OPTI 403A/503A
"MATHEMATICAL METHODS FOR OPTICS AND PHOTONICS"

Spring Semester (Wednesday, January 10 – Wednesday, May 1) 2024

Time: Mondays & Wednesdays, 11:00 am – 12:15 pm

Place: James C. Wyant College of Optical Sciences, Meinel Building (West Wing), Auditorium 305

Course Description: This course covers the basic mathematics needed for an in-depth understanding of the science and technology of Optics & Photonics, including fiber-optical communication systems. Every mathematical tool/technique developed in this course will first be motivated by the relevant application. The students are not expected to have a broad-based prior knowledge of the topics covered in this course, but they should generally be familiar with the basics of algebra, Euclidean geometry, trigonometry, integral and differential calculus, simple differential equations, and the rudiments of complex number theory and applications. The course aims to cover complex analysis, Fourier transform theory, stationary-phase approximation (in the context of optical diffraction), vector algebra, linear algebra, ordinary and partial differential equations (e.g., Maxwell's electrodynamics, wave equation, diffusion equation), special functions (e.g., Bessel functions needed to study the guided modes of optical fibers), and probability theory (needed for understanding various sources of noise in communication systems, photodetection theory, digital communication via noisy channels, Information theory, etc.).

OFFICE HOURS
Tuesdays & Thursdays 2:00 to 3:30 pm (College of Optical Sciences, Room 638).
TEACHING ASSISTANT (TA) AND OFFICE HOURS
Teaching Assistant: **Ms. Sihan Wu (sihanwu@arizona.edu)**

Office Hours: **Mondays:** **4:00 – 5:00 pm** (Meinel, 8th floor, open area)
Wednesdays: **9:00 – 10:00 am** (Meinel, 8th floor, open area)
Fridays: **2:00 – 3:00 pm** (Meinel, 8th floor, open area)

MAKE-UP AND TAPE-AHEAD LECTURES
Friday, February 2 (11:00 am – 12:15 pm): Make-up Lecture (Meinel Bldg., West Wing, Rm 307)
Friday, February 16 (11:00 am – 12:15 pm): Recitation Lecture (Meinel Bldg., West Wing, Rm 307)
Friday, March 15 (11:00 am – 12:15 pm): Recitation Lecture (Meinel Bldg., West Wing, Rm 307)
Friday, March 29 (11:00 am – 12:15 pm): Recitation Lecture (Meinel Bldg., West Wing, Rm 307)
Friday, April 12 (11:00 am – 12:15 pm): Recitation Lecture (Meinel Bldg., West Wing, Rm 307)
Friday, April 26 (11:00 am – 12:15 pm): Recitation Lecture (Meinel Bldg., West Wing, Rm 307)

CANCELLED LECTURES AND/OR OFFICE HOURS
Monday, January 15: Martin Luther King Holiday (No Lectures)

Thursday, January 25: Prof. is out of town (No Office Hours)
Monday, January 29: Prof. is out of town (No Lectures)
Monday, March 4: Spring Break (No Lectures)
Wednesday, March 6: Spring Break (No Lectures)

LECTURES POSTED ON D2L

By the end of day on Mondays and Wednesday, the recorded lectures will be posted on the OPTI 503A D2L web page. You can find the lectures under "UATools", then choose the Panopto dropdown. The lectures will be posted regularly throughout the semester. Please note that there will be no lectures on Monday, January 15th (MLK Holiday), Monday, March 4th (Spring Break), and Wednesday, March 6th (Spring Break).

ASSIGNMENTS

Graduate students must solve all the assigned problems. For undergraduates, the problems marked with an asterisk (*) are optional.

Assignment 1:	Chapter 1, Problems 3, 4, 5, 8*, 9, 16, 17	Due: Wednesday, January 24
Assignment 2:	Chapter 2, Problems 2, 4, 5, 6*, 8, 9, 12*, 13	Due: Monday, February 5
Assignment 3:	Chapter 3, Problems 2, 5, 8*, 9, 10*, 11, 12, 13	Due: Wednesday, February 14
Assignment 4:	Chapter 4, Problems 1, 3, 4, 7, 9, 12*, 16, 18*	Due: Wednesday, February 21
Assignment 5:	Chapter 5, Problems 1, 5, 7, 9*, 10, 11, 13	Due: Wednesday, February 28
Assignment 6:	Chapter 6, Problems 2, 5, 6*, 7, 11, 13*, 14	Due: Wednesday, March 20
Assignment 7:	Chapter 6, Problems 24, 27, 30*, 32, 33, 35*	Due: Wednesday, April 3
Assignment 8:	Chapter 7, Problems 2, 6*, 17, 18, 25*, 30, 39	Due: Wednesday, April 10
Assignment 9:	Chapter 8, Problems 2, 5, 7, 8, 13*, 20	Due: Monday, April 22
Assignment 10:	Chapter 9, Problems 1, 4, 6, 7, 10, 17*	Due: Wednesday, May 1

LATE HOMEWORK POLICY

In general, students are encouraged to hand-in their homework on time. Only under exceptional

circumstances will late homework be allowed. Electronic submissions are due by the end of day (i.e., before midnight) on the due date. Assignments will be graded out of 100 points, and 10 points will be deducted for every day that the homework is late. Late submissions can be arranged with the instructor and TA for extenuating circumstances. Also, be warned that the TA may take off points for illegible or disorganized work.

EXAMS & SOLUTIONS

There will be one midterm and one final exam.
Midterm (in class, open book, open notes): Wednesday, March 13, 11:00 am – 12:15 pm
Final (in class, open book, open notes): Monday, May 6, 10:30 am – 12:30 pm
Grading criteria: Midterm (counting for **35%** of total grade), final exam (counting for **50%**); homework assignments (counting for **15%**).
Note: Each homework assignment contains one or more problems marked with an asterisk (*). These problems are **required** for graduate students, but are **optional** for undergraduates.

TEXTBOOK

M. MANSURIPUR, *MATHEMATICAL METHODS IN SCIENCE AND ENGINEERING* (*APPLICATIONS IN OPTICS AND PHOTONICS*), FIRST EDITION COGNELLA ACADEMIC PUBLISHING, SAN DIEGO, CALIFORNIA (2020).
You may purchase your course material here: **https://store.cognella.com/82392-1B-009**. For help with ordering from *Cognella*, please email **orders@cognella.com** or call 858-800-2675 ext. 508.
The following books are recommended but not required:
1. G. B. Arfken and H. J. Weber, "Mathematical Methods for Physicists," 6th edition, Academic Press, 2005.
2. F. B. Hildebrand, "Advanced Calculus for Applications," 2nd edition, Prentice-Hall, New Jersey, 1976.
3. R. Bracewell, "Fourier Transform and its Applications," 3rd edition, McGraw-Hill, New York, 1999.
4. M. Mansuripur, "Introduction to Information Theory," Prentice-Hall, New Jersey, 1987.
5. J. Mathews and R. L. Walker, "Mathematical Methods of Physics," 2nd edition, Benjamin/Cummings Publishing, California, 1970.
6. G. Stephenson and P. M. Radmore, "Advanced Mathematical Methods for Engineering and Science Students," Cambridge University Press, United Kingdom, 1990.