OPTI 586L: Polarization in Optical Design Lab
Syllabus Fall 2022 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.
- **Realistic 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.

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, but I welcome the use of in-class time to review relevant concepts. Students are encouraged to take this lab class concurrently with the associated 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: MATLAB, Python, 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:

Greg A. Smith
Wyant College of Optical Sciences, Room 106A
The University of Arizona
1630 East University Boulevard, Meinel Building
Tucson, AZ 85721
Phone: 520-621-8742
gasmith@arizona.edu

Office hours:
For discussion outside class hours, feel free to 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
- late penalty of 10% per day unless permission granted in advance or emergency situation

Final Exam: none

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%

Attendance Policy:

Absences are sometimes unavoidable. Although it is your responsibility to obtain and review any information that was missed, I can assist you to minimize disruption to the learning experience. If you must be absent for any reason, please contact me when it is practical.

Academic Integrity:

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. https://deanofstudents.arizona.edu/policies/code-academic-integrity

Accessibility and Accommodations:

At the University of Arizona we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268 or http://drc.arizona.edu/) to establish reasonable accommodation.

Preferred Gender Pronoun:

This course affirms people of all gender expressions and gender identities. If you prefer to be called a different name than what is on the class roster, please let me know. The University of Arizona is committed to creating and maintaining an environment free of discrimination.

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 see: https://academicaffairs.arizona.edu/syllabus-policies

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