

Introduction to Solid Mechanics

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What Is Solid Mechanics?

- