CAE 315 – Materials of Construction (required)
Syllabus
Fall 2011

2008-10 Catalog Data: Physical principles of elastic and plastic deformation of construction materials. Mechanical testing methods including tensile, compressive, toughness, creep and fatigue. Properties of concrete, wood, iron and steel and other construction materials. The emphasis is on concepts from solid mechanics which explain the behavior of materials to the extent needed in the design of load-bearing constructs.


References: ASTM E9 – Standard Test Methods of Compression Testing of Metallic Materials at Room Temperature
ASTM 370 – Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM D143 – Standard Test Methods for Small Clear Specimens of Timber

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Goals and Objectives: The goals of this course are: to provide students with a basic understanding of the properties of materials used in construction; how these properties are determined and used; become familiar with Standards where material properties may be found; become familiar with testing methods used in measuring these properties; gain hands-on experience with laboratory procedures for determining mechanical properties and the preparation of laboratory reports for documenting tests and results. These goals will be achieved through lectures, assigned homework, laboratory experiments, and preparation of laboratory reports.

Prerequisites by topic:
1. Statics
2. Mechanics of Materials
3. Use of available computer software for spreadsheets, graphing, word processing.

Lecture topics:
1. Introduction – course content, syllabus, homework, laboratory procedures and report requirements
2. Material properties of interest in design – steel, wood, concrete
3. Nominal stress-strain properties in simple tension – steel, wood
4. Nominal stress-strain properties in compression – steel, wood
5. True stress-strain properties in simple tension - steel
6. Modification of stress-strain relations
7. Utilization of simple tension and compression properties in design
8. The problem of failure
9. Nature of fatigue failures
10. Types of fatigue loading
11. Factors influencing fatigue strength
12. Utilization of fatigue properties in design
13. Notched bar impact properties
14. Utilization of impact properties in design
15. Hardness properties of metals
16. Utilization of hardness properties in design
17. Static tension and compression tests
18. Impact and hardness tests
19. Fatigue tests
20. Selection and preparation of test specimens
21. Selection of testing apparatus
22. Analysis and presentation of data
23. Laboratory safety and duties

Laboratory Projects:

Experiments using steel
1. Tension test
2. Compression test
3. Charpy impact test
4. Brinell hardness test
5. Fatigue test

Experiments using wood
1. Tension parallel to grain
2. Tension perpendicular to grain
3. Compression parallel to grain
4. Compression perpendicular to grain
5. Shear parallel to grain
   (Each laboratory period is 150 minutes)

Computer Usage:
1. Computers and/or calculators are to be used for stress analysis and homework preparation
2. Computers/Word are to be used for the preparation of laboratory reports
3. The use of Excel for storing laboratory data and plotting graphs is highly encouraged
Expected Knowledge Gain:
Upon successful completion of this course, a student is:
1. expected to be familiar with mechanical properties of construction materials;
2. expected to be familiar with U.S. standards where construction material properties are published and corresponding Standardizing Agencies;
3. is expected to be familiar with the basic laboratory measuring tools and their accuracies;
4. expected to be able to prepare test specimens;
5. expected to be able to design experiments for determining the basic mechanical properties of steel and wood;
6. expected to be able to fully document results of experiments dealing with material properties determination.

Assessment Measures:
1. Student grades in homework problems, midterm and final examinations, laboratory reports.
2. Completeness of homework assignments.
3. Completeness and presentation of laboratory reports.
4. Comments provided by students in their end-of-semester instructor/course evaluations.

Homework and Laboratory Report Assignments:
The goals of homework and laboratory assignments are to develop analysis skills; emphasize concepts covered in the lectures through assigned problems; develop skills in reporting and documenting data determined in the laboratory experiments; monitor your understanding of material covered in the course; and provide you with feedback.

Homework is to be submitted on engineering pad sheets written on one side only. All homework assignments are due at the beginning of class one week after being assigned. Late homework assignments will be accepted but with a reduced grade of 25% for each day of lateness. You are encouraged to work on the homework in groups. However, note that it is your responsibility to make sure you understand the material as you will not be allowed to consult with your classmates during examinations.

Ten laboratory reports are required. The format for the laboratory reports will be provided by the instructor. Laboratory reports are due at the beginning of the laboratory period one week after the experiment is completed. The grade will be reduced 25% for each day of lateness. All laboratory reports including graphs will be done on the computer. You are encouraged to use digital cameras to take photographs of the experiment and the equipment used (neat, hand drawn sketches of apparatus will be accepted). Note: handwritten reports will not be accepted.

Reading Assignments:
Students will be responsible for all assigned reading material whether covered in class or not.

Grading:
The final grade for the course will be distributed among the various activities as follows:

- **Homework:** 20%
- **Lab Reports:** 25%
- **Mid-Term Exam:** 25% date to be determined
- **Final Exam:** 25% per University final exam schedule
- **Class/Lecture Participation:** 05%

**Notes:** Homework solutions and exam solutions will be posted on the IIT Blackboard.

**Prepared by:** A. Longinow, August 19, 2011