OPTI 600B: Linear Algebra for Optics
Effective Fall Semester 2014

Course Description:

Linear algebra techniques arise in many areas of optics. However, due to the diversity of backgrounds, students taking optics coursework may have limited or no exposure to these techniques. This course reviews the fundamentals of linear algebra and illustrates these concepts with applications to various fields of optics. The goal of the course is to improve the student's linear algebra skills and connect the mathematical concepts to real world applications.

Pre-requisites:

No specific coursework is required, but students should have a basic understanding of the concepts of geometrical optics, polarization, resonators and color spectra. Familiarity with a high level programming language such as Matlab for data analysis and matrix manipulation is required.

Number of Units/ component:

1

Locations and Times:

Dynamically Dated course: 08/25/2014-09/25/2014

MW 3:30-4:45

Meinel room 307

Instructor Information:

Jim Schwiegerling, PhD
Meinel 725
520-621-8688
jschwieg@u.arizona.edu
Office hours: By Appointment

Expected Learning Outcomes:

- Ability to mathematically manipulate matrices including addition, multiplication and inversion.
- Apply matrix techniques to analysis of optical system properties, polarization optics and colorimetry.
- Analyze and fit data using matrix techniques such as least squares, principal component analysis and singular value decomposition.

Required Texts:

Course notes will be available on the course website.

Topics and/or general calendar:

Tentative Lecture Schedule:

1. Review of basic matrix operations: Addition, subtraction, scalar multiplication, matrix multiplication, transposition, determinants.
2. Gauss-Jordan elimination, matrix inversion, eigenvectors and eigenvalues, null space.
3. Coordinate transformation, affine transforms
4. Application of 2x2 matrices to the layout of rotationally symmetric optical systems.
5. Finding cardinal points, system matrix, extensions to systems with planar symmetry.
6. Resonators
7. Polarization optics, Jones calculus
8. Stokes vectors and Mueller calculus
9. Principal components analysis
10. Singular value decomposition

Number of Exams and Papers:

Exams and papers will not be used for this class. Evaluation of knowledge will be done with a series of progressively more sophisticated homework assignments that require the student to implement the concepts discussed in that week's class and apply the knowledge to real world problems.

Course Policies:

<u>Grading Policy</u>

The final grade will be comprised of a total of five homework assignments.

<u>Homework(5 assignments total)</u>   100%
Total   100%

The grade will be determined according to the cumulative percentage earned such that 90-100% = A, 80-89% = B, 70-79% = C, 60-69% = D, below 60% = E.

Academic Integrity (http://web.arizona.edu/~studpubs/policies/cacaint.htm)

According to the Arizona Code of Academic Integrity, "Integrity is expected of every student in all academic work. The guiding principle of academic integrity is that a student's submitted work must be the student's own." Unless otherwise noted by the instructor, work for all assignments in this course must be conducted independently by each student. Co-authored work of any kind is unacceptable. Misappropriation of exams before or after they are given will be considered academics misconduct.

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.

Attendance Policy

It is important to attend all classes, as what is discussed in class is pertinent to adequate performance on assignments and exams. If you must be absent, it is your responsibility to obtain and review the information you missed. This is especially important in this course where a substantial amount of course material will emerge through class discussion.

"All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion. Absences pre-approved by the UA Dean of Students (or Dean's designee) will be honored."

Classroom Behavior

The Arizona Board of Regents' Student Code of Conduct, ABOR Policy 5-308, prohibits threats of physical harm to any member of the University community, including to one's self. See: http://policy.web.arizona.edu/threatening-behavior-students.

Students with Disabilities

If a student is registered with the Disability Resource Center, he/she must submit appropriate documentation to the instructor if he/she is requesting reasonable accommodations. (http://drc.arizona.edu/instructor/syllabus-statement.shtml).

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