

# OPTI 586L: Polarization in Optical Design Lab

Syllabus Spring 2026 1 credit instructor: Greg A. Smith

## Time and Location:

Friday, 11:00am-11:50am in Meinel 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 be 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:

- **Fundamentals.** Interpreting Jones matrices. Coordinate systems
- **Polarization Effects at Reflecting and Refracting Interfaces.** Fresnel equations. Multilayer thin films.
- **Polariscope Insights.** Increase benefits from this tool.
- **Advanced Polarization Models.** Anisotropic materials. Realistic waveplates and realistic polarizers.

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 metals, coated and uncoated dielectric surfaces, as well as crystal materials

## Pre-requisites and requirements:

You are expected to be familiar with basic polarization concepts and are encouraged to take this lab class concurrently with the lecture class (OPTI-586).

*Mathematica software is required.* Previous experience with Mathematica is not required, but students are expected to learn basic functionality during the semester. Significant algorithms and code will be provided. 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 monthly, semester, and yearly terms. The *desktop version of Mathematica* is strongly recommended. Coding assignments must be submitted as Mathematica notebooks.

**Instructor Information:**

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**Office hours:**

For discussion outside class hours, I have an open door policy. When the door is open, you are welcome to stop by my office, and we can discuss. Feel free to also contact me at any time 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: -5%
- Each additional day: -10%
- Maximum late penalty: -50%

In other words, the maximum score attainable for submissions more than one week late is 50%. On time homework will be graded and returned within a week of due date, 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%

## **Generative AI**

In this course, the use of generative artificial intelligence/large language model tools is permitted, but must be acknowledged or cited. If you do not acknowledge or cite AI generated content as part of your code comments or other submitted material, it will be considered a form of cheating or plagiarism.

You are responsible for checking facts, finding reliable sources for, and making a careful, critical examination of any work that you submit. The goal of this class is to improve your polarization knowledge, but AI tools can sometimes assist with the programming aspects of the course. At the same time, AI tools may make up or hallucinate information. These tools may also reflect misconceptions and biases of the data they were trained on and the human-written prompts used to steer them. In my experience, errors are especially common for advanced polarization topics covered in this class. You are responsible for ensuring the accuracy of all submitted materials.

## **Accessibility & 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, <https://drc.arizona.edu/>) to establish reasonable accommodations.

## **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 additional policies regarding safety 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.*