HAMPTON UNIVERSITY
PHYSICS 625 – DIAGNOSTIC IMAGING

Lecturers: Lars A. Ewell


LECTURE SCHEDULE
JANUARY 15, 2014 – MAY 2, 2014
11:00AM – 12:30PM WEDNESDAY AND FRIDAY

1. Ionizing Radiation (January 17, 2014) Bushberg Ch. 1, 2, 3
   - Radiation & Interaction with Matter
   - Radiation Biology
   - Non-Ionizing
   - Image Resolution
   - Image Formation: Reflection vs. Transmission vs. Emission

2. X-Ray Production (January 22, 2014) Bushberg Ch. 5, 6
   - Radiography
   - X-Ray Tubes
   - kVp, mAs
   - Contrast and Dose vs. kVp

3. Radiation Interactions, Attenuation, Mammography (January 24, 2014) Bushberg Ch. 3, 8
   - Photon Interactions
   - Photon Attenuation
   - Mammography
4. **Image Quality** (January 29, 2014) Bushberg Ch. 10
   - Contrast
   - Resolution
   - Point Spread Function

5. **Image Quality 2** (February 5, 2014) Bushberg Ch. 10
   - Frequency Domain
   - Modulation Transfer Functions
   - Noise

6. **Image Quality 3** (February 7, 2014) Bushberg Ch. 10
   - Noise/Contrast Resolution
   - Sampling and Nyquist Criteria
   - Receiver Operating Characteristics

7. **Digital Radiography** (February 12, 2014) Bushberg Ch. 11, 12
   - Film vs. Digital
   - Charge Couple Devices (CCDs)
   - Image Correction
   - Geometric Tomography

8. **Tomography** (February 14, 2014) Bushberg Ch. 12, 13
   - Tomography
   - Geometric Tomography
   - Tomographic Reconstruction
   - Computed Tomography

9. **Computed Tomography** (February 19, 2014) Radiology Review, Bushberg Ch. 13
   - Attenuation Coefficients
   - CT Numbers
   - Collimator Pitch
   - Image Reconstruction

10. **Computed Tomography 2** (February 21, 2014) Radiology Review, Bushberg Ch. 13
    - Filtered Backprojection
    - Radon Transform

- Radon Transform/Inverse Radon Transform
- Sinogram

12. Computed Tomography 4 (March 7, 2014) Bushberg Ch. 13, Radiology Review

- Sinogram
- CT radiation dose
- Partial Volume Averaging

13. Nuclear Magnetic Resonance (March 12, 2014) Bushberg Ch. 14

- Magnetic Fields
- Magnetic Resonance
- History of MRI

14. Magnetic Resonance Imaging (March 19, 2014) Bushberg Ch. 14, Haacke Ch. 4

- Gyro-magnetic Ratio
- Rotating Reference Frame
- Bloch Equations

15. Magnetic Resonance Imaging 2 (March 21, 2014) Bushberg Ch. 14, Haacke Ch. 4

- Magnetic Energy
- Bloch Equations

16. Magnetic Resonance Imaging 3 (March 26, 2014) Haacke Ch. 21

- Diffusion Weighted MRI
- Applications to Radiation Therapy
- Sulci Density Map

17. Magnetic Resonance Imaging 4 (March 28, 2014) Bushberg Ch. 14

- Chemical Shift Imaging
- Magnetic Resonance Spectroscopy
- Radiation Necrosis/Recurrent Disease Differentiation
18. Positron Emission Tomography 1 (April 2, 2014) Bushberg Ch. 22

- Positron – Dirac Equation
- Positron – Experimental Discovery
- PET Physics
- PET Engineering

19. Positron Emission Tomography 2 (April 4, 2014) Bushberg Ch. 22

- PET Diagnosis
- PET Scintillators
- PET Coincidence and Timing

20. Positron Emission Tomography 3 (April 9, 2014) Bushberg Ch. 22

- PET Detection Efficiency
- Attenuation Corrections
- Scatter Corrections

21. Single Photon Emission Tomography (April 11, 2014) Bushberg Ch. 22

- 2D vs. 3D Data Acquisition
- PET vs. SPECT
- SPECT Collimation

22. Ultrasound Imaging (April 16, 2014) Bushberg Ch. 16, Radiology Review

- Acoustic Waves
- Sound Speed/Sound Attenuation
- Acoustic Impedance

23. Therapeutic Imaging (April 18, 2014) Radiology Review

- Diagnostic Imaging vs. Therapeutic Imaging
- Treatment Planning Algorithm
- Patient Set Up
- Portal Images
- Cone Beam CT