Carleton University
Department of Mechanical and Aerospace Engineering

MECH 4101: Mechanics of Deformable Solids

Lectures: 3 hours per week **Winter Term**
Instructor: Professor C.L. Tan

Course Outline

1. Review of Elementary Stress Analysis: Failure modes in mechanical design. Governing equations in elementary theory of elasticity; general methods of solution.

2. Axisymmetric Elastic Deformations: Review of Lame**=**s solutions for pressurised thick-walled cylinders and rotating discs. Thermal stresses in thick-walled cylinders and thin discs.

3. Stress Functions: Airy**=**s stress functions and the biharmonic equation; solution by polynomials. Use of polar coordinates; practical applications; stress concentrations.

4. Shock or Impact Loading: Energy method for 1-D systems; impact factor; effects of geometry and yielding. Stress wave propagation. Changes in material properties under impact loads.

5. Elasto-Plastic Analysis: Review of yield criteria; idealisation of material yield behaviour. Elasto-plastic bending of beams; residual stresses and spring-back analysis; strain-hardening. Elasto-plastic deformation of pressurised thick-walled cylinders; residual stresses and autofrettage.

6. Creep Analysis: Bailey-Norton law; creep relaxation; creep in uniaxial and multiaxial stress systems. Larson-Miller parameter; reference stress technique. Cumulative creep concepts; time-hardening, strain-hardeing and life fraction rules.

Assessment

Mid-Term Examination	20 %
Final Examination	80 %
Total	100 %

References

1. A.C. Ugural and S.K. Fenster, *Advanced Strength and Applied Elasticity*, 5th Edition, PTR Prentice Hall, 2011.

2. E. Volterra and J.H. Gaines, *Advanced Strength of Materials,* Prentice Hall, 1971.

3. S.P. Timoshenko and J.N. Goodier, *Theory of Elasticity*, McGraw Hill, 1970

4. J.H. Faupel and F.E. Fisher, *Engineering Design*, John Wiley, 1981.

5. R.K. Penny and D.L. Marriot, Design for Creep, McGraw Hill, 1971