

BME333 Modern Optical Microscopy and Imaging – Fall 2020

Time: Tuesday & Thursday 9:40-11:00 AM
Room: Tech L361

Instructor: Dr. Hao F. Zhang
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Office hours: Tuesday & Thursday 11:00 AM -12:00 PM or by appointment

Co-instructor: Biological Imaging Facility Director, Dr. Jessica Hornick
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Office hours: By appointment

Textbook: *Fundamentals of Light Microscopy and Electronic Imaging*, Douglas B. Murphy, Wiley-Liss, ISBN: 0-471-25391-X
References: *Biomedical Optics: Principles and Imaging*, Lihong V. Wang and Hsin-i Wu, Wiley Interscience, 1st Edition, ISBN: 0471743046
Biomedical Photonics Handbook, Tuan Vo-Dinh, CRC Press, ISBN: 0849311160
Tissue Optics, Valery Tuchin, SPIE Press, 2nd Edition, ISBN: 0819464333
Optics, Eugene Hecht, Addison-Wesley, 4th Edition, ISBN: 0805385665
Handbook of Biological Confocal Microscopy, James B. Pawley, 3rd Edition, Springer, ISBN: 0-387-25921-X

Prerequisite: Physics, Calculus, and Differential equations

Course Objectives: Bio-optical imaging has played a critical role in almost all major breakthroughs in recent biomedical research. Knowledge of current bio-optical imaging technologies is important for students who plan for future careers or graduate studies in biomedicine related fields. This course provides students with (1) Fundamental background of tissue optics; (2) Understanding of physics, strengths, and limitations of various existing bio-optical imaging technologies; (3) Knowledge of emerging bio-optical imaging technologies for anatomic and functional studies; (4) Problem-solving skill when facing a specific biomedical challenge.

Topics

Introduction to optics, optical properties of tissue, and photon-tissue interactions

Monte Carlo simulation

Sensing of optical properties and spectroscopy

Ballistic imaging

Wide-field and dark-field microscopy

Polarization, phase contrast, and differential interference contrast microscopy (DIC) microscopy

Fluorescence microscopy

Confocal microscopy
Two-photon microscopy
Optical coherence tomography
Super-resolution imaging

Special note related to hybrid teaching: BME 333 has significant and exciting (fun) lab components. Some students may be unable to attend the in-person labs. In this case, projects designed for numerical simulation will be assigned instead.

Grading

Midterm/Monte Carlo Project	30%
Homework	30%
Lab	30%
Final presentation/report	10%
Total	100%

Note: Homework due one week after the initial assignment (may be extended for a second week depending on the performance of most of the class or specified otherwise). There will be a penalty for missing classes without prior permission. Research project requirements will be discussed in class.

It is difficult to find a single textbook that covers all of the aforementioned course material. Accordingly, we will draw upon other references (book chapters, research articles, etc.) and internet resources as needed.

The current schedule is subjected to minor revisions as the quarter proceeds.

The skill of searching and retrieving scientific literature from databases, such as PubMed, is required.

Homework and research projects involve the use of Python (highly encouraged) or Matlab.

If unanticipated conflicts arise, the student should contact the instructor at least one week in advance to discuss arrangements for make-up examinations or turning in project/homework late.

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability –and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment for every other member of the class.

Any student requesting accommodations related to a disability or other condition is required to register with ANU (accessiblenu@northwestern.edu; 847-467-5530) and provide professors with an accommodation notification from AccessibleNU, preferably within the first two weeks of class. All information will remain confidential.

Zero tolerance to academic plagiarism and dishonesty