ME 3402 - Solid Mechanics and Design I
Outcomes and schedule of topics

1 Minimum outcomes
After successfully completing this course, the student should have attained, at the very least, an ability to:

2. Define Stress and Strain, and apply the general concept of 3-D stress equilibrium to 1-D and 2-D problems.
3. Define constitutive laws for linear elastic behavior and apply them in 1-D and 2-D problems in solid mechanics.
4. Solve problems of torsion, stress concentration, and pressurized cylinders.
5. Solve beam problems that involve normal bending stresses and shear stresses, composite beams, and curved beams.
6. Transform stresses between coordinate systems.
7. Calculate deflections in straight and curved beams using the principle of superposition and energy methods.
8. Solve statically indeterminate problems.
9. Define commonly used static failure theories and utilize them for quantitative predictions.
10. Define and describe fatigue failure theories such as Stress-Life and Strain-Life, and utilize them in quantitative predictions of fatigue failure.
11. Account for fluctuating stresses and combined loads in fatigue failure calculations.
12. Apply concepts from fracture mechanics in calculating residual fatigue life in engineering components.

2 Topics and schedule
The following is a tentative list of which topics will be covered, test dates and scheduled project work. These dates are only guidelines and may change.

Week 1: 8/24–8/26 (2 classes): Quick review of FBDs, Shear Force and Bending Moment Diagrams in Beams, Factor of Safety

Week 3: 9/5–9/9 (2 classes, Labor Day): Constitutive laws, Lame constants, thermal strains

Week 4: 9/12–9/16 (3 classes): Example using elasticity equations, torsion, stress concentration, pressurized cylinders, normal stresses in beams

Week 5: 9/19–9/23 (3 classes): Shear stresses in beams, composite beams, curved beams in bending

Week 6: 9/26–9/30 (3 classes): Stress transformations, combined loading, deflection of beams. Test 1 (Stresses)

Week 7: 10/3–10/7 (3 classes): Superposition principle, curved beam deflection, statically indeterminate problems. Introduction of design project

Week 8: 10/10–10/14 (0 classes, Fall Break):

Week 9: 10/17–10/21 (3 classes): Statically indeterminate problems, energy methods (Castigliano’s theorem etc.), buckling

Week 10: 10/24–10/28 (3 classes): Failure theories, Max SST, Max DET, Coulomb Mohr. Design project work in class.

Week 11: 10/31–11/4 (3 classes): Brittle failure, fracture mechanics

Week 12: 11/7–11/11 (3 classes): Reliability methods, fatigue concepts, stress life method. Test 2 (Indeterminate problems, failure)


Week 14: 11/21–11/25 (1 class, Thanksgiving Break): Fatigue failure theories

Week 15: 11/28–12/2 (3 classes): Fatigue failure theories (cont.), combined loads, cumulative fatigue damage

Week 16: 12/5–12/9 (3 classes): Cumulative fatigue damage (cont.), Design Project work in class.

Week 17: 12/12 (1 class): Test 3 (Fatigue)