1. ER327 Applied Nuclear Physics

2. Credit Hours (3)/Contact Hours (3)

3. Course Director – Stephen R. McHale

4. Modern Physics, 4th Ed., by K.S. Krane,; John Wiley, 2019 – ISBN 978-1-119-49546-8

5. Specific course information

a. Introduction to the basic concepts of nuclear physics for engineering students. Emphasis is placed on the structure and stability of the nucleus, nuclear forces, decay processes, nuclear reactions, and interactions of radiation with matter. Nuclear Engineering applications are highlighted.
b. Prerequisites: ER301
   Corequisites: SM212
c. Required for Nuclear Engineering Program

6. Educational objectives for the course

a. Demonstrate an understanding of elements of special relativity and quantum mechanics necessary for the study of fundamental nuclear physics
b. Demonstrate an understanding of nuclear properties such as nuclear charge, mass, and binding energy
c. Demonstrate an understanding of forces between nucleons and properties of nuclear forces
d. Demonstrate an understanding of the shell structure of the nucleus, as well as nuclear and atomic excitation and de-excitation
e. Demonstrate an understanding of nuclear stability and radioactive decay processes including alpha, beta, gamma and other competing decay mechanisms
f. Demonstrate an understanding of elements of interactions between radiation and matter, nuclear reactions, fission, and fusion

7. Specific program outcomes addressed by this course

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Reinforced		X			X	X	X
Mastered	X						

8. Brief list of topics to be covered
   a. Relativity
      i. Classical and Special Relativity
      ii. Time Dilation and Length Contraction
      iii. Relativistic Dynamics
      iv. Relativistic Decays and Collisions

b. Quantum Mechanics
    i. The Schrodinger Wave Equation
    ii. The Infinite Potential Well
    iii. Potential Energy Steps and Barriers
    iv. The Hydrogen Atom
    v. The Nuclear Shell Model
c. Nuclear Decay
    i. Alpha Decay
    ii. Beta Decay
    iii. Nuclear Excite State Decays
d. Radiation Interactions with Matter
    i. Heavy Charged Particle Interactions
    ii. Electron Interactions with Matter
    iii. Photon Interactions with Matter
    iv. Photon Attenuation
    v. Neutron Interactions with Matter
e. Nuclear Applications
    i. Neutron Activation
    ii. Fission and Fusion Energy Production
    iii. Introduction to Radiation Transport, Shielding, and Dosimetry
    iv. Multi-group Estimates of Radiation Dose
    v. Introduction to Monte Carlo Methods of Radiation Transport and MCNP6