SYLLABUS

OPTI 421L/521L FALL 2026
Introduction to optomechanical engineering laboratory
Lecture: Wednesdays 1:00 PM–1:50 PM, Meinel 432
Lab times: Thursdays 9:00 AM–11:50 AM (Sec. 1); Fridays 11:00 AM-1:50 PM (Sec. 2), Meinel 436

Description of Course
This course provides a hands-on introduction to optomechanical hardware and alignment skills, using laser interferometry as the practical platform for developing them. The course begins with foundational Gaussian beam optics and two-beam interference, then develops interferometer architectures (homodyne and heterodyne detection), signal processing and noise analysis, and feedback control and cavity locking. Each week pairs a 50-minute lecture with an extended laboratory session in which students build, characterize, and troubleshoot real optomechanical hardware. The course emphasizes careful experimental practice throughout: every measurement is expected to include a reported uncertainty, and every lab report requires narrative interpretation.

Instructor and Contact Information
Instructors:
Dr. Felipe Guzman, Professor of Optical Sciences
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Teaching Assistant:
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Course format
This course is primarily a laboratory course, paired with a lecture course to cover the fundamentals, with each module's lecture content reinforced by hands-on optomechanical hardware work: building, aligning, and characterizing real optical systems and interferometers. The course is organized into four modules. Module 1 (Foundations) covers Gaussian beam propagation, coherence, basic interferometry, and optical component characterization. Module 2 (Interferometer Architectures) introduces the major interferometer topologies and develops homodyne detection and light modulation techniques. Module 3 (Signal Processing & Noise) builds the mathematical tools (e.g., power spectral densities, SNR/CNR, and optimal filtering)

needed to characterize and mitigate noise in precision measurements, and introduces heterodyne detection. Module 4 (Control & Advanced Topics) covers feedback and servo locking, optical cavities, and balanced detection.

Course communication

Students are required to check D2L and their official University of Arizona email address regularly for class announcements. This is the most effective way for instructors and teaching assistants to reach the whole class.

Required Texts or Readings

No textbooks are required. Lecture notes, assignments, and other course materials will be posted on the course D2L site.

Required or special matters

Students should bring a laptop and/or USB drive to laboratory sessions for saving and transferring data (e.g., oscilloscope traces, exported measurements, etc.). Typically, only one laptop per group is needed.

Assignments and Examinations: Schedule/Due Dates

Students will work in teams of two or three people for all lab activities and reports. The teams will stay the same throughout the semester. Under normal circumstances, all members of a group will receive the same grade.

The final grade will be based on the average of all lab reports. Each report will be graded according to the following rubric:

- 75%: technical content
- 25%: writing and presentation

All written reports are due one week after the corresponding lab session unless otherwise stated by the instructor. (Example: If a student's lab day is 20-Sept, the lab report is due before 11:59 PM on 27-Sept.) Reports must be submitted via D2L as PDF files. Extensions will only be granted with at least 48 hours' notice.

If a lab has not been completed within its allotted time, it may be resumed the following week with the instructor's agreement. In that case, the report will be due on another date to be agreed with the instructor.

Late work policy

Late worksheets and report submissions will be penalized by 10% of the assignment value per day after the due date for up to five days (50%). Fractional days are rounded up to the nearest whole number of days. Late work will not be accepted after five days.

Final Exam

There is no final examination for this course. Instead, students may earn extra credit through an oral presentation at the end of the semester.

Grading Scale and Policies

The grading system for this course will result in grades from A (excellent) through E (failure).

Grading Scale:
85-100%: A
75-85% : B
65-75% : C
50-65% : D
<50% : E

Tentative schedule

This course has a lecture and a lab component. Lectures are delivered once weekly to both sections at the same time. Labs are hosted nearly once weekly to each section.

The anticipated course schedule is below but is subject to change as needed to accommodate delays, facility issues, and high workloads. Any changes will be communicated as early as possible.

Week #	Week start	Lecture period content	Lab
1	24-Aug	Introduction & Course Overview	No Lab
2	02-Sep	Gaussian beams	Lab 1
3	09-Sep	Definitions and basics of interferometry	Lab 2
4	16-Sep	Optical components	Lab 3
5	23-Sep	Interferometer architectures	Lab 4
6	30-Sep	Homodyne interferometry	Lab 4 (cont'd)
7	07-Oct	Light modulation	Lab 5
8	14-Oct	Noise and frequency-domain analysis	Lab 6
9	21-Oct	Noise in interferometers	Lab 7
10	28-Oct	Heterodyne interferometry (i)	Lab 8
11	04-Nov	Heterodyne interferometry (ii)	Lab 8 (cont'd)
12	11-Nov	No class (Veterans day)	No Lab
13	18-Nov	Feedback and servo control	Lab 9.
14	25-Nov	No class (Thanksgiving week)	No Lab
15	02-Dec	Balanced detection/Optical cavities	Lab 10
16	09-Dec	Oral presentations (TBC)	No Lab

Attendance Policy

Critical material required to complete the labs will be presented in class and at the labs. Lab attendance is required to collect the data needed for reporting.

Statement on the use of AI/GenAI

The use of generative AI tools in this course is permitted as long as they are used in accordance with the University of Arizona's academic integrity policies. If GenAI tools are used, the student must provide a statement of what tools were used, how and for what purpose. Please note that while these tools can support learning, the student remains responsible for understanding and learning the material, and all the work submitted to this course.

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 and http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal respectively.

Code of 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. See:

http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity.

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted under any circumstances. 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.

Also, students using images from the internet without citation is considered an act of plagiarism. If you have any questions regarding this, please see the instructor. The University Libraries have some excellent tips for avoiding plagiarism. See: http://new.library.arizona.edu/research/citing/plagiarism.

Accessibility and Accommodations

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, you are welcome to let me know so that we can discuss options. You are also encouraged to contact Disability Resources (520-621-3268) to explore reasonable accommodation.

Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Absence & Class Participation Policy

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 laboratory sessions. Students who miss class due to illness or emergency are required to bring documentation from their health-care provider or other relevant, professional third parties. Failure to submit third-party documentation will result in unexcused absences.

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: 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.

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

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.

UA Nondiscrimination and Anti-Harassment Policy

The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/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.

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.).

Additional Resources for Students

UA Academic policies and procedures are available at http://catalog.arizona.edu/policies

Student Assistance and Advocacy information is available at http://deanofstudents.arizona.edu/student-assistance/students/student-assistance

Confidentiality of Student Records

http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa

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.