UNIVERSITY OF CALIFORNIA at MERCED
SCHOOL of ENGINEERING

BIOE 124 Introduction to Biomedical Imaging
Fall, 2017
Kollig 296; TR 12:00-1:15pm

Instructor: Changqing Li

Office Hours: 1:30-2:30pm, Wednesday

DESIGNATION

Introduction to Biomedical Imaging

CATALOG DESCRIPTION

This course has been designed to introduce fundamental principles of biomedical imaging commonly used in biomedical engineering research and applications. Techniques and principles of biomedical imaging include x-ray photon generation, x-ray imaging, fluorescence optical imaging, position emission tomography, single photon emission computed tomography.

TEXTBOOKS and other REQUIRED MATERIALS

Required: Introduction to Biomedical Imaging, Andrew Webb, 2003
Recommended: Physics in Nuclear Medicine, Simon R. Cherry, James A. Sorenson, Michael E. Phelps, 2012

COURSE Goals:

1. Learn physics in biomedical imaging.
2. Gain understanding of the biomedical imaging principles in aspects of device and algorithms.
3. Gain knowledge of topics in cutting-edge research by which biomedical imaging scientists study and apply methods to understand and predict phenomena.
4. Analyze contemporary case studies by reviewing current articles.
5. Be able to communicate knowledge gained.

LEARNING OUTCOMES: By the end of the course, students will demonstrate:

1. An understanding of physics in biomedical imaging.
2. An understanding of the biomedical imaging principles in aspects of device and algorithms.
3. An understanding of the techniques, skills and modern engineering tools necessary for engineering practice.
4. An ability to analyze contemporary biomedical imaging studies to make connections and decisions based on their scientific merit.

5. An ability to communicate and function effectively on a multi-disciplinary team.
6. An ability to strengthen self-learning methods and organizational skills to enhance problem-solving abilities and efficiency.

Relationship to Program Learning Outcomes:
BIOE 124 maps directly to the following Program Learning Outcomes for Bioengineering undergraduate students:

PLO (a) an ability to apply knowledge of mathematics, science, and engineering.
PLO (d) an ability to function on multidisciplinary teams.
PLO (i) a recognition of the need for, and an ability to engage in life-long learning.
PLO (j) a knowledge of contemporary issues.
PLO (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

PREREQUISITES by TOPIC

MATH 021, PHYS 019, ENGR 065 or BioE 065

COURSE POLICIES

HOMEWORK

- Homework is a critical component of this course and is designed to help you learn, understand and practice the material. Homework will be due on the dates indicated in the detailed schedule provided to course participants via UCMCROPS.

- Late homework will not be accepted.

- You are encouraged to work with your peers when doing homework. However, each student must turn in his/her own homework assignment and it must reflect his/her own work. You must explicitly identify all peers with whom you worked.

EXAMS

- There will be a midterm exam as indicated on the detailed schedule.
- There will also be a comprehensive final exam.
- There will be couple quizzes. Each quiz will be around 10 minutes and will be announced in the previous lecture.
- There will be no make-up exams. If you are sick during a regularly scheduled exam, please bring a note from the university clinic or your own doctor verifying your illness. Your course grade will then be determined by the rest of your work.
- Crib sheets will not be allowed during any of the exams. However, calculators will be allowed when necessary, provided that they are not used to store data or formulae pertaining to the course.

DROPPING THE COURSE

- Please see the UC Merced General Catalog and the Registrar's / Student First website for details.

CATCOURSES.ucmerced.edu

- The CATCOURSES site will be used for periodic course announcements, and for the distribution of class notes, discussion exercises, homework sets, and (some) solutions.
- You can check the scores that you have received on your homework assignments and exams.
- Warning: pay no attention to any letter grade that is reported on CATCOURSES, except for the final grade.

CONDUCT

- Students are expected to complete their own work and to abide by the UC Merced academic honesty policy, which can be found on the Student Life website http://studentlife.ucmerced.edu/ under the "Student Judicial Affairs" link.
- Note that most of the handouts provided in this course are protected by copyright, and are flagged accordingly on UCMCROPS. They are for your personal use only. Re-posting the files or their contents on sites such as (for example) "Course Hero" is an explicit violation of this copyright.
- Students and instructors are expected to honor UC Merced's Founding Principles of Community: http://www.ucmerced.edu/about-uc-merced/principles-community.

SPECIAL ACCOMMODATIONS

- The instructor will make every effort to accommodate all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance.
- Please speak with the lead instructor during the first week of class regarding any potential academic adjustments or accommodations that may arise due to religious beliefs.

ACADEMIC DISHONESTY STATEMENT

- Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work.
- You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an email, an email attachment file, a diskette, or a hard copy. Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Policy can also be extended to include failure of the course and

University disciplinary action.

- During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

DISABILITY STATEMENT

Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.

TOPICS

1. Review of physics
2. Generation of x-ray photons
3. Nuclear radiation
4. Interaction of high energy photons with matters
5. X-ray imaging
6. X-ray CT imaging
7. Single photon emission computed tomography
8. Position emission tomography
9. Optical photon propagation in tissues
10. Optical imaging
11. Principle of optical fluorescence
12. Fluorescence optical imaging

GRADE:

Assignments 10%
Project: 20%
Quiz: 10%
Midterm Exam: 20%
Final Exam: 40%

CLASS SCHEDULE

Aug 24. Lecture 1: Syllabus and Introduction to Biomedical Imaging
Aug 29. Lecture 2: Review of Physics
Aug 31. Lecture 3: Source of radiation
Sept 5. Lecture 4: Generation of X-ray photons

Sept 7. Lecture 5: Interaction of high energy photons with matters
Sept 12. Lecture 6: X-ray imaging
Sept 14. Lecture 7: X-ray imaging methods and characteristics
Sept 19. Lecture 8: Computed tomography (CT) (Quiz 1)
Sept 21. Lecture 9: CT reconstruction algorithms
Sept 26. Lecture 10: General principles of nuclear medicine
Sept 28. Lecture 11: Radiation decay and Technetium generator
Oct 3. Lecture 12: Gamma camera: Basic principle
Oct. 5. Lecture 13: SPECT
Oct 10. Lecture 14: PET
Oct 12. Lecture 15: Middle Term Exam review and homework review
Oct 17. Lecture 16: Middle Term Exam
Oct 19. Lecture 17: Ultrasound
Oct 24. Lecture 18: Ultrasound
Oct 26. Lecture 19: MRI
Oct 31. Lecture 20: MRI
Nov 2. Lecture 21: MRI
Nov 7. Lecture 22: MRI
Nov 9. Lecture 23: Photon transportation in tissues (Quiz 2)
Nov 14. Lecture 24: Optical imaging
Nov 16. Lecture 25: microscope imaging and super resolution optical imaging
Nov 21. Lecture 26: Optical tomography imaging
Nov 28. Lecture 27 Elective research topics
Dec 30. Project Presentation
Dec 5. Project Presentation
Dec 7. Final review
Final Exam: 8:00am to 11:00 am, Dec 14