ME/MSE 4790 Materials Selection and Design (Elective)

Catalog Description: ME/MSE 4790 Materials Selection and Design (3-0-3)

Prerequisites: COE 3001 Mechanics of Deformable Bodies or MSE 3003 Mechanical Behavior of Materials

Crosslisted with ME and MSE.

Principles of selecting materials and processes for engineering applications. Methodologies for designing new materials and conceiving hybrid solutions.

Textbook: Michael F. Ashby, *Materials Selection in Mechanical Design*, 4th Edition, Butterworth-Heinemann, 2011.

Software: CES EduPack, Granta Design, www.grantadesign.com (available to students as free download through OIT and on computer clusters in ME.

Topics Covered:

1. Engineering materials and their properties
2. Introduction to materials selection software
3. Material property charts
4. Strategy for materials selection
5. Materials selection without shape
6. Materials selection involving multiple constraints and/or conflicting objectives
7. Selection of material and shape
8. Hybrid materials
9. Bio-inspired materials
10. New frontiers in systems design of materials: Integrated Computational Materials Engineering
11. Material processes and process selection
12. The material life-cycle and environment-friendly selection
13. Failure analysis and materials selection for durability
14. Aesthetics and industrial design

Course Outcomes:

Outcome 1: To provide the students a thorough systematic approach to the selection of metals, ceramics, polymers, and composites required for mechanical design.

1.1 Students will demonstrate how performance indexes based on mechanics analyses can be overlaid on material property charts to identify promising materials for specific applications using both manual and computer techniques.

Outcome 2: To familiarize the students with material properties and materials fabrication processes and an approach for selecting a process capable of producing a component possessing the size, shape, properties, and cost dictated by the design.

2.1 Students will construct and use material property charts to identify a small set of materials meeting mechanical, physical, and cost requirements.

2.2 Students will use material processing charts to select suitable fabrication processes.

Outcome 3: To teach students how to deal with multiple constraints and conflicting objectives including realistic constraints involving the economics, environment, manufacturability, and sustainability.

3.1 Students will construct a translation table for problems involving either multiple constraints or conflicting objectives, and systematically identify candidate materials.

Outcome 4: To introduce the students to the methodologies for designing new materials and conceiving hybrid solutions.

4.1 Students will show that they can conceive hybrid material solutions that fill "white spaces" on the material property charts.

4.2 Students will demonstrate an understanding of the methodologies used in materials design.

Correlation between Course Outcomes and Student Outcomes:

ME 4790											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	X		X								X
Course Outcome 2.1	X		X								X
Course Outcome 2.2	X		X								X
Course Outcome 3.1	X		X								X
Course Outcome 4.1	X		X		X					X	X
Course Outcome 4.2	X		X		X					X	X

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Prepared by: Richard W. Neu