Mathematical Methods for Optics, OPTI 604, Fall 2021

**Course contents:** Linear systems theory and Fourier theory with applications in paraxial optics and imaging. Coherent and incoherent imaging. Operator theory and integral transforms. Special functions and orthogonal polynomials. Linear algebra. Green's functions.

**Pre-requisites:** MATH 223, PHYS 142 and PHYS 241

**Learning Outcomes:**
- Compute relevant parameters for discrete and continuous linear systems and relate to physical observables.
- Identify operator transforms to model basic optical experiments.
- Describe common challenges and solutions in numerical implementations.
- Propose an optical experiment and design the system’s numerical model with stated assumptions, limitations, and propose validation measurements.

**Instructor:** Meredith Kupinski, Research Professor
Wyant College of Optical Sciences, The University of Arizona
1630 East University Boulevard, Meinel Building Room 645 Tucson, AZ 85721
Phone: 520-626-3985 meredith@optics.arizona.edu

**Class Hours:** Tuesday & Thursday 12:30 - 1:45 pm in Meinel 432

**Cancellations:** week of Thanksgiving break

**Office Hour:** Tuesday 1:45 pm - 2:45 pm Meinel 645

**Teaching Assistant:** Khalid Omer, komer@email.arizona.edu

**TA Office Hour & Recitation:** Monday 1pm, break area near Meinel 747 (virtual on Aug 30th)

**D2L Web Site:** is set up for posting problem sets and solutions, and submitting homework. Homework is submitted through D2L. The late policy is as follows:
- Within 24 hours of due date: -10%
- Within 1 week of due date: -20%
- More than 1 week late: -50%

i.e. 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.

**Please put the problem number and your name on every page to facilitate grading. Only D2L homework submissions will be accepted.**
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UA library (electronic version)
https://ebookcentral.proquest.com/lib/uaz/detail.action?docID=708238

**Grading:**

Due on 11:59 PM-MST of dates listed below

- 6 Homework Assignments 40%  
  Mondays:
  Aug 30, Sept 13, 27,  
  Oct 11, 25, Nov 8

- Midterm Report 30%
  1. Blind peer submission  
     Monday Nov 15
  2. Peer feedback  
     Monday Nov 22
  3. Final submission  
     Monday Nov 29

- Presentations in class 30%  
  Dec 1, 6, 8

- (20 min each student)

**Course Outline:**

Chapter 1

Chapter 2

Chapter 3
- **Fourier Analysis.** View from the complex plane. Relations between Fourier series, Fourier transform, and discrete Fourier transform. Convergence issues. Convolution and correlation. Sampling theory.

Chapter 4
- **Series Expansions and Integral Transforms.** Orthogonal Polynomials. Prolate spheroidal wave functions. Laplace, Radon, Mellin, Hilbert transform.

Chapter 5

Course Syllabus
Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at [http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete](http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete) and [http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal](http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal) respectively.

**Absence and Class Participation Policy**

The UA’s policies concerning Class Attendance, Participation, and Administrative Drops is available at: [http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop](http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop)

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, [http://policy.arizona.edu/human-resources/religious-accommodation-policy](http://policy.arizona.edu/human-resources/religious-accommodation-policy).

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: [https://deanofstudents.arizona.edu/absences](https://deanofstudents.arizona.edu/absences)

Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all lectures and discussion section meetings. Absences may affect a student’s final course grade. If you anticipate being absent, are unexpectedly absent, or are unable to participate in class online activities, please contact me as soon as possible. *To request a disability-related accommodation to this attendance policy, please contact the Disability Resource Center at (520) 621-3268 or drc-info@email.arizona.edu.* If you are experiencing unexpected barriers to your success in your courses, the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office is located in the Robert L. Nugent Building, room 100, or call 520-621-7057.

**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. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog: [http://deanofstudents.arizona.edu/codeofacademicintegrity http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity](http://deanofstudents.arizona.edu/codeofacademicintegrity http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity). The UA Libraries have some excellent tips for avoiding plagiarism, available at: [http://new.library.arizona.edu/research/citing/plagiarism](http://new.library.arizona.edu/research/citing/plagiarism). Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor’s express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

**Students with a Learning Disability**

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, [https://drc.arizona.edu](https://drc.arizona.edu)) to establish reasonable accommodations.

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](http://drc.arizona.edu/instructor/syllabus-statement.shtml)).
Nondiscrimination and Anti-harassment Policy
Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others. The UA is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Classroom Behavior Policy
To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Threatening Behavior Policy
The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

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