

# Deformation and Failure of Engineering Materials

ED 3160 - Fall 2011

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<b>Lectures</b>	Tue-Thu, A slot, Room ED 108		
<b>Tutorial</b>	Fri A slot		

## 1 Description

This course introduces the student to modes of deformation and failure of common engineering materials, such as metals, polymers and ceramics. Materials selection is an integral part of the engineering design process and the primary goal of this course is to equip the student with the necessary scientific background required to perform this task.

## 2 Ground Rules

1. I have a **zero-tolerance** policy on unethical practices. This includes plagiarism and any other practice that is commonly accepted as unethical or unprofessional. (Plagiarism is defined as the unauthorized use or close imitation of the language and thoughts of another author and the representation of them as one's own original work). **If found guilty, all parties involved will get zero credit for entire homework, quiz, or exam and will be reported to the authorities as deemed fit.**
2. Attendance will be taken at the beginning of each class and **Institute rules regarding W grades** will be strictly enforced.
3. All **mobile phones must be switched OFF** (not on silent) during class; if not, you will lose attendance for that class.
4. Students will work on in-class tutorials in groups of three, chosen by the instructor. Discussion within the group is encouraged, but not across groups. Each team member is expected to turn in solutions individually in order to get a grade.

## 3 Grading Policy

A 5-minute quiz will be given to students at the beginning of each class, and attendance will be given only to those who turn this quiz in.

<b>Daily quiz</b>	10%
<b>Tutorials</b>	20%
<b>Exams</b>	70%
<b>Quiz I</b>	15%
<b>Quiz II</b>	15%
<b>Final</b>	40%

To obtain a passing grade, you will have to satisfy separate cut-offs on the tutorials and the exams.

## 4 Learning Objectives

At the end of this semester, the student will be able to:

1. *define* the concept of failure in a structural component

2. *enumerate* various types of materials used in engineering applications
3. *describe* the mechanical properties of metals, ceramics, polymers and composites
4. *understand* the relationship between structure and mechanical properties
5. *enumerate* some commonly observed modes of deformation and failure in engineering structures
6. *distinguish* between various constitutive responses
7. *define* elastic response of a solid
8. *state* Hooke's law for multiaxial stresses and use it in calculations
9. *define* plastic response in a solid and explain it through a stress-strain curve
10. *state* common yield criteria and use them in calculations to check for failure
11. *describe* dislocations and their role in plastic deformation
12. *define* visco-elastic behaviour of a solid
13. *identify* materials for which visco-elasticity is important
14. *understand* fundamental ideas of fracture mechanics
15. *illustrate* differences between ductile and brittle fracture
16. *calculate* stress intensity factor and energy release rate
17. *define* fatigue failure
18. *distinguish* between low-cycle and high-cycle fatigue
19. *compute* number of cycles to failure using Paris law
20. *define* creep deformation
21. *distinguish* between different stages of creep deformation
22. *understand* failure by creep rupture

## 5 Textbooks

1. R. Balasubramaniam, *Callister's Materials Science and Engineering*, Wiley-India, 2010
2. M. A. Meyers and K. K. Chawla, *Mechanical Behavior of Materials*, Second Edition, Cambridge, 2003