

# APHY 315: Medical Physics I

#### **Course Description**

Biomechanics, statistical physics, bioelectric fields, biomagnetic fields, electricity and magnetism at the cellular level. (3 credit hours)

Prerequisite: PHYC 112 OR PHYC 122, MATH 166, and BIO 111 are required; BIO 215 and PHYC 260 are recommended.

#### **Course Objective**

The objective of this course is to provide an understanding of how physics plays a major role in biophysical phenomena and provide practice in working out specific examples using biophysical concepts. It is also to offer the student an introduction to the development of outstanding concepts of medical physics to develop a background sufficient to allow the student a more knowledgeable reading of current research and background to attack problems in the workplace.

## **Course Rationale**

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

## Course Content, Format, and Bibliography

Content

Biomechanics

Translational and rotational equilibrium

Hydrostatics

Statistical Physics

Thermal equilibrium

Entropy

The laws of thermodynamics

The Boltzmann factor and the principle of equipartition of energy

Fick's first and second laws of diffusion

Transport of fluid and neutral solutes through a membrane

**Bioelectric fields** 

Electrochemical processes in nerve and muscles

Hodgkin-Huxley Model of membrane

Electric potentials of living tissues

EEG,EMG and EKG

Electrical stimulation

Nerve conduction velocity

#### **Biomagnetic fields**

Magnetic fields associated with living tissues

The detection of weak magnetic fields

Magnetic simulations of living tissues

MEG

Electricity and magnetism at the Cellular Level

Gouy-Chapman model

Debye-Huckel model

Nernst-Plank equation

Gated membrane channels

Noise in membranes

#### 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 biophysics.

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.

## Bibliography

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

Bioelectromagnetism, Jaakko Malmivuo and Rober Plonsey

Bioelectricity, A Quantitative Approach, 2<sup>nd</sup> edition, Robert Plonsey and Roger Barr

www.bsu.edu/physics