APHY 516 Medical Physics II

Course Description

Signal analysis, images (Radiography, Fluoroscopy, CT, Ultrasound, PET), Biomagnetism, X-rays, Nuclear medicine, Magnetic resonance imaging, Biomedical Optics. (3 credit hours)

Prerequisite: PHYC 260 and APHY 315.

Course Objective

The objective of this course is to provide a deeper understanding of how physics plays a major role in medical/biological fields and provide practice in working out specific examples using medical physics concepts. This course will help the student to understand the concepts of medical physics; to develop a solid background to allow the student a more knowledgeable reading of current research and background to attack problems in the workplace.

Course Rationale

This medical physics course is designed for the undergraduate of the biological and physical sciences, in particular those with a major or minor in the area of medical physics, bio-nanotechnology, biology, physiology and who have a sufficient mathematical and biological maturity to meet the necessary prerequisites, This course would be an excellent course for premedical, bio-nanotechnology and medical physics students.

Course Content, Format, and Bibliography

Content

Signal analysis

- New Techniques
- Noise reduction
- Fourier Series and integrals
- Correlation functions
- Power spectrum
- Frequency Spectrum
- EEG, MEG, etc…

Images

- Radiometry
- Forming images

- The relationship between the objects and images
- Image reconstruction from projections
- Computed Tomography
- Ultrasound

Biomagnetism

- Magnetic fields from nerves
- Magnetic materials and biological systems
- Detection of weak magnetic fields
- Magnetic stimulation
- The magnetocardiogram

X-rays

- Production of X-rays
- Radiation interactions
- The diagnostic radiograph
- Image quality
- biological effects of radiation
- The Risk of radiation
- Fluoroscopy

Nuclear medicine

- Nuclear decay: decay rate and half-life etc...
- Gamma decay
- Beta decay
- Radioactive absorption within the body
- Detectors (Gamma Camera)
- PET
- SPECT

Magnetic resonance imaging

Magnetic moments in an external magnetic field

The magnetization

Behavior of the magnetization vector

Relaxation times

Detecting the signal

Optics of the Eye

Photometry

Optical representation and functions of the eye

Vision correction with external lenses

Laser surgery of the eye

Format

Course activities will center on the lectures and assigned problems. It will be expected that the student will study several references during the course. The computer-generated animations are used to introduce, motivate, and illustrate the concepts of medical physics.

This course is taught as a dual undergraduate/graduate course. Students will be required to complete activities appropriate for the level of the course in which they are enrolled. Student performance on homework, exams and/or labs will be evaluated using different standards for undergraduate and graduate students.

Lectures and problem solving.

Course term paper

Assigned readings/report on the literature

Bibliography

Physics of Diagnostic Imaging, David J. Dowsett

Intermediate Physics for Medicine and Biology, 3rd edition, Russell K. Hobbie

Bioelectricity, A Quantitative Approach, 2nd edition, Robert Plonsey and Roger Barr

Introduction to Optics, 3rd Edition, Chapter 19, F. L. Pedrotti

Electricity and Magnetism in Biological Systems, D. T. Edmonds

The essential Physics of Medical Imaging, Jerrold T. Bushberg