1. Course number and name

MEEG321, Materials Engineering Fall Semester 2016

2. Credits and contact hours

3 credits, 3 contact hours

3. Instructor's or course coordinator's name

Erik T. Thostenson, Mechanical Engineering Date completed, August 29, 2016
Bingqing Wei, Mechanical Engineering

4. Required Textbook

Materials: Engineering, Science, Processing and Design; Ashby, Shercliff and Cebon - ISBN-13: 978-0080994345; Published by Butterworth-Heinemann © 2013 (3rd edition)

5. Specific course information

Catalog Data:

Mechanical properties and materials behavior under static and dynamic loading; fatigue, creep, wear and corrosion; properties and applications of metals, ceramics, polymers, and composites; forming and joining of materials; practical examples of materials selection in design and the use of materials databases.

Prerequisites

MEEG 215 Mechanics of Solids and MSEG 302 Materials Science for Engineers

Required undergraduate course

6. Specific goals for the course

6a. Specific outcomes of instruction

The objective of the course is to provide the background necessary to make informed decisions and recommendations concerning the suitability of materials for engineering applications. This course extends the knowledge gained in the introductory course "Materials Science for Engineers" (MSEG 302) and "Solid Mechanics" (MEEG 215). It explores the way in which materials are used and the way in which production and fabrication routes influence their fitness for engineering applications.

Aspects of materials selection and utilization are introduced and the first segment of the course considers the principal properties of engineering materials that are of major importance for the practicing mechanical engineer, namely properties such as strength, toughness, stiffness, and dynamic properties and are discussed in the context of a design-led approach. Throughout the course materials selection is emphasized and makes extensive use of materials selection charts and the CES Edu Pack Software (available in the E-calc labs). Contemporary issues such as energy and environment have been addressed in selecting materials and associated processes. The sequence adopted provides a logical basis for making informed decisions concerning materials selection and use for engineering components. Emerging areas of materials engineering and research, including advanced composite materials and nanomaterials, are discussed.

Finally, each student group is assigned a project in which they are required to apply the entire semester's content to illustrate, for some specific component or assembly, how the material(s) were selected on the basis of their required function, processed to the required shape and size, and assembled into the finished form in a timely and economical manner. The environmental impact of the materials and processes was

also addressed by every group.

6b. Student outcomes

Outcome J: Knowledge of contemporary issues.

- Specific lectures in the course address contemporary topics including sustainable materials design and emerging materials (composite materials and nanomaterials).

Specific student work to be assessed:

- Design Project: Design projects (5 students/group) were assigned to students for the design, material selection and production route of a product. As part of the detailed design report each group must conduct an appraisal of the societal impact of the choice of material and its reduction route. The Eco-Audit tool in CES EduPack must be used by each group in their appraisal.
- Exam question: A question on the midterm or final exam will focus on composite materials or nanomaterials.

7. Topics

- Mechanical properties of materials (stiffness, strength, fracture toughness, cyclic loading/fatigue, creep/damping)
- Physical properties of materials (e.g. thermal, creep)
- Microstructure and properties of materials (dislocations and strengthening mechanisms)
- Properties of metals (Steel and aluminum alloys, iron-carbon phase diagram, microstructure, etc.)
- Composite materials (types of composites, fiber materials, matrix materials, manufacturing, predicting composite properties/rule-of-mixtures equations).
- Manufacturing processes (shaping processes, joining processes, surface treatments, cost estimation)
- Durability (galvanic corrosion, oxidation)
- Sustainability: Materials, processes and the environment (eco-audit, material consumption and energy).