1. ER313 Nuclear Materials Science

2. Credit Hours (4)/Contact Hours (5)

3. Course Director – Elizabeth Getto

4. Fundamentals of Materials Science and Engineering: An Integrated Approach, 6th Ed., by W.D. Callister and D.G. Rethwisch; Wiley, 2021 – ISBN 978-1-119-74773-4

5. Specific course information

a. ER313 is an introductory course in materials science and engineering with an emphasis on the importance of material selection and design for the Nuclear Engineering major. It involves the study of the structure and properties of materials and how these are interrelated and influenced by processing and environment. The course concentrates predominantly on metallic materials but also discusses polymeric, ceramic, and composite materials to a lesser extent. All laboratory projects are structured to provide strong physical illustrations for the topics covered in lectures.
b. Prerequisites: n/a
c. Required for Nuclear Engineering Program. EM313 may be approved as substitute

6. Educational objectives for the course

a. Explain the relationship between the microstructure of engineering materials and the mechanical and physical properties of these materials.
b. Demonstrate some of the common laboratory tools used to characterize the structures of engineering materials.
c. List various mechanical properties of engineering materials that can influence material selection decisions and explain the various testing methods for evaluating these properties.
d. Describe and recognize various types of material failure.
e. Explain how thermal and mechanical processing influence and control the structures and properties of engineering materials and use conceptual tools to make predictions of processing effects.
f. Describe how the environment can influence the properties of engineering materials.
g. Describe radiation effects on structural materials used in nuclear reactor plants.

7. Specific program outcomes addressed by this course

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

8. Brief list of topics to be covered
a. Crystal Structures of Metallic Materials
b. Defects in Metallic Materials
c. Diffusion in Solid Materials
    i. Fick's 1st and 2nd Laws

d. Mechanical Testing
e. Deformation, Strengthening, and Annealing
f. Fracture Mechanics and Mechanisms
g. Fatigue
h. Creep
i. Phase Diagrams and Transformations
    i. Binary Eutectic
    ii. Fe-C
    iii. Microconstituents
    iv. Nucleation and growth
j. TTT and CCT diagrams
k. Non-ferrous metal alloys
l. Metal Fabrication Processes
m. Corrosion
n. Polymer materials
o. Ceramic materials
p. Radiation Damage
q. NDE methods
r. Additive Manufacturing