# MSE 450 - MECHANICAL BEHAVIOR OF MATERIALS
## SPRING 2008

PROF. K.L. MURTY *EB1 01010 9:35 – 10:25AM* T/A:…………………………..
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| *Objective* |
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| • The course covers the basic concepts for the mechanical properties and mechanics of materials. The essential elements of elasticity, plasticity and dislocation theory will be covered. Topics include strengthening mechanisms, creep behavior, fracture mechanics, toughening mechanisms and fatigue. |
| • The relationship between microstructure and properties will be emphasized. |

**TEXT:** ***Mechanical Metallurgy, G. E. Dieter, McGraw-Hill, 3rd edition, 1986***
**References:** Mechanical Behavior of Materials, M. A. Meyers and K. K. Chawla, Prentice-Hall, 1999.
Mechanical Properties of Materials, Thomas H. Courtney, McGraw-Hill, 1990.

**ASSIGNMENTS AND TESTS:**

• **Assigned chapters/sections should be read in conjunction with the lectures for background not covered in class**. •

• *It will be helpful to have the book in the class.* •

Homework assignments will be distributed and collected/graded during the semester.

**GRADING:**

Homework---------------------------- 5 % <u>due on the assigned date (by 5pm)</u> [**no exceptions !**]
Quizzes (~once/week) --------------15 % (delete one least grade - see Policies & Procedures)
Tests #1(15) & 2(25)----------------40 % (dates as discussed in class)
**Final** ----------------------------------40 % (comprehensive)

## Syllabus

<u>Topic</u> -----------------------------<u>Text (Chap:sec)</u>
Introduction
*Review of Elastic and Plastic Deformation & Multiaxial Flow* --------------------------- **1**:1-10
$\tau_{RSS}$ */ Stress & Strain Tensors* ------- **2:**1-8,10
*Elastic Behavior / Hooke's Law* ------- **2**:11-13
*Plasticity / Yield Criteria* ------- **3**:1-6,8,10,11
Plastic Deformation in Single and Poly Crystals ------------------------ **4:**1-7,10,11
<u>**Test 1** (15%)</u>
Dislocation Theory (class notes) ------- **5:**1-15
Crystal structure and dislocation geometry
Dislocations in real crystals and reactions
Elastic fields; energy and force relations
Dislocation motion and plastic strain tensor

<u>Topic</u> ----------------------------<u>Text (Chap:sec)</u>
Strengthening Mechanisms ----- **6:**1-3, 5-9, 13-15
Dislocation-defect interactions; flow stress; grain boundaries; obstacles; Thermal activation; climb and diffusion processes; Strain hardening
<u>**Test 2** (25%)</u>
Fracture -------------------------------- **7**:1-8; **14**:1-4
Tension & Hardness Tests **8**:1-3,6-9,11; **9**:1-5,10
Fracture and Fracture Mechanics ------------**11**:1-9
Fatigue -----------------------------**12**:1-10,13,20-21
Creep and Stress Rupture ----------**13:**1-5, 8-14,15
Creep Mechanisms & Superplasticity (class notes) ----------------**13**:6-7
Sheet Metal Forming (time permitting)-**20**:1-2,5,6,8
*Review*
**Final (40%) – comprehensive**

**References**

1. T. H. Courtney, *Mechanical Properties of Materials*
2. M.A. Meyers and K.K. Chawla, *Mechanical Behavior of Materials*
3. R.E. Reed-Hill, *Physical Metallurgy Principles*
4. D. Hull and D.J. Bacon, *Introduction to Dislocations*

## • Policies and Procedures •

• *Tests* As stated in the syllabus, there will be 3 tests as per the syllabus shown along with the weights indicated. All tests will be closed book with *all relevant information* summarized in one page at the end of the test(s).

• *In-Class Quizzes* Will try to have about 1 per week with a total weight of 15%; will allow to have 1 missed (i.e., will count the total number of quizzes less 1); all quizzes will be open book.

• *Home Works* Required homeworks are due on the assigned date (by 5pm to the instructor / TA). **Use regular rule paper and fold the pages vertically** when you hand them in, and on the outside put your name, the date and the problem set number.

• +/- grading will be adopted (no curving) :

A+ ≥ 95 A ≥ 92.5 A- ≥ 90 B+ ≥ 85 B ≥ 82.5 B- ≥ 80 C+ ≥ 75
C ≥ 72.5 C- ≥ 70 D+ ≥ 65 D ≥ 62.5 D- ≥ 60 F<60

See Academic Regulation at: http://www.ncsu.edu/provost/academic_regulations/syllabus/reg.htm

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**Home Works : (Rules to be followed** ----- *penalized for not following the rules)*

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1. Use all sheets of the same size – standard 8.5x11 size
2. Write on only one side of the paper
3. Staple pages (in the order of HW #s) at the top left

**MSE 450**

• Instructional Objectives •

At the end of the course you will be able to

- *calculate* the stresses and strains in a body due to multiaxial loading
- *estimate* the damage accumulated in a material in a given structure, and thus the *remaining* useful life of the structure made of these materials
- *describe* the various yielding criteria appropriate to a given case
  – *required* for proper design of structures
- *explain* why a specific material was chosen for a given application
- *identify* problems (materials related with emphasis on mechanical and fracture) encountered in structures in technologies (aerospace, automotive, chemical, nuclear, electronic, etc.)
- *choose* the best and optimum material for a given application;
  - *compare* two competing materials for a given application
- *predict* the reliability (dimensional stability) of a given component
- *outline* procedure(s) for detecting the problems and
  *suggest* plausible remedial solutions
- *distinguish* between various effects resulting in the deterioration of a given component in-service

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- The course requires reading the appropriate sections of the text as well as handouts – available on web (<http://www4.ncsu.edu/~murty>)