OPTI 586L: Polarization in Optical Design Lab
Syllabus Fall 2023 1 credit instructor: Greg Smith

Time and Location:
Friday, 9:30am-10:20am in room 305

Course Description:
Polarization is a fundamental component of electromagnetic waves. In some products, such as LCD monitors, polarization forms the backbone of optical design. For other components, such as the coated optics, polarization may not the main objective but can play a role in optical system performance.

The goal of this course is to apply theoretical principles of polarization to practical problems in optical design, and practice overcoming common pitfalls in polarization engineering. Topics grow from fundamental to advanced and follow the associated lecture class:

- **Mathematica Fundamentals.** Programming fundamentals.
- **Polarization Ray Tracing.** Cascading polarization effects through systems. Interpreting Jones matrices.
- **Polarization Effects at Reflecting and Refracting Interfaces.** Fresnel equations. Multilayer thin films.
- **Advanced Polarization Models.** Anisotropic materials and interfaces. Birefringent ray tracing.

You will develop skills through weekly questions designed to illustrate how polarization analysis is applied to practical applications. In-class time will be primarily spent reviewing the concepts associated with the assignment. Collaboration to understand concepts is strongly encouraged, but each person is required to submit their own work. Expected weekly workload is approximately 2-3 hours beyond the in-class time.

Expected Learning Outcomes:
By the end of this course, you should be able to:

- solve polarization Jones vector and Jones matrix calculations making use of Mathematica programming language
- infer properties of diattenuation and retardance by analyzing polariscope images
- assess impact of system polarization arising from optical components including coated and uncoated surfaces as well as crystal materials
- design a computational model for evaluating a polarization-sensitive system

Pre-requisites and requirements:
You are expected to be familiar with OPTI-586 lecture material and are encouraged to take this lab class concurrently with the lecture class.

Mathematica software is required. Previous experience with Mathematica is not required, but students are expected to learn basic functionality during the semester. Students are also expected to be familiar with basic programming principles found in scientific programming environments (example: Python, MATLAB, etc.). Mathematica may be purchased from: http://store.wolfram.com Student licenses are available with semester, yearly, and perpetual terms. You will need the *desktop version of Mathematica*.

Instructor Information:

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Office hours:

For discussion outside class hours, I have an open door policy. Please contact me at any time by phone or by email. If I cannot immediately respond, we can make a plan to meet in person or via Zoom.

Grading Policy:

Weekly questions (approximately 10 questions per week): 100%
- 80%: demonstration of correct concepts
- 20%: calculation correctness

Final Exam: none

Late policy is as follows unless permission is granted prior to the due date
- Within 24 hours of due date: -10%
- Within 1 week of due date: - 20%
- More than 1 week late: -50%

In other words, the maximum score attainable for submissions more than one week late is 50%. All students will receive a one-time late submission grace period of one week without any grade reduction. On time homework will be graded and returned within a week of submission, late assignments will be graded within 2 weeks of submission.

Assignments, related materials, and grades will be posted in the course D2L website (https://d2l.arizona.edu/). Weekly questions range in scope from correct application of relevant concepts to open-ended questions about improving or expanding polarization usage in optical design.

Grade evaluation and feedback, via solution sets and comments in returned assignments, will focus primarily on whether correct concepts are demonstrated. This means all answers must be supported with logical, fact-based evidence such as calculations or plots. Explaining your reasoning with comments is also a recommended strategy, especially if you get stuck or are unsure. To further the learning objectives, bonus points may be awarded for self-initiated polarization analysis related to the assignment topic.

Final grades are computed from the total of all points and are awarded based on percentage of available points. Please contact me if you have any questions about grades.

A: over 90% B: 80% - 90% C: 70% - 80% D: below 70%

Safety on Campus and in the Classroom:
For a list of emergency procedures for all types of incidents, please visit the website of the Critical Incident Response Team (CIRT):
https://cirt.arizona.edu/case-emergency/overview

Nondiscrimination and Anti-harassment Policy
The University of Arizona is committed to creating and maintaining an environment free of discrimination. In support of this commitment, the University prohibits discrimination, including harassment and retaliation, based on a protected classification, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information. For more information, including how to report a concern, please see: http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

University Policies
The university maintains several policies regarding safety, inclusiveness, and academic integrity, among others. As instructor, I firmly believe in upholding these values, and expect you to abide by the policies as well. For details regarding all university policies related to this course syllabus, please visit: https://catalog.arizona.edu/syllabus-policies

Information contained in this course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor of this course.