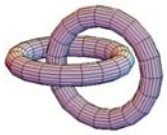
King Fahd University of Petroleum & Minerals
Mechanical Engineering Department
ME551: Continuum Mechanics

Spring Semester (082)

Days: SM, Time: 6:15PM-7:45 PM, Room: 24-106



==========

Catalog Description: ME 551 Continuum Mechanics (3-0-3)

Review Tensors, indicial notation, transformation of coordinates. Stresses, principal stresses. Mohr's circles. Deformation and strain. Velocity fields and compatibility conditions. Constitutive equations. Isotropy. Mechanical properties of solids and fluids. Field equations: applications to elasticity, viscoelasticity, plasticity, and fluid mechanics. **Prerequisite: Graduate Standing**

Textbook: J.H. Heinbockel, ***Introduction to Tensor Analysis and Continuum Mechanics***, Trafford Publishing 2001.

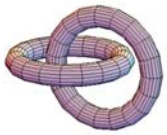
References:

- Mase, G.E., Schaum's Outline of Continuum Mechanics, McGraw-Hill, 1969.
- Frederick, D., Chang, T.S., Continuum Mechanics, Scientific Publishers Inc., 1972.
- Fung, Y.C., First Course in Continuum Mechanics, 3rd Ed, Prentice Hall, 1994.
- Chandrasekharaiah, D.S., Debnath, L., Continuum Mechanics, Academic Press, 1994.
- Spencer, A.J.M. "Continuum Mechanics", Dover Publications, 2004.

Instructor: **Dr. Hussein Al-Qahtani**
Room 22-215-3, Phone: 2846, E-mail: QahtaniH@kfupm.edu.sa

Course Content Outline:

Topics Covered	#Lectures
INDEX NOTATION 1. Symmetric and Skew-Symmetric Systems 2. Summation Convention, Addition, Multiplication and Contraction 3. The e-permutation symbol and Kronecker delta 4. The e-δ Identity & Generalized Kronecker delta 5. Additional Applications of the Indicial Notation 6. Transformation Equations 7. Calculation of Derivatives 8. Vector Identities in Cartesian Coordinates 9. Indicial Form of Integral Theorems 10. Determinants, Cofactors	(3)
TENSOR CONCEPTS AND TRANSFORMATIONS 1. Reciprocal Basis 2. Coordinate Transformations 3. Scalars, Vectors and Tensors 4. Transformations Form a Group 5. Cartesian Coordinates 6. Scalar Functions and Invariance 7. Vector Transformation, Covariant & Contravariant Components 8. Higher Order Tensors, Dyads and Polyads 9. Operations Using Tensors	(3)
TENSOR NOTATION FOR VECTOR QUANTITIES 1. Gradient, Divergence, Curl, and Laplacian	(2)



2. Eigenvalues and Eigenvectors of Symmetric Tensors

BASIC EQUATIONS OF CONTINUUM MECHANICS (4)

1. Hooke's Law
2. Normal and Shearing Stresses
3. The Stress Tensor & Cauchy Stress Law
4. Conservation of Linear & Angular Momentum
5. Strain in Two Dimensions
6. Transformation of an Arbitrary Element
7. Cartesian Tensor Derivation of 3D Strain.
8. Lagrangian and Eulerian Systems
9. General Tensor Derivation of 3D Strain.
10. Compressible and Incompressible Material
11. Conservation of Mass

CONTINUUM MECHANICS (SOLIDS) (8)

1. Constitutive Equations
2. Restrictions on Elastic Constants due to Symmetry
3. Material Symmetries & Axis of Symmetry
4. Alternative Approach to Constitutive Equations
5. Basic Equations of Elasticity
6. Navier's Equations & Boundary Conditions
7. General Solution of Navier's Equations
8. Compatibility Equations
9. Cartesian Derivation of Compatibility Equations
10. Compatibility Equations in Terms of Stress
11. Plane Strain & Plane Stress
12. Airy Stress Function

CONTINUUM MECHANICS (FLUIDS) (8)

1. Constitutive Equations for Fluids
2. Linear Viscous Fluids
3. Navier-Stokes-Duhem Equations of Fluid Motion
4. Scaled Variables
5. Boundary Conditions
6. Conservation of mass, Momentum, and Energy
7. Conservative Systems
8. Computational Coordinates
9. Fourier law of heat conduction
10. Equilibrium and Nonequilibrium Thermodynamics
11. Equation of state
12. Entropy inequality

Grading

Homework	**10%**
First Midterm Exam …….. (Monday, April 6th 2008)	**20%**
Second Midterm Exam … (Monday, May 25th 2008)	**20%**
Term Paper / Project …….(Presented in Week No. 15)	**20%**
Final Exam …….. (June 24th 2009, at 7PM)	**30%**