

ANALYSIS OF COMPOSITE LAMINATES
CE 729 (3-0)3

Instructor: Dr. Uğurhan Akyüz

References: **J.N. Reddy**, Mechanics of Laminated Composite Plates, CRC Press, 1997.
C.T. Herakovich, Mechanics of Fibrous Composites, John Wiley and Sons, 1998.
M. W. Hyer, Stress Analysis of Fiber-Reinforced Composite Materials, Mc. Graw Hill, 1998.

Goals: To provide fundamental information on the engineering properties and advantages of fibrous composites.

Course Outline

1. Introduction and Fundamentals

- 1.1. Fibers
- 1.2. Composite Forms
- 1.3. Advantages of Composites
- 1.4. Basic Concepts and Characteristics

2. Equations of Anisotropic Elasticity

- 2.1. Kinematics
- 2.2. Kinetics
- 2.3. Constitutive Equations

3. Mechanical Behavior of a Lamina

- 3.1. Constitutive Equations of a Lamina
- 3.2. Transformations of Stresses and Strains
- 3.3. Plane Stress Constitutive Relations

4. Theories of Laminated Composite Plates

- 4.1. The Classical Laminated Plate Theory
- 4.2. The First-Order Laminated Plate Theory
- 4.3. Laminate Stiffnesses

5. Analysis of Specially Orthotropic Plates

- 5.1. Bending of Simply Supported Rectangular Plates
- 5.2. Bending of Plates with Two Opposite Edges Simply Supported
- 5.3. Bending of Rectangular Plates with Various Boundary Conditions
- 5.4. Buckling of Simply Supported Plates Under Compressive Loads
- 5.5. Buckling of Rectangular Plates Under In-Plane Shear Load
- 5.6. Vibration of Simply Supported Plates
- 5.7. Buckling and Vibration of Plates with Two Parallel Edges Simply Supported.

6. Analytical Solutions of Rectangular Laminates

- 6.1. Governing Equations in Terms of Displacements
- 6.2. Navier Solutions of Antisymmetric Cross-Ply Laminates
- 6.3. Navier Solutions of Antisymmetric Angle-Ply Laminates
- 6.4. The Levy Solutions
- 6.5. Analysis of Midplane Symmetric Laminates

7. Finite Element Analysis of Composite Plates

- 7.1. Laminated Beams and Plate Strips
- 7.2. Timoshenko Beam/Plate Theory
- 7.3. Finite Element Models of Laminated Plates

8. Failure Analysis of Multidirectional Laminates

- 8.1. Types of Failure
- 8.2. First Ply Failure (FPF) of Symmetric Laminates
- 8.3. FPF Analysis of General Multidirectional Laminates

9. Strengthening of RC Beams with FRP-composites

Course Evaluation:

Two take home exams	50 %
One final exam	35 %
Homeworks	15 %