ENGR 617-Continuum Mechanics
T TH 2:30-3:45 PM

Instructor: Ahmed Al-Ostaz
Room 202 Carrier Hall
Email: alostaz@olemiss.edu
Phone: 662-915-5364.

Office Hours: T, TH 10:00-10:50 PM or by appointment

Text G. T. Mase and G. E. Mase, Continuum Mechanics for Engineers, Second Edition.
ISBN: 0849318556. Publisher: CRC

Content

Continuum hypothesis, forces and stress fields, displacement and strain fields, governing field laws, applications to fluid, solid and magnetofluid mechanics, electrodynamics, electro- and thermoviscoelasticity

References

1. Mase, G. E., Continuum Mechanics, Schaum's Outline Seriese, McGraw-Hill
2. A. Cemal Eringen, Mechanics of Continua.
3. Tim'oshinko, S. P. and Goodier, J. N., Theory of Elasticity, Mcgraw- Hill, 1970
4. Boresi, A., and Chong, K., Elasticity in Engineering Materials, Elsevier, 1987.
5. Little, R. W., Elasticity, Prentice-Hall, 1973.

TOPICS

Continuum Theory
- The Continuum Concept
- Continuum Mechanics

Essential Mathematics
- Scalars, Vectors, and Cartesian Tensors
- Tensor Algebra in symbolic Notation
- Indicial Notation
- Matrices and Determinants
- Transformation of Cartesian Tensors
- Principal Values and Principal Directions of Symmetric Second-Order Tensors
- Tensor Fields, Tensor Calculus
- Integral Theorems of Gauss and Stokes

Stress Principles
- Body and Surface Forces; Mass Density
- Cauchy Stress Principle
- The Stress Tensor
- Force and Moment Equilibrium
- Stress Transformation Laws

- Principal Stress; Principal Stress Directions
- Maximum and Minimum Stress Values
- Mohr's Circle for Stress
- Plane Stress
- Deviator and Spherical Stress States
- Octahedral Shear Stress

Kinematics of Deformation and Motion

- Particles, Configurations, Deformations, and Motion
- Material and Spatial Coordinates
- Lagrangian and Eulerian Descriptions
- The displacement Field
- The Material Derivative
- Deformation Gradients, Finite Strain Tensors
- Infinitesimal Deformation Theory
- Stretch Ratios
- Rotation Tensor, Stretch Tensors
- Velocity Gradient, Rate of Deformation, Vorticity
- Material Derivative of Line Element, Areas, Volumes

Fundamental Laws and Equations

- Balance Laws, Field Equations, Constitutive Equations
- Material Derivatives of Line, Surface, and Volume Integrals
- Conservation of Mass, Continuity Equation
- Linear Momentum Principle, Equations of Motion
- The Piola-Kirchoff Stress Tensors, Langrangian Equations of Motion
- Moment of Momentum (Angular Momentum) Principle
- Law of Conservation of Energy, the Energy Equation
- Constitutive Equations

Applications: Linear Elastic Solids

- Compatibility Equations for Infinitesimal Strain
- Elasticity, Hooks Law, Strain Energy
- Hooks Law for Isotropic Media, Elastic Constants
- Generalized Hook's Law for Anisotropic Materials
- Elastic Symmetry, Hooks Law for Isotropic Media
- Isotropic Elastostatics and Elastodynamics, Superposition Principles
- Plan Elasticity
- Linear Thermoelasticity

Applications: Classical Fluids

- Viscous Stress Tensor, Stokesian and Newtonian Fluids
- Basic Equations of Viscous Flow, Navier-Stokes Equations
- Specialized Fluids
- Steady Flow, Irrotational Flow, Potential Flow
- The Bernoulli Equation, Kelvin's Theorem

Applications: Nano mechanics

Applications: Viscoelasticity

Grading

Midterms	30%
Final	30 %
Homework	25 %
Project	15 %