NE-107 Introduction to Imaging

Department of Nuclear Engineering
University of California
Berkeley

Fall Semester, 2008

Teachers

	Location/phone/e-mail	Office Hours
Kai Vetter, Instructor	4171 Etcheverry Hall/642-7071 kvetter@nuc.berkeley.edu	Wed 11:00-12:00
Daniel Chivers, Teaching Assistant	4171 Etcheverry Hall/642-7071 dchivers@berkeley.edu	TBA
Siva Darbha, TA	4126 Etcheverry Hall/642-2130 siva.darbha@berkeley.edu	TBA

General Course Information

Lecture:	Tuesdays and Thursdays, 12:30-14:00 in (Lectures starting Tuesday, September 2)
Location:	3102 Etcheverry Hall
Text:	J.T. Bushberg, J.A. Seibert, E.M. Leidholdt, Jr, and J.M. Boone, "The Essential Physics of Medical Imaging", Lippincott Williams & Wilkins, (2002)
References:	S.R. Cherry, J.A.Sorenson, and M.E. Phelps, "Physics in Nuclear Medicine", Saunders (2003) K. Shung, M. Smith, B. Tsui, "Principles of Medical Imaging", Academic Press (1992) S. Webb, Ed., "The Physics of Medical Imaging", IOP Publishing (1996)
Class web site:	http://www.nuc.berkeley.edu/dept/Courses/NE-107/NE107.html. Announcements, useful course information, and downloadable documents will be available on the web site.
Prerequisite:	NE-101, NE104A or an upper-division course in nuclear physics or nuclear instrumentation

This is a lecture course on (a) physics of X-ray imaging, (b) physics of radionuclide imaging, and (c) the physics of nuclear magnetic resonance. The lectures cover the fundamental physics principles in imaging methodologies that rely on electromagnetic radiation, e.g. X-rays, gamma rays, and radiowaves for transmission, emission, and magnetic resonance imaging, respectively.

The course grade will be based 40% on the final exam, two-midterm exams, each with 20%, and the homework problem sets with 20%.

LECTURES

Week/Lecture	Day	Date	Topic
1/1	Tuesday	Sep 2	Course Introduction/General Introduction to Medical Imaging

REVIEW OF PHOTON INTERACTIONS, DETECTION, AND DOSIMETRY

Week/Lecture	Day	Date	Topic
1/2	Thursday	Sep 4	Photon Interactions with Matter. Attenuation Coefficients
2/3	Tuesday	Sep 9	Radiation Dose Definitions, Dose Limits, Whole Body/Critical Organ Doses
2/4	Thursday	Sep 11	X-Ray Sources and Principles of X-Ray Spectra
3/5	Tuesday	Sep 16	General Principles of Photon Detection. General Principles of Scintillation Detectors

THE PHYSICS OF X-RAY IMAGING

3/6	Thursday	Sep 18	X-Ray Image Formation: Analog and Digital Detectors
4/7	Tuesday	Sep 23	Image Quality (Noise, Contrast, Spatial Resolution)
4/8	Thursday	Sep 25	Noise and Image Perception
5/9	Tuesday	Sep 30	Imaging Systems. Examples. Issues in Mammography
5/10	Thursday	Oct 2	Tomographic Image Reconstruction/Filtered Backprojection
6/11	Tuesday	Oct 7	X-Ray Computed Tomography I
6/12	Thursday	Oct 9	X-Ray Computed Tomography II
7/13	Tuesday	Oct 14	MIDTERM EXAM

THE PHYSICS OF RADIONUCLIDE IMAGING

Week/Lecture	Day	Date	Topic
7/14	Thursday	Oct 16	Introduction to Nuclear medicine
8/15	Tuesday	Oct 21	No Lecture
8/16	Thursday	Oct 23	No Lecture
9/17	Tuesday	Oct 28	The Anger Principle and Anger Camera
9/18	Thursday	Oct 30	Planar Image Formation and Statistical Noise
10/19	Tuesday	Nov 4	Collimators, Spatial Localization, and Spatial Resolution
10/20	Thursday	Nov 6	Photon Scatter, Energy Discrimination, Image Contrast, Dynamic Imaging
11/-	Tuesday	Nov 11	Nuclear Tomography - Instrumentation
11/-	Thursday	Nov 13	Nuclear Tomography - Image Reconstruction
12/21	Tuesday	Nov 18	PET Imaging
12/22	Thursday	Nov 20	MIDTERM II

THE PHYSICS OF NUCLEAR MAGNETIC RESONANCE

Week/Lecture	Day	Date	Topic
13/23	Tuesday	Nov 25	Introduction to Applied NMR Imaging
13/24	Thursday	Nov 27	Quantum Bulk Magnetization and Relaxation Processes
14/25	Tuesday	Dec 2	Spin-Lattice T1 and Spin-Spin T2 Relaxation Mode
14/26	Thursday	Dec 4	Pulse Sequences in NMR Imaging
15/27	Tuesday	Dec 10	Qualitative NMR Spectroscopy