Syllabus: OPT 586 Fall Semester 2021

Polarization in Optical Design (3) Principals of the calculation of polarization effects in optical systems; Geometrical optics; Polarization ray tracing. Polarization aberration function. Examples of polarization aberrations.

Units: Lecture (3), Lab (1)

Monday and Wednesday 9:30 – 10:45 am Room: Meinel 305

Instructor: Russell A. Chipman, Professor
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Course Outline

- **Polarized Light and Polarization Elements.** Jones vectors and matrices. Diattenuation. Retardance. Birefringence. Dichroism. 3D polarization ray tracing calculus.
- **Geometrical Optics and Optical Design**. Ray tracing. Exit pupil. Aberrations. Wavefront aberration function.
- **Polarization Ray Tracing.** Cascading polarization effects through systems. Polarization aberration function and Jones pupil.
- **Polarization Effects at Reflecting and Refracting Interfaces.** Fresnel equations. Multilayer film polarization.
- **Polarization Aberrations.** Angle of incidence, diattenuation and retardance maps. Amplitude response matrix and polarization point spread function. Calculation of retardance.
- **Polarization Aberrations Examples.** Uncoated lens. Microscope objective. Combinations of folding mirrors. Cassegrain telescope.
- **Polarization Models.** Anisotropic materials and interfaces. Birefringent ray tracing.
- **Polarization Analysis Examples.** Selection of examples from the following topics: Skew aberration. Matrix logarithms and exponentials. Crystal polarizers. Diffractive optical elements and RCWA. Liquid crystal cells. Stress birefringence. Retardance spectra in compound retarders. Comparison of polarization aberration and polarization ray tracing methods.

Class treats the principals of the calculation of polarization effects when light propagates through optical systems and the interpretation of the resulting polarization aberrations. Use of Mathematica. Students are encouraged to register for the associated one unit Polarization in Optical Design Lab OPTI 586L.

Grading:

- Homework 70%
- Midterm 10%
- Final exam 20%

Textbook: Polarized Light and Optical Systems, Russell Chipman, Wai Sze Tiffany Lam, and Garam Young, CRC Press, 2018. ISBN 9781498700566.

Available from:
https://www.amazon.com/Polarized-Optical-Systems-Sciences-Applications/dp/149870056X
https://www.crcpress.com/Polarized-Light-and-Optical-Systems/Chipman-Lam-Young/p/book/9781498700566

Software

Class will use Mathematica from Wolfram Research and the Polaris-M polarization analysis program from Airy Optics, Inc. Students should purchase a student version of Mathematica from Wolfram Research. Two week trial licenses are available.
Please begin your Mathematica training with Steven Wolfram's book available online
https://www.wolfram.com/language/elementary-introduction/2nd-ed/
Information on Polaris-M will be provided during class.

Suggested reference works on polarization (not required)

- D. Goldstein, Polarized Light, Third Edition. CRC Press, 2010.
- J. Damask, Polarization Optics in Telecommunications. Springer. 2005.
- C. Brosseau, Fundamentals of Polarized Light, Wiley, 1998.

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Misconduct of any kind will be prosecuted and may result in any or all of the following:

* Reduction of grade
* Failing grade
* Referral to the Dean of Students for consideration of additional penalty, i.e. notation on a student's transcript re. academic integrity violation, etc.

Accessibility and Accommodations

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