of basic optics	1.5
Review of thin lenses, mirrors and imaging	4.5
Thick Lenses: principle planes, equivalent power front and back vertex power	6.0
Matrix methods: matrix algebra, refraction, translation and thin lens matrix, system matrix	1.5

TEST: THICK LENSES (In class/take home)

Aberrations: description of 3rd order; calculation of correction for spherical aberration and chromatic aberration	4.5
Apertures, stops and pupils	4.5

LAB TEST: telescope design

WAVE OPTICS

Review of interference	1.5
Diffraction gratings and interferometers	6
Thin films and air wedges	3
TEST: Interference	**1.5**
Coherence	1.5
Diffraction	3
Scattering	1.5
Polarization	4.5

FINAL: Wave Optics (in class/take home)

TENTATIVE LAB EXPERIMENTS

Two thin lenses	Telescope design
Negative lens focal length	Filter characterization
Spherical mirror focal length	Air wedge
Equivalent lenses	n for air- Michelson interferometer
Matrix Methods	single slit diffraction
Aberrations	malus' law
Lens design	identification of polarization state

Exam Policy

Several exams are scheduled- some in class and some take home. Teamwork is not discouraged on take home tests- in fact, it is encouraged as long as all members of the team are equally involved. For in class exams, a sheet of equations will be allowed.

Makeup exams will only be given in the case of serious illness or other bona-fide excuse. Students will be expected to have appropriate documentation to schedule a make-up exam.

If it becomes evident that good effort is not being expended on homework, there will be pop quizzes as well. These will be open book but time limited.

Laboratory Reports

Each lab will have specific items that need to be handed in. Be sure to find out what is expected of you before leaving the lab for the day. Most labs will be graded on the basis of 10 points, but some may only be checked off that they were completed.

ALL labs are expected to be neat and complete. Incomplete labs will not be graded.

No lab reports will be accepted more than 2 weeks after the experiment is completed, or after the graded lab is returned to the class.

Grade Determination

The final grade will consist of:

Class participation	10%	
Tests:	65%	
Lab:	25%	(You must pass the lab to pass the course)

Class Participation: The class participation grade will depend first and foremost on attendance, being on time and prepared with completed homework. Occasional assignments such as research on companies or participation in out of class enrichment activities (field trips, volunteer activities), will be included in this category.