

November 2, 2021

TO: The Faculty of the College of Engineering

FROM: The Faculty of the Weldon School of Biomedical Engineering

RE: Changes to Undergraduate Course, BME 43000, Introduction to Biomedical Imaging

The Faculty of the School of Biomedical Engineering has approved the following course number, requisite, and description changes to an undergraduate course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM: BME 43000: Introduction to Biomedical Imaging

Terms offered: Fall or Spring, Lecture 3, Cr. 3

Prerequisites: PHYS 24100 or PHYS 23400 or PHYS 27200

Description: Provides a conceptual framework for understanding the theory and technical principles behind major bioimaging modalities. The main focus is on basic principles and modes of imaging involving interactions of electromagnetic radiation with biological tissue. Main concepts include imaging and detection, modes of imaging modalities (e.g. reflection, transmission, absorption, and emission), and basic image characterizations. Applications include several critical biological and biomedical imaging methods, such as optical microscopy, ultrasound, X-ray imaging, computed tomography, positron emission tomography, and magnetic resonance imaging. Demonstrations of conventional bioimaging modalities are used to teach the topics.

TO: BME 36000: Introduction to Biomedical Imaging

Term Offered: Spring, Lecture 3, Cr. 3

Prerequisites: BME 20700

Concurrent prerequisite: ECE 30100

Major Restriction: Biomedical Engineering only

Description: The main focus of this course is on basic principles and modes of major bioimaging modalities. This course covers image characterization, interactions of electromagnetic radiation with tissue, fundamental principles in imaging and detection, and modes of imaging modalities (e.g. reflection, transmission, absorption, and emission). Conventional bioimaging modalities will be used to teach the topics. This course is particularly aimed at students in science and engineering interested in gaining a conceptual understanding of several critical biological and biomedical imaging methods, including optical microscopy, ultrasound, X-ray imaging, computed tomography, nuclear medicine, magnetic resonance imaging, and mobile health. Overall, this course provides a conceptual framework for biomedical imaging in a reasonably concise and understandable format (with minimal mathematical approaches).

Reason: The BME Undergraduate Curriculum Committee has reviewed this course in the context of the revised curriculum structure and determined that since the previous prerequisites were 200-level courses and that it aligned with the new level of 300-level pathway courses, the course should be renumbered at the 300-level. This course has been taught successfully twice as BME 43000 with an enrollment of 10 students in Spring 2019 and 37 students in Spring 2021. It will be a required course for students in the new Bioimaging pathway.

A handwritten signature in black ink, appearing to read "David M. Umulis". The signature is fluid and cursive, with the first name "David" being the most prominent.

David M. Umulis
Dane A. Miller Head and Professor
Weldon School of Biomedical Engineering



Course Information

- BME 36000 Introduction to Biomedical Imaging
- 2x/week for 75 minutes
- Cr. 3
- Prerequisite: BME 20700
- Concurrent prerequisite: ECE 30100

Instructor(s) Contact Information

- Name of the instructor: Young L. Kim
- Office Location: MJIS 3027
- Office Phone Number: 6-2445
- Purdue Email Address: kim50@purdue.edu
- Student Consultation hours, times, and location: TBD

Course Description

The main focus of this course is on basic principles and modes of major bioimaging modalities. This course covers image characterization, interactions of electromagnetic radiation with tissue, fundamental principles in imaging and detection, and modes of imaging modalities (e.g. reflection, transmission, absorption, and emission). Conventional bioimaging modalities will be used to teach the topics. This course is particularly aimed at students in science and engineering interested in gaining a conceptual understanding of several critical biological and biomedical imaging methods, including optical microscopy, ultrasound, X-ray imaging, computed tomography, nuclear medicine, magnetic resonance imaging, and mobile health. Overall, this course provides a conceptual framework for biomedical imaging in a reasonably concise and understandable format (with minimal mathematical approaches).

Learning Resources, Technology & Texts

Textbook: From Signals to Image: A Basic Course on Medical Imaging for Engineers 1st ed. 2020 Edition

<https://link.springer.com/book/10.1007%2F978-3-030-35326-1>

Brightspace will be used to communicate, track grades, post lectures, reading materials, assignments, etc.

