1. EM313 Materials Science

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

3. Course Director – Emily L. Retzlaff

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. An introductory course in the physical and mechanical properties of engineering design materials including metals, ceramics and plastics, their structures, use in engineering applications and failure phenomena. All laboratory projects are structured to provide strong physical illustrations for the topics covered in lectures.
b. Prerequisites: n/a
c. Required for Mechanical Engineering Program

6. Educational objectives for the course

a. Apply the aspects of material selection in engineering design.
b. Explain the relationship between microstructure of engineering materials and the mechanical and physical properties of these materials.
c. Describe the mechanical properties of engineering materials which influence material selection decisions and to explain the various testing methods for evaluating mechanical properties.
d. Determine how thermal and mechanical processing influence, and can be used to control, the microstructure and properties of engineering materials.
e. Evaluate how the environment can influence the structure and properties of materials.
f. Describe various types of material failure and to present procedures to avoid them.
g. Demonstrate in the laboratory some of the more common basic tools used to characterize the structure and properties of engineering materials.

7. Specific program outcomes addressed by this course

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Reinforced	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. Composite materials
q. NDE methods
r. Additive Manufacturing