Miami Dade College

Course Description

NMT2613 | Nuclear Medicine Physics and Mathematical Applications | 3.00 credits

Students will learn the basic concepts of atomic, nuclear and radiation physics with an emphasis on the interactions of radiation with matter. Alpha, beta, and gamma sources are explained in this course. Prerequisites: MAC1105, PHY1004; corequisites: NMT1002L, NMT1312C

Course Competencies:

Competency 1: The student will be able to accurately describe the basic concepts of nuclear physics by:

1. Defining:
    a. the fundamental units of measurements
    b. matter and weight and differentiating between them
    c. electromagnetic, gravitational and nuclear force
    d. kinetic and potential energy
    e. atom
    f. molecule
    g. particulate
    h. ion and ionization
2. Illustrating common conversion factors
3. Discussing Newton's Laws of Motion
4. Discussing the historical contributions to nuclear physics made by:
    a. Wilhelm Roentgen
    b. Henri Becquerel
    c. Marie and Pierre Curie
    d. others are associated with early inventions, developments, and applications to nuclear medicine
5. Discussing the composition of the atom (protons, neutrons, electrons) and other elemental particles
6. Discussing electron shells and the stability of binding energy
7. Identifying atomic nomenclature (atomic mass number, atomic number, isotope, isomer, isobar, and isotone)

Competency 2: The student will be able to accurately differentiate the various types of photon interactions with matter by:

1. Stating what occurs during Coherent Scatter and identifying the energy at which it commonly occurs
2. Discussing and explaining:
    a. what happens during a Photoelectric effect
    b. what occurs during a Compton Effect
    c. the relationship between a photoelectric effect and characteristic radiation
    d. what occurs during Triplet Production, including its minimum energy requirement
    e. what occurs during Bremsstrahlung Radiation
    f. what occurs during Characteristic Radiation
    g. what happens during internal conversion
    h. the fundamentals of Pair production and Annihilation
3. Listing what variables would increase and decrease:
    a. the probability of a photoelectric effect
    b. the probability of Bremsstrahlung occurring
4. Demonstrating how to calculate all of the following about the Compton Effect:
    a. Scatter gamma
    b. Degree of scatter
    c. Transferred energy
5. Defining Auger electron

Competency 3: The student will be able to differentiate the various modes of decay accurately by:

1. Defining the specific ionization path length and range
2. Explaining the direct and indirect relationships between specific ionization
3. Defining Linear Energy Transfer and expressing how it relates to specific ionization
4. Discussing the causes of alpha decay
5. Discussing what occurs during beta decay, differentiating positron and beta minus decay modes
6. Defining and differentiating between a neutrino and anti-neutrino
7. Comparing and contrasting the energy ranges between alpha versus beta decay
8. Explaining what occurs during electron capture
9. Comparing and contrasting the similarities and differences of electron capture and positron decay
10. Discussing gamma decay about internal and isomeric conversions
11. Stating the various combination modes that occur
12. Exploring the Perceptions of Whites

Competency 4: Students will be able to accurately describe the fundamentals of statistics and its importance to the field of nuclear medicine by:

1. Defining Systematic and Random Errors
2. Defining and calculating the mean, mode, and median
3. Defining and calculating the formula for variance
4. Defining and calculating standard deviation
5. Discussing the Poisson and Gaussian distribution curves
6. Applying the distribution curves to quality control data obtained in nuclear medicine
7. Explaining confidence levels through the application of the formula
8. Defining and calculating coefficient variation
9. Demonstrating how to calculate:
    a. sample, background, and net counts of a given sample within a given time frame
    b. the minimal detectable activity value
    c. quality control wipe test when given a scenario
    d. efficiency of nuclear medicine equipment percent error

<u>Learning Outcomes:</u>

- Communicate effectively using listening, speaking, reading, and writing skills
- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Formulate strategies to locate, evaluate, and apply information