Fall 2015
MSE 527L- Mechanical Behavior of Materials Laboratory, class#14996

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Office Hour: W 5:30-6:00pm

Course Description:
Prerequisites: MSE 227 and MSE 227L
One 2.5–hour laboratory per week, Design units: 1.0.

The main techniques used in this course center around the application of scientific principles to real-life situations, by using appropriate mechanical tests. The course covers dislocation theory and plastic deformation in order to explain strengthening mechanisms in different materials. Materials applications in elevated temperature are studied to understand the design criteria for these applications. Fundamental of fracture mechanics, microstructure aspects of fracture toughness, transition temperature, environment-assisted cracking, and fatigue crack propagation is discussed to be able to design based on the damage tolerant concept, and failure analysis using scanning electron microscopy.

Textbook: R. W. Hertzberg, R. P. Vinci and J.L. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, 5th Ed., J. Wiley & sons, 2013.
227L Lab Manual located at http://www.csun.edu/~bavarian/mse_227_lab.htm

Time: Wed 20:00-21:50 PM, Room JD1504
MSE 527L- Mechanical Properties of Materials Lab.

	Grp #1	Grp #2	Grp #3	Grp #4
26-Aug		**Introduction**		
2-Sep	**Tension**	**Impact**	**Kt Concent**	**SEM**
9-Sep	**Project I**	**Project I**	**Project I**	**Project I**
16-Sep	**Impact**	**Tension**	**SEM**	**Kt Concent**
23-Sep	**Kt Concent**	**SEM**	**Tension**	**Impact**
30-Sep	**SEM**	**Kt Concent**	**Impact**	**Tension**
7-Oct	**SCC, plan Project II**	**Fatigue/FCG**	**Fract Toughness**	**Mg Deform**
14-Oct		**Project I Presentation & Planning Project II**		
21-Oct	**Fract Toughness**	**SCC, Project II**	**Mg Deform**	**Fatigue/FCG**
28-Oct	**Fatigue/FCG**	**Mg Deform**	**SCC, Project II**	**Fract Toughness**
4-Nov	**Mg Deform**	**Fract Toughness**	**Fatigue/FCG**	**SCC, Project II**
18-Nov	**Project II**			
25-Nov	**Project II (check SCC samples)**			
2-Dec	**Project II Presentations**			

Project I: ASTM test standards: ASTM E399, ASTM E647, ASTM E1820, ASTM D6068, ASTM E139

Suggested topics for Lab Final projects:

1. Impact Test, to identify DBTT for different crystal structure
2. Testing materials in tension, to generate stress-strain curve, define elastic modulus, and the strain hardening coefficient.
3. Fracture behavior of materials, generate ductile and brittle failure and define their fracture toughness values.
4. Fatigue of materials, using Bending Beam, Rotating Beam, to generate S-N curve, effect of surface condition on fatigue behavior, and Environmental effects on fatigue (corrosion fatigue)
5. Effects of microstructure on mechanical properties, verify Hall-Petch formula (grain size effects)
6. Environmentally assisted cracking, Stress corrosion cracking, hydrogen embrittlement and define K_{IEAC}
7. Deformation of Mg (slip and twining mechanisms for plastic deformation)
8. Determine Fracture toughness K_{IC} of a material
    - Design test specimen
    - Perform the test
    - Check on the validity of the test
    - Factors affecting the fracture toughness
9. Define Fracture toughness using Charpy Impact Test
    - Define K_{ID}
    - Define K_{IC}
10. Failure Analysis, prepare a report on a failure case
11. Scanning Electron Microscopy, to study its application in analyzing fracture behavior

Format of the required reports:

* Memo Report (Tension tests, Impact and Fracture Toughness)
** Formal Report (Project I, and project II)

Grading:

3 Memo Reports	30%
2 Projects Reports	50%
2 Oral Presentations	20%

Grading System:

Letter Grades	Grade Points
A Outstanding	4.0
B Excellent	3.0
C Acceptable	2.0
D Passing	1.0
F Failure	0.0

Plus/Minus Grading

Attendance is mandatory for all Lab. sessions

References:

1. D. G. Rethwisch and W. D. Callister Jr, Fundamentals of Materials Science and Engineering: An Integrated Approach, John Wiley & Sons, NY, 3rd Edition, 2012.
2. R. E. Reed Hill and R. Abbaschian, Physical Metallurgy Principles, PWS-KENT, 1992.
3. G. E. Dieter, Mechanical Metallurgy, McGraw-Hill, NY, 1994.
4. V. J. Colangelo and F.A. Meiser, Analysis of Metallurgical Failures, J. Wiley & Sons, NY, 1987.
5. ASM Metals Handbook, Volume 11, Failure Analysis and Prevention, Metals Park, 1986.
6. R. M. Caddell, Deformation and Fracture of Solids, 1980.
7. **A.** G. Guy, Elements of Physical Metallurgy, 1984.

Course Objectives

1. This course will increase your ability to apply your knowledge of mathematics, chemistry, and physics in the mechanical behavior of materials and structural design.
2. The laboratory component will increase your ability to design and implement experiments to meet process design and selection of proper materials.
3. This course will increase your ability to design structural components base on proper knowledge of materials properties, manufacturing processes and environmental effects.
4. This course will increase your ability to identify, formulate, and solve engineering problems and develop solutions that are competitive and economical.
5. This course will increase your ability to understand ethical responses and to address contemporary issues and civic responsibilities and to develop an involvement in the professional roles.
6. This course will increase your ability to design a sound engineering system to satisfy.

Standard Operating Procedures

1. Class members are expected to maintain personal and professional standards consistent with the Code of Ethics of the National Society of Professional Engineers, the Preamble and Fundamental Canons of which are as follows:

   Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

   - using their knowledge and skills for the enhancement of human welfare,
   - being honest and impartial, and serving with fidelity the public, their employers and clients;
   - striving to increase the competence and prestige of the engineering profession; and
   - supporting the professional technical societies of their disciplines.

   Engineers shall:

   - hold paramount the safety, health and welfare of the public in the performance of their professional duties
   - perform services only in the areas of their competence

- issue public statements only in an objective and truthful manner
- act in professional matters for each employer or client as faithful agents or trustees, and avoid conflicts of interest
- build their professional reputation on the merit of their services, and not compete unfairly with others
- act in such a manner as to uphold and enhance the honor, integrity and dignity of the profession
- continue their professional development throughout their careers and provide opportunities for the professional development of those engineers under their supervision

2. Class members are expected to submit original work except in joint projects in which the activities are cooperative and collaborative.
3. Class members are expected to attend class except when circumstances are outside the members control.
4. Class members are responsible for material in the reading assignments, class presentations, discussions, and homework examples.
5. Homework sets and project reports are due at the time requested
6. Class members are expected to be cooperative with other class members and to collaborate when appropriate with colleagues.
7. Class members are expected to participate in the oral presentations are required.
8. Class members are expected to comply with University regulation governing intellectual property, origin of work, and honesty. Failure to maintain these standards will result in student disciplinary action and a grade of F in the course.

Formats for Work

1. The members of the class will make a presentation to the projects related to mechanical behavior of materials or design for mechanical testing.
2. The format for the project design report is described in the MSE 227L laboratory manual.