

**BIOMEDICAL ENGINEERING 325
INTRODUCTION TO MEDICAL IMAGING
FALL 2015 ALAN V. SAHAKIAN**

Class Room and Times: Tech L251, Mon., Wed., Fri. 1:00 – 1:50 PM

Instructor: Alan V. Sahakian, 847-491-3641, e-mail: a-sahakian@northwestern.edu

Office Hours: (Tentative) Mon., Wed., Fri. 2:00-2:50 p.m., Tech. room L356/352 (or M394).

Teaching Assistant: Yong Ik Jeong <YongJeong2013@u.northwestern.edu>office hours TBA

TENTATIVE SCHEDULE (THIS MAY CHANGE)

Week	Dates	Topics	Readings (pp.)
1	Sept. 21,23, 25	Introduction to basic concepts of medical imaging	Lecture notes, Ch. 1
2	Sept. 28, 30 Oct. 2	Generation and detection of x-rays	Ch. 2,3,6,7
3	Oct. 5, 7, 9	X-ray methods; Computed Tomography; Biological effects	Ch. 10,11
4	Oct. 12,14,16	Ultrasound: Acoustic fundamentals; Generation and detection of ultrasound	Ch. 14
5	Oct. 19,21,23	Ultrasound diagnostic methods; Biological effects	
6	Oct. 26	Exam 1	
6	Oct. 28,30	Ultrasound continued (Wednesday), midterm returned Fri. Project proposals due Friday.	
7	Nov. 2,4,6	Radionuclide methods	Ch. 15,16,17,18,19
8	Nov. 9,11,13	Nuclear Magnetic Resonance (NMR/MRI)	Ch. 12,13
9	Nov. 16,18,20	MRI methods; Biological effects of EM fields	Lecture notes
10	Nov 23,25	Emerging areas in medical imaging. Diagnostic value, statistical performance measures.	Lecture notes
	Nov 27	Thanksgiving Break (no class on Friday)	
11	Nov. 30, Dec. 2,4	Graduate student project presentations. All written project reports due Friday Dec. 4 in class and electronically.	Lecture notes
12	Thurs. Dec 10	FINAL exam 9:00 to 11:00 am in room L251 (comprehensive)	

Tentative Grade Breakdown: Homework: 25%, Exam 1: 25%, Project: 25%, Exam 2: 25%

Prerequisites: The EA math sequence, some Signals and Systems course covering Fourier concepts (co-registration in BME 305 is OK) Note: the text's Appendix G has a review of Fourier Transforms and Convolution; Physics 135-3 (Fields and Waves), or equivalents, or consent of instructor.

Required Text:

The Essential Physics of Medical Imaging, **Third Edition**, J.T. Bushberg, J. A. Seibert, E.M. Leidholdt, J.M. Boone, Publisher: Lippincott, Williams and Wilkins, 2012. (two copies are on reserve at the Science and Engineering Library).

Reference Texts (on reserve at the Science and Engineering Library):

- 1) Principles of Medical Imaging, K. Kirk Shung, Michael B. Smith, Benjamin Tsui, Academic Press, 1992.
- 2) Christensen's Introduction to the Physics of Diagnostic Radiology, Thomas S. Curry, III, James E. Dowdey and Robert C. Murry, Jr., Leigh and Febiger, 1984.

Course Description: Fundamentals of the four most-important clinical medical imaging modalities: X-ray, Ultrasound, Radionuclide, and MRI. The primary focus is on the physical principles, instrumentation methods, and imaging algorithms, however the medical interpretation of images, and the clinical, research and ethical issues in medical imaging are also included where possible to give students a deeper understanding of the development and applications of medical imaging.

Projects: Each student will individually complete a written report (about fifteen double-spaced pages, including figures and references) on a topic related to the course. In addition, each **Ph.D.** student will give a short (about 12 minute) presentation on his or her project during the final week of class. The choice of project topic is left to the student, but students must submit a short (one-page) proposal of their project to the instructor by Friday, October 30 for approval. The report may be a discussion of a new imaging modality, a new development in a classical modality, a new clinical application, an in-depth review of the history of some modality, a detailed technical discussion of some aspect of a modality (perhaps including a MATLAB or other program), a discussion of a clinical or research imaging problem and solutions, or another relevant topic which you find interesting. **All** students will be responsible for attending the Ph.D. students' oral presentations, as this material will be considered fair game on the final.