Medical Imaging Physics (BB 663)

(3 credit, half semester course)

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Course objectives

- Grasp the physics concepts behind the imaging techniques. The emphasis in this course is more on understanding concepts. Mathematically not complex.
- Solve simple numerical problems related to imaging physics.
- Learn self study to give a short presentation on a related topic from the topics I circulate. This will not be a group presentation.
- Actively participate in the course (graded). Ask questions on the Moodle discussion forum. Try to answer other students' questions.

How much do we cover (~ 21 classes)?

Planar X-rays:

- Generation and characteristics of x-rays
- X-ray tube and its different parts
- Interaction of x-rays with tissues (photoelectric and Compton effects, relation to image formation and contrast)

Magnetic resonance imaging (MRI):

- Physics of MRI (spin physics, rotating coordinate systems, transformation between coordinate systems, Bloch equations and their solutions)
- Contrast in MRI images
- MRI magnets (steady, RF and gradient)
- Simple imaging sequences (saturation recovery, inversion recovery, spin echo)

Ultrasound

(we are unlikely to have enough time to cover this module)

- Generation of ultrasound
- Interaction of ultrasound with tissues; contrast mechanisms
- Doppler effect and its use in imaging

What I will **not** cover in this course

- Other imaging modalities (tomography, nuclear medicine, etc.)
- Image processing/3D reconstruction techniques
- Imaging instrumentation
- Clinical details

For students interested in these topics, I recommended Medical Imaging Methods (3 credits; second half semester) course in BSBE and the various image processing courses offered in other departments (EE/CSE).

Reading material

- My lectures will not follow any specific book. Portions from the following books will be used.
  1. Medical Imaging physics, Hendee and Ritenour. (*PDF copy is available for download from IITB library website).*
  2. Introduction to Medical Imaging: Physics, Engineering and Clinical Applications, Smith and Webb. (*Two copies available in BSBE Library).*

  Drop me an email in the first week if you are having trouble locating the PDFs of the books.

- For self-study presentation: Look at **Section 616** in the main library for books on medical imaging.

Grading scheme (tentative)

- Quiz (1 or 2): 30%
- Class presentation and viva: 20%
- Mid-semester exam: 50%

Presentation: 10th & 12th September

- Presentation on an assigned topic based on self-study.
- I will share the topics and instructions on Moodle next week.

Logistics

1. Class timings (slot 2):

   Mon: 9:30 – 10:30 am

   Tues: 10:30 – 11:30 am

   Thurs: 11:30 am – 12:30 pm

2. Slides and other material will be uploaded on Moodle.
3. Post your questions on Moodle discussion forum. Don't email me with questions.
4. Don't share any course material without my express consent.