

# **OPTI BME 630: Biomedical Optics and Biophotonics**

## **Effective Spring Semester 2026**

### **Course Description:**

This course covers the basic optical principles and techniques and instruments used in basic life science research and clinical applications. It also includes details of light interaction with tissue and case studies using optical imaging methods for clinical applications. This course is intended for graduate students in optical sciences, biomedical engineering, or other engineering field.

### **Pre-requisites:**

N/A

### **Number of Units/ component:**

3

### **Locations and Times:**

MRB202

Tu, Th 11:00am - 12:15 pm

### **Instructor Information:**

Dongkyun Kang

Meinel 621

Office hours: By appointment only.

### **Expected Learning Outcomes:**

Upon completion of this course students will be able to

- 1) Understand the working principles and key performance specifications of biomedical optical instrument,
- 2) Identify biomedical applications, specify the performance requirements, and find adequate optical imaging solutions.

### **Course Objectives:**

During this course students will

- 1) Review geometrical optics, wave optics, and digital imaging concepts relevant to biomedical applications,
- 2) Learn optical imaging technologies used in basic life science research,
- 3) Learn optical imaging technologies used in medical applications.

### **Required Texts:**

NA

### **Recommended books:**

Optical System Design (Robert E. Fischer): Available online through the UA library.  
Optics (Hecht)  
Fourier optics (Goodman)

### **Topics:**

### Part 1: Optics and Microscopy

- Geometrical optics
- Wave optics
- Digital imaging
- Image processing, analysis

### Part 2: Optics in basic life science research

- Microscopy (bright field, dark field, DIC, fluorescence)
- Confocal microscopy, Multi-photon microscopy
- Structured illumination microscopy, Deconvolution
- STED
- Light sheet microscopy
- Single molecule microscopy
- FLIM, CARS
- Quantitative phase imaging

### Part 3: Optics in medical diagnosis

- Tissue optics
- In vivo confocal microscopy
- Optical coherence tomography
- Laser speckle imaging
- Photoacoustic imaging
- Diffuse optical imaging
- Clinical applications (Dermatology, Point of care imaging)

### Number of Exams and Papers:

2 Mid-term exams

4 Homework assignments

2 Lab reports

1 Final report and presentation

### Course Policies:

#### Grading Policy

Midterm exam (2 total)	30%
Presentation	15%
Final report	15%
Homework (4 assignments total)	20%
Lap reports (2 lab reports total)	10%
Class Participation	10%
<u>Total</u>	<u>100%</u>

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.

### 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>

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 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.).

### **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.

### **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>.

### **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.

If our class meets at a campus location: 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.

### **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.*