



Mechanics of Materials I:

Fundamentals of Stress & Strain and Axial Loading

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Module 1 Learning Outcomes

- Describe the importance of studying Mechanics of Materials
- Outline the general analysis approach
- List the major topics in the course

Engineering Mechanics/Engineering Science

Math

Physics

Basic Sciences



Mechanical Engineering

Civil Engineering

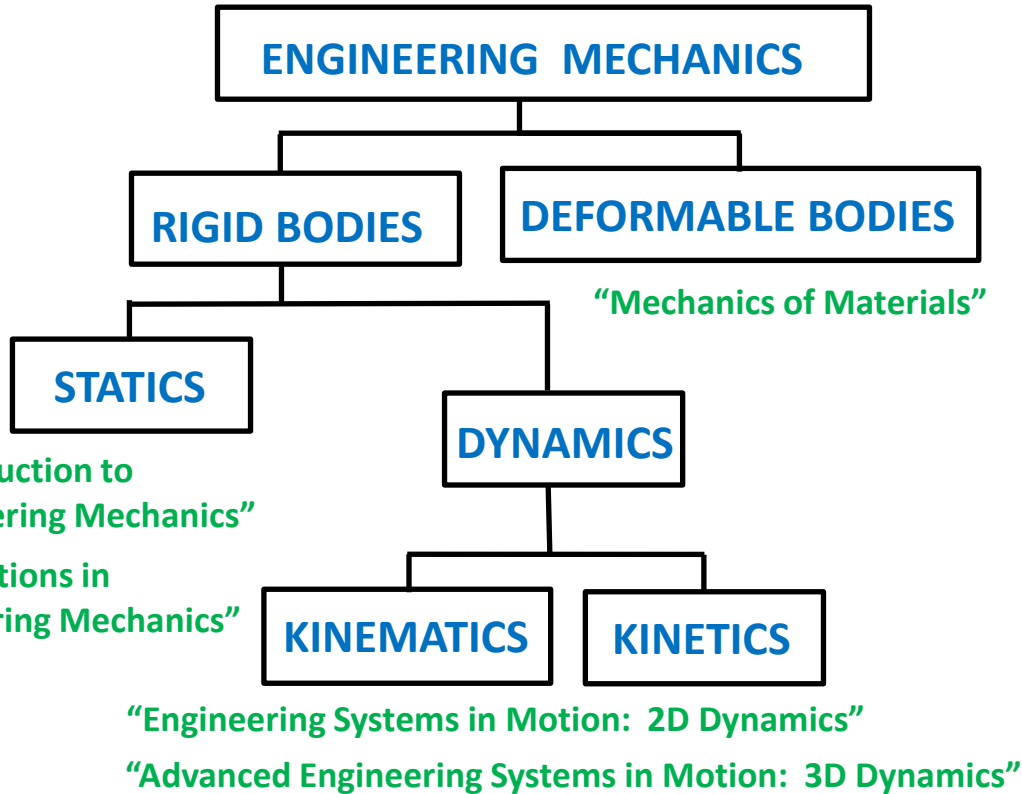
Aerospace Engineering

Material Science Engineering

Other Engineering

**“How the physical
world works”**

**“Application of
science to fill a
human need”**



Mechanics of Materials

Foundation for all structural and machine design



Mechanics of Materials I:

Fundamentals of Stress & Strain and Axial Loading

- ☐ Internal Forces due to External Loads
- ☐ Axial Centric Loads
- ☐ Normal Stress and Shear Stress
- ☐ General State of Stress at a Point (3D)
- ☐ Plane Stress (2D)
- ☐ Normal Strain and Shear Strain
- ☐ Stress-Strain Diagrams
- ☐ Mechanical Properties of Materials
- ☐ Linear Elastic Behavior, Hooke's Law, and Poisson's Ratio
- ☐ Stresses on Inclined Planes
- ☐ Principal Stresses and Max Shear Stress
- ☐ Mohr's Circle for Plane Stress
- ☐ Stress Concentrations
- ☐ Mohr's Circle for Plane Strain
- ☐ Strain Transformation and Measuring Strains
- ☐ Generalized Hooke's Law for Isotropic Materials
- ☐ Factor of Safety and Allowable Stresses/Loads
- ☐ Nonlinear Behavior and Plasticity
- ☐ Statically Indeterminate Structures
- ☐ Thermal and Pre-strain Effects

Mechanics of Materials II: Thin-Walled Pressure Vessels and Torsion

- ☐ Thin-Walled Pressure Vessels - Internal Pressure
- ☐ Torsional Shearing Stress and Strain
- ☐ Elastic Torsion Formula
- ☐ Elastic Torsion of Straight, Cylindrical Shafts
- ☐ Inelastic Torsion of Straight, Cylindrical Shafts
- ☐ Statically Indeterminate Torsion Members

Mechanics of Materials III: Beam Bending

- ☐ Elastic Flexural Stresses and Strains
- ☐ Elastic Flexural Formula
- ☐ Properties of Sections
- ☐ Inelastic Bending
- ☐ Shear Force and Bending Moment Diagrams
- ☐ Shear Stress in Beams
- ☐ Principal Stresses in Bending

Mechanics of Materials IV: Deflections, Buckling, Combined Loading, & Failure Theories

- ☐ **Beam Curvature**
- ☐ **Singularity Functions for Beam Deflections**
- ☐ **Beam Deflections by Superposition**
- ☐ **Statically Indeterminate Beams**
- ☐ **Column Buckling**
- ☐ **Combined Static Loading**
- ☐ **Theories of Failure**

**My emphasis will be on
understanding the principles of
mechanics of materials rather
than on extensive
computational/computer work**

Let's get started!