

King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT

**ME493 Special Topics in Materials and Manufacturing:
Materials Selection in Mechanical Design, Spring 2015 (142)**

Catalogue Description: (3-0-3)

Principles of mechanical design and a novel approach of presenting materials properties to select materials and processes for optimum engineering performance. Product shape, multiple constraints, and conflicting objectives are considered to improve the design objectives. Designing hybrid materials for specific properties and the impact of materials selection on the environment are addressed. The course is supplemented with extensive case studies.

Status in Curriculum: Design Elective (offered every year)

Prerequisites: ME 216, ME307, and ME322 or equivalents

Prerequisites by Topics:

- Mechanical Properties of Materials (ME216)
- Manufacturing Processes (ME322)
- Elements of Design (ME307)

Textbook: *Materials Selection in Mechanical Design & CES EduPack 2011, BH, 2011.*

References:

1. M.F.Ashby, D.R.H.Jones, Engineering Materials: An Introduction to their Properties and Applications.
2. M.F.Ashby, D.R.H.Jones, Engineering Materials: An Introduction to Microstructures, Processing and Design.
3. G.E. Dieter, Engineering Design.
4. F.A.A. Crane and J.A.Charles, Selection and Use of Engineering Materials.
5. G. Budinski, M. K. Budinski, Engineering Materials: Properties and Selection.

Instructor:Dr. Zuhair Gasem, Associate Professor of Mechanical Engineering

Goals:

This course is intended to enhance students understanding of materials properties and their significant role in design performance, apply the design process for products development, optimize materials selection and processes, integrate knowledge learned from other ME courses into product design, and develop presentation and team-work skills.

Course Outline (Lecture Topics):

- 1) Introduction and the Design Process
- 2) Engineering Materials Properties
- 3) Materials Properties and Charts using CES 2011
- 4) Materials Selection –The Basics
- 5) Case studies: Materials Selection
- 6) Multiple Constraints and Conflicting Objectives
- 7) Case Studies: Multiple Constraints
- 8) Selection of Materials and Shape
- 9) Case studies: Materials and Shape
- 10) Designing Hybrid Materials
- 11) Case Studies: Hybrids
- 12) Processes and Process Selection
- 13) Case Studies: Process Selection
- 14) Materials and the environment & Eco Design Module of CES EduPack
- 15) Project Presentations

Design Activities/Projects:

Design assignments and projects.

Computer Usage:

CES EduPack 2011 software, Granta will be made available for students to use for HW and projects.

Assessment Tools:

Homework 15%, 4-5 Quizzes 15%, Midterm 20%, Projects 25%, Final 25%

Course Learning Outcomes:

After successful completion of the course, students will be able to:

1. Identify requirements for various mechanical designs in terms of: function, multiple constraints (geometrical and functional), design objective (s), and free variables.
2. Develop optimization equations for selection of materials for single and multiple design objectives.
3. Use material property charts to select the best performing materials for a given design objective (s).
4. Select material, product shape, manufacturing process, and the impact on the environment for optimum design performance.
5. Use of CES EduPack software in material selection designs.
6. Present the results of the material selection optimization process in technical reports and presentations.

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>
Course-to-Student outcome mapping	1,2		1,2,3,4		1		6	4			5
Emphasis*	S		S		M		M	M			M

*L: Little/None M: Moderate

S: Strong

Date prepared: 25, January, 2015

Prepared by: Dr. Zuhair Gasem