Learning Outcomes

By successfully completing this course, students will be able to:

1. Explain the principles of conventional bioimaging modalities.
2. Distinguish advantages and disadvantages of each modality.
3. Describe utilizations of imaging in biological and medical fields.
4. Determine appropriate bioimaging methods for particular studies and applications.

Assignments

Weekly assignments will include hands-on analyses of basic principles covered during lectures. This course will use MATLAB to conduct basic calculations and hands-on exercise. Each assignment will be evaluated critically. We will have one midterm project and one final project. These will be individual assignments and detailed instructions will be given

throughout the course. Because of various issues and topics on current research in mobile health, a few selected topics will be provided with a list of suggested readings. More detailed guideline will be given.

Grading Scale

Grade Assessment

- 25% - Class participation and assignments
- 30% - Midterm exam
- 30% - Final exam
- 15% - Projects

Grading [Tentative]

- | | |
|-----------------------------------|---|
| Your total $\geq 90\%$: | A |
| $80\% \leq$ your total $< 90\%$: | B |
| $70\% \leq$ your total $< 80\%$: | C |
| $60\% \leq$ your total $< 70\%$: | D |

Attendance Policy

This course follows Purdue's academic regulations regarding attendance, which states that students are expected to be present for every meeting of the classes in which they are enrolled. Attendance will be taken at the beginning of each class and lateness will be noted. When conflicts or absences can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to the instructor is not possible, the student should contact the instructor as soon as possible by email or phone. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases falling under excused absence regulations, the student or the student's representative should contact or go to the [Office of the Dean of Students website](#) to complete appropriate forms for instructor notification. Under academic regulations, excused absences may be granted for cases of grief/bereavement, military service, jury duty, and parenting leave. For details, see the [Academic Regulations & Student Conduct section](#) of the University Catalog website. Guidance on class attendance related to COVID-19 are outlined in the [Protect Purdue Pledge for Fall 2021](#) on the Protect Purdue website.

Academic Guidance in the Event a Student is Quarantined/Isolated

If you must miss class at any point in time during the semester, please reach out to me via email so that we can communicate about how you can maintain your academic progress. If you find yourself too sick to progress in the course, notify your adviser and notify me via email or Brightspace. We will make arrangements based on your particular situation. Please note that, according to Details for Students on Normal Operations for Fall 2021 announced on the Protect Purdue website, "individuals who test positive for COVID-19 are not guaranteed remote access to all course activities, materials, and assignments."

Course Schedule

- Week 1 - Course introduction and mobile Health (mHealth)
- Week 2 - Overview of bioimaging modalities and image characterization
- Week 3 - Introduction to major types of light-tissue interaction
- Week 4 - X-ray imaging and computed tomography
- Week 5 - Introduction to nuclear medicine and radioactivity
- Week 6 - Emission imaging, emission tomography, and radiation safety
- Week 7 - Introduction to geometrical optics and wave optics

Week 8 - Midterm exam + optical microscopy I
Week 9 - Optical microscopy II
Week 10 - Introduction to ultrasound imaging
Week 11 - Ultrasound imaging
Week 12 - Introduction to magnetic resonance imaging
Week 13 - Magnetic resonance imaging I
Week 14 - Magnetic resonance imaging II
Week 15 - Magnetic resonance imaging III and final review

Classroom Guidance Regarding Protect Purdue

Any student who has substantial reason to believe that another person is threatening the safety of others by not complying with Protect Purdue protocols is encouraged to report the behavior to and discuss the next steps with their instructor. Students also have the option of reporting the behavior to the [Office of the Student Rights and Responsibilities](#). See also [Purdue University Bill of Student Rights](#) and the Violent Behavior Policy under University Resources in Brightspace.

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

Nondiscrimination Statement

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies.

Accessibility

Purdue University is committed to making learning experiences accessible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

Mental Health/Wellness Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try [WellTrack](#). Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the [Office of the Dean of Students](#). Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a [Purdue Wellness Coach at RecWell](#). Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact [Counseling and Psychological Services \(CAPS\)](#) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday. Considering the significant disruptions caused by the current global crisis as it related to COVID-19, students may submit requests for emergency assistance from the [Critical Needs Fund](#)

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.