NRE 4750 Diagnostic Imaging Physics (Elective)

Catalog Description: NRE 4750 Diagnostic Imaging Physics (3-0-3)
Prerequisite: NRE 3301 or NRE 6756
Physics and image formation methods for conventional X-ray, digital X-ray CT, nuclear medicine, and magnetic resonance and ultrasound imaging.

Textbook: Webb, A., Introduction to Biomedical Imaging, John Wiley & Sons, Inc., 2003

Topics Covered:

1. Conventional Planar Imaging
    1. X-ray production
    2. X-ray image formation and contrast
    3. Photographic process and film characteristics
    4. Fluoroscopic imaging systems
    5. Image Noise
2. Digital X-ray Imaging and Computed Tomography
    1. Digital imaging systems and image processing
    2. Computed tomography CT image formation
    3. CT image quality
    4. Specialized digital techniques
    5. Bioeffects and safety
3. Nuclear Medicine Imaging
    1. The gamma camera
    2. Detection and process of gamma-ray signals
    3. Tomographic image formation
    4. Image quality
    5. Bioeffects and safety
4. Magnetic Resonance Imaging MRI
    1. Intrinsic and extrinsic parameters affecting MRI contrast
    2. The magnetic field B0 and the equilibrium distribution
    3. The Larmor Frequency and the radiofrequency field B1
    4. Relaxation mechanisms T1, T2, T2* and effects of common contrast agents
    5. The spin-echo sequences
    6. Spatial coding using linear magnetic field gradients
    7. Imaging quality
    8. Bioeffects and safety
5. Ultrasound Imaging
    1. Ultrasound plane waves
    2. Propagation of sound waves through tissue
    3. Single element transducers
    4. Transducer arrays
    5. Pulse echo equipment signal processing
    6. B-mode Imaging
    7. Continuous wave and pulse Doppler
    8. Flow imaging with ultrasound
    9. Imaging quality
    10. Bioeffects and safety

Course Outcomes:
Outcome 1: The students will have the knowledge on the diagnostic imaging methods used in medicine.

Outcome 1.1 The students will learn the general characteristics and parameters used to define the quality of an image.

Outcome 1.2 The students will learn the common mathematical methods used for image reconstruction.

Outcome 1.3 The students will learn the various methods on how a planar or CT X-ray image is formed and on the parameters that are important to the image quality.

Outcome 1.4 The students will learn the various methods on how a SPECT or PET image is formed and on the parameters that are important to the image quality.

Outcome 1.5 The students will learn the various methods on how an ultrasound image is formed and on the parameters that are important to the image quality.

Outcome 1.6 The students will learn the various methods on how a MR image is formed and on the parameters that are important to the image quality.

Correlation between Course Outcomes and Program Educational Outcomes:

NRE 4750 Diagnostic Imaging Physics	Outcome a			Outcome b	Outcome c	Outcome d	Outcome e	Outcome f	Outcome g	Outcome h	Outcome i	Outcome j	Outcome k
Course Outcomes	i	ii	iii										
Course Outcome 1.1		x											
Course Outcome 1.2	x												
Course Outcome 1.3		x			x								
Course Outcome 1.4		x			x								
Course Outcome 1.5			x		x								
Course Outcome 1.6			x		x								

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