Optomechanical Design and Analysis
Updated 11/09/2020

Spring 2021

OPTI 423/523: Optomechanical Design and Analysis

Course Meeting Information:
Tuesday/Thursday
3:30 – 4:45 PM
Meinel, Room 307

Course Description
This course will focus on the optomechanical design process, building on the material covered in OPTI 421/521 and filling in some gaps. We will cover first-order mechanical analysis, detailed analysis using finite element models, and design for fabrication, assembly, and test of optomechanical systems. Students will complete a design project on an optomechanical topic of their choosing.

Instructor Information
Dr. Brandon Chalifoux
Assistant Professor
College of Optical Sciences
Office: Meinel West 733
Office hours: Wednesday 3-4pm, or by appointment (via Zoom)
Email: bchal@arizona.edu [please begin subject with “OPTI 423/523:"

Learning Outcomes
After taking this course, students should be able to:
- Identify the appropriate time to transition from first-order to detailed analysis
- Identify the most important aspects of an optomechanical system for detailed analysis
- Evaluate numerical models for accuracy using several approaches
- Integrate numerical and optical simulation tools
- Graduate students: Construct defensible error budgets for optomechanical systems

400/500 Co-convened Course Information
Graduate students will complete a more involved design project than undergraduates, and will be assigned additional problems.

Required Texts and Materials

Schedule of Topics and Activities
Fundamentals of Optomechanical system design
- Optomechanical design process
- Error budgeting basics
- Design for fabrication, assembly, test

Kinematics and springs
- Constraints, over- and exact-constraint
- Lumped mechanical models
- Flexures

Finite element analysis
- Basic mathematical concepts
- Value and limitations
- Model validation: convergence testing, sanity checks, comparison with simple models
- Boundary conditions
- Loading – forces, torques, thermal loading
- Post-processing and integration with optical software
Analysis and design for mounting small optics
- Common small lens and mirror mounts
- First-order analysis
- Finite element analysis for stress and deformation
- Analysis of thermal performance
- Design for fabrication, assembly, test

Analysis and design for large optics
- Large mirror mounts
- Large lens mounts

Assessments
Assessment will be based on: class participation, around 7 problem sets, a midterm exam, and a design project.

Students will complete a design project on an optomechanical topic of their choosing. Graduate students will write a brief (< 1 page) proposal and a mid-term report with preliminary design results, followed by a final report due at the end of the semester. Undergraduate students will complete a project with reduced scope and depth.

Homeworks (around 7 assignments) 35%
Midterm exam 30%
Design project 35%

Grading Scale and Policies
Grading will be on a regular scale: A (>=90%), B (>=80%), C (>=70%), D (>=60%), E (<60%)

University Policies
All university policies related to a syllabus are available at: https://academicaffairs.arizona.edu/syllabus-policies.

Subject To Change Notice
Information contained in the course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor of this course.

 Graduate Student Resources
University of Arizona’s Basic Needs Resources page: http://basicneeds.arizona.edu/index.html