

ME/MSE 413: Mechanics of Solids

- Course description:* Elasticity, elastic stress distributions; plastic deformation of single and polycrystals; introduction to dislocation theory and its applications; creep, fracture, and fatigue.
- Number of credits:* 3. This course is required for MSE.
- Course Coordinator:* Scott Beckman
- Prerequisites by course:* MSE 201, CE 215
- Prerequisites by topic:*
1. Newtonian mechanics
 2. Elementary stress analysis
 3. Crystal structures
 4. Introductory concepts of dislocations
 5. Polycrystalline nature of engineering alloys
- Postrequisites:* MSE 513 (recommended)
ME/MSE 537 (recommended)
- Textbooks/other required materials:* R.W. Hertzberg, R.P. Vinci, and J.L. Hertzberg. *Deformation and Fracture Mechanics of Engineering Materials*. Wiley and Sons, Hoboken, NJ.
- Course objectives:*
1. To analyze the stresses and strains that exist within a body subjected to non-uniaxial loading.
 2. To be able to determine yielding under multiaxial loading.
 3. To understand the fundamental processes involved in deformation, fracture, and fatigue under ambient conditions.
 4. To compute fracture stresses and fatigue lives of engineering components.
 5. To be able to match applications with the appropriate material based on an understanding of both the mechanics and fundamental material behavior.
 6. To use numerical techniques in the solution of complex problems
- Topics covered:*
1. Stress and Strain
 2. Mohr's Circle
 3. Tensor Notation
 4. Linear Elasticity and Hooke's Law
 5. Principles of Stress Analysis
 6. Continuum Plasticity
 7. Flow Curves and Constitutive Relations
 8. Yield Criteria and Flow Under Multiaxial Stress
 9. Crystal Plasticity and Dislocation Theory
 10. Strengthening Mechanisms in Metals
 11. Fracture and Fracture Mechanics-Toughness, Fatigue and Stress Corrosion Cracking
 12. Applications of LEFM to Design and Ethical Implications
 13. High Temperature Deformation

Expected learning outcomes:

1. Ability to calculate the state-of-stress at a point for complex loads using transformation equations and graphical techniques such as Mohr's Circle.
2. Ability to determine if yield will occur using Tresca and von Mises yield theories.
3. Ability to describe deformation, fracture, and fatigue in terms of dislocation motion and arrangements.
4. Use fracture mechanics concepts to compute fracture stress and fatigue lives given materials data and loading conditions.
5. Ability to select an appropriate material from a number of possible choices given the operating conditions.
6. Calculate the high temperature life of a component using engineering data and the Larson-Miller parameter.
7. Ability to appreciate ethical implications of engineering decisions related to fracture and fatigue.

Class schedule:

Three 50-minute lecture sessions per week, for one semester.

Laboratory schedule:

None.

Contribution to meeting the professional component:

Engineering Topics

Relationship of course to student outcomes for ME:

Meets (for ME):

1. School of MME educational objectives: 1, 2, 3
2. ABET, Criterion 3 program outcomes: 1, 2, 3, 5, 7
3. School of MME program outcomes: 1, 2, 3, 5, 7

Meets (for MSE):

1. School of MME educational objectives: 1, 2, 3
2. ABET, Criterion 3 program outcomes: 1, 2, 3, 5, 7
3. School of MME MSE program outcomes: 1, 2, 3, 5, 7, 8, 9, 10, 11

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POLICIES

A. Reasonable Accommodation (the nature of the particular course determines which one applies):

- **Pullman Campus.** Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center.
- **WSU Online Course.** Reasonable accommodations are available in online classes for students with a documented disability. All accommodations must be approved through your WSU Disability Services office. If you have a disability and need accommodations, we recommend you begin the process as soon as possible. For more information contact a Disability Specialist on your home campus: Pullman or WSU Online (<http://accesscenter.wsu.edu>), Spokane (<http://spokane.wsu.edu/students/current/studentaffairs/disability/>), Tri-Cities (<http://www.tricity.wsu.edu/disability>), Vancouver (<http://studentaffairs.vancouver.wsu.edu/student-resource-center/disability-services>).

B. Academic Integrity

WSU expects all students to behave in a manner consistent with its high standards of scholarship and conduct. Students are expected to uphold these standards both on and off campus and acknowledge the university's authority to take disciplinary action. The Standards of Conduct for Students can be found at <http://conduct.wsu.edu>.

C. WSU Safety

WSU is committed to maintaining a safe environment for its faculty, staff, and students. Safety is the responsibility of every member of the campus community and individuals should know the appropriate actions to take when an emergency arises. In support of our commitment to the safety of the campus community the University has developed a Campus Safety Plan, <http://safetyplan.wsu.edu>. It is highly recommended that you visit this web site as well as the University emergency management web site at <http://oem.wsu.edu/> to become familiar with the information provided.