Medical Imaging Systems
Biomedical Engineering 530 / Medical Physics 530

BME 530 / Medical Physics 530 Syllabus
Spring 2009

1. Introduction (1.5 lecture)
   a. History
   b. Basic principles
   c. Resolution, applications, toxicity

2. Imaging Theory (4 lectures)
   a. Review of 1D Linear system theory
   b. 2D superposition and space-invariance
   c. Sampling theory
   d. 2D Fourier Theory and Theorems
   e. Hankel Transforms

3. Projection Radiography (4 lectures)
   a. X-ray physics
   b. Attenuation coefficient and scatter
   c. Source and object magnification
   d. Recorder considerations
   e. Poisson processes
   f. Radiography SNR

4. Tomography (4 lectures)
   a. Projection-slice theorem
   b. Convolution-back projection
   c. CT hardware
   d. CT and X-ray Lab Visit

5. MIDTERM Last class prior to Spring Break

6. Magnetic Resonance Imaging (8 lectures)
   a. Spin physics
   b. Bloch equation
   c. Signal equation
   d. K-space trajectories
      i. Projection reconstruction
      ii. 2D Fourier transform trajectory
   e. Image contrast
   f. MRI SNR
   g. Excitation K-space
   h. MR Imaging Lab

7. Ultrasound (4 lectures)
   a. Ultrasound echo equation
      i. Geometric extension of transducer
   b. Impulse response
      i. Diffraction (Fresnel and Fraunhofer regions)
      ii. Lateral and depth resolution
   c. Phased array systems
   d. Ultrasound lab visit
10. In-class review, last class period
11. Final: Official Timetable Time