OPTI 415L/515L – Optical Fabrication and Testing Laboratory

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Class: Meinel 432, on Wednesdays 11:00 – 11:50
Lab: Meinel 440, times to be arranged

This class introduces students to equipment and techniques for setting up optical experiments and making measurements in the lab. The labs should demonstrate some fundamentals of optical fabrication and testing.

The class meets weekly on Wednesdays to go over the upcoming lab, and to discuss results from the previous lab. The lab work should be done in groups of two to four students per group, in three-hour weekly sessions.

Each group must schedule their lab session with the TA, who will post the schedule, and will assist with the labs. You will usually be able to stay past the scheduled time, and you can schedule additional time in the lab. You may have access to the lab after hours, just coordinate this with the TA.

Preparation for the labs is essential. Handouts will be available the previous week before the experiment, available at http://www.optics.arizona.edu/fab&test/Fall09/lab/index.htm. References are listed and will be posted at that site.

The **lab notebook** is the most important part of the lab. You need to keep your notebook up to date, and write in it as you do the lab. You must use a bound notebook that has numbered pages that cannot come out. Your notebooks must contain everything needed to reproduce the experiment:

Date, time, lab partner(s)
Objective of the experiment
Diagrams of any set-ups
All observations and comments
Required calculations with equations
Answers to the questions from the handouts

The notebook must be neat enough that somebody else reading your notebook could understand what you did. All markings in the lab notebook should be made in pen. It is a good idea to cut out and tape relevant material into your notebook where appropriate. Use digital images where appropriate. It is also useful to keep a table of contents for your notebook.

The grade for this course is based on your lab notebook (75%) and a final paper (25%). The notebooks will be graded on the basis of completeness of the lab write-up and answering the questions. Each lab will be graded for the following:

- Preparation: Before starting the lab, the objective should already be entered into the notebook, along with a summary of the preparation that was completed.
- Diagrams of lab setups, Should be concise, yet include important parameters
- Any data, presented in a neat form, including labels
- Observations, should be concise and neat
- Answers to questions if any

Final Paper

At the end of the term, you must submit a 3-5 page paper covering a topic of your choice from this course. The paper, which should be written as an informal technical memo, will be worth 25% of your grade. The paper should present a summary of one of your labs in a complete and concise way. It should include the following:

- Introduction
- Description of the equipment and setup
- Presentation of the data, including uncertainties
- Discussion, including interesting observations
- Lessons learned

The paper is due at the end of the term with your lab notebook, but it can be turned in any time in the semester before that.

Nominal Syllabus (To be modified)

First Order Optics
Use paraxial properties and PSM to find radii, index and thickness of a lens
Use nodal slide to find effective focal length

Image Quality
Use PSM to look at unaberrated spot through focus
Use PSM to look at comatic and astigmatic spot through focus

Wavefront Quality
Use interferometer to study same aberrations as in previous lab
Show relationship of image aberration to wavefront aberration

Alignment and Affects of Misalignment
Use PSM and alignment telescope to align a system of two lenses as a 4f system
View aberrations as alignment errors are reduced

Micro Interferometry and Surface Roughness
Interference microscopes to inspect for defects and surface imperfections
Study lens mechanical parameters like center thickness, diameter and wedge

Test at Finite Conjugates
Interferometric testing at center of curvature and errors due to misaligned interferometer

Index Measurement and Spectrophotometry
Measurement of index using prism spectrometer, Abbe refractometer and Brewster's angle
Spectrophotometry using prism spectrometer

Measurement of Parallelism, Angle and Transmission
Use autocollimator to measure parallelism of windows and prism surfaces and combined with sine plates and angle gauge blocks to measure prism angle
Use test plates and plano interferometer to study flatness of transmitted wavefront through window

Lens Centering and Wedge Measurement
Use Twyman-Green and PSM with rotary table to measure lens centering and wedge

Alignment of Aspheres
Lateral shearing interferometry
Off-axis parabola alignment with PSM and autocollimating flat

Knife edge, Wire and Ronchi Test
Perform Focault, wire and ronchi test on lenses

System Alignment
Construct and align optical system used in the 515 class using a PSM and alignment fixture