MEE320
FALL 2000

Instructor: Michael "Mick" Peterson, Ph.D.
Office Hours: M,T,W,Th 10:50-11:40 p.m.
or by ***e-mail*** appt.
Office Location: 208 Boardman
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Text: Michael F. Ashby, *Materials Selection in Mechanical Design*, Butterworth Heinemann, , 1999
Class Room: Boardman 310
Class Meeting: M, W, Fri 9:00 to 9:50 a.m.

I. PHILOSOPHY

This course is intended to reinforce previous courses in mechanics, chemistry and physics. A particular emphasis of the course is on providing an understanding of how materials selection fits into the design process. The use of appropriate materials is critical to the success of engineering designs. Design courses tend to evaluate failure based on criteria derived from strength objectives or strain to failures. However, the strength of a real engineering material is not a fundamental value that can be related directly to atomistic elements and changes to the material based on environmental conditions and the condition of the material. Thus, a more basic understanding of the mechanisms of failure of a material are required in order to understand the real choices that are made in the mechanical allowables that are chosen during engineering design. This class will provide an opportunity to practice skills as well as to demonstrate proficiency. In addition, an engineer needs to know when to perform analysis. Occasional problems will be included as homework that address this objective, and this will be a primary objective of the design portion of the class.

II. COURSE OBJECTIVES

- To introduce approaches to selecting materials for Mechanical Design using criteria based on material performance.
- To introduce the various forms of failure that materials undergo in normal as well as hostile environments. These failure modes include
  - -- Fracture
  - -- Fatigue
  - -- Creep
  - -- Corrosion
- To reinforce basic problem analysis skills.
- To learn through practice, the design skills needed for the engineering profession.

III. EXPECTATIONS

- Attend class, attendance will not be taken, but it is the responsibility of students to obtain any information from their peers if they miss class. Class participation is graded so the positive marks cannot be applied to your grade if you do not attend class.
- Homework is a significant factor in this course. The homework must be completed neatly and turned in using the approved format. Any homework that is late or deviates from the specified format will not be graded at the discretion of the instructor and grader. Solutions will be posted.
- It is expected that all academic honesty issues will conform to University regulations and that everyone will maintain a level of professionalism such that no issues will arise in this area. The policy on academic integrity is available and should be reviewed.

IV. CLASS SCHEDULE

This schedule is tentative and will be used for planning. The later in the semester, the more tentative the schedule!!

Week	Chapter	Topic	Homework
1	1	Introduction – What is materials in design and why study materials in design	
2	2	Materials in the Design Process	
3	3	**Overview of Materials and Their Properties** - Strengthening Mechanisms	
4	4	**Materials Selection Charts** – Definition Relationship to study based on materials selection charts	
4	5	**Applying Materials Selection**	
4	6	**Case Studies** – Specific properties/elastic properties	
5	6	**Case Study 6.7 –** materials for springs/CREEP *Creep* – High temperature deformation of crystalline materials *Creep* – Mechanisms, engineering aspects	
6/7	6	**Case Studies 6.12,6.13** Fracture Toughness – historical *Fracture* – Griffith Theory *Fracture* – fracture modes *Fracture* – Other metallurgical factors	
8/9	6	**Case study fatigue –** time dependent fracture *Fatigue* – Evidence for the role of plastic strain *Fatigue* – Material models for fatigue	
10/11	6	**Case study 6.10** – Corrosion – history; impact *Environmental attack* – Forms of corrosion *Environmental attack* – Corrosion control *Environmental attack* – Localized corrosion	
12/13		**Case Study –** Materials at Temperature Extremes *Hot/Cold* – Mechanisms that control *Hot/Cold* – Developing materials for use at temperature extremes	
14/15		**Analysis of Engineering Failure** - Fracture Surface examination Student Presentations	

V. GRADING

Aspect	Points	Total
Quizzes	2@10%	20
Homework		25
Term Project		30
Class Participation/Recitation		15
	Total	100

Homework will be graded and returned. Homework will become part of your class notes. Class notes MAY be graded and included as part of your homework grade depending on the need for clarification. Homework will be graded individually but can represent collaboration with your colleagues.

The quizzes represent a significant portion of your grade. It is expected that a large variation between class members will be in this area. Quizzes will be closed book and closed note with a single information card (4 inch by 6 inch or smaller) to be used to jog your memory. If you miss any quiz you will need to have a reasonable excuse. If the excuse if deemed to be reasonable by the instructor, your class grade will depend on the grades you have received on the quizzes which you have taken. Chronic absence from quizzes and class or clearly marginal excuses can result in assignment of a zero on those exams. If you have any questions about this rule ask! All questions regarding quizzes or assignments must be submitted within 24 hours of return of the assignment. The question must be in writing and must be accompanied by the original unmarked copy of the assignment. You will receive a written reply to all grading questions as well. No exceptions will be made to the policy of no verbal discussion of grading details or clarification. Quizzes represent individual effort and absolute personal integrity is expected. The design project final grade will be based on a presentation. A review form will be provided to you to help you to prepare your written and oral documents.

Class participation!!! You will be graded on your ability to respond to a question at the beginning of class based on the reading assigned from the prior class. You should be able to explain the case for the day and describe the tradeoffs that are being made. This will develop over the course of the semester. If you want to clarify the statements of a class member then you should be sure that I have your name.

VI. ABET

Program objectives met with this course : An ability to apply knowledge of mathematics, science and engineering and an ability to identify, formulate and solve engineering problems.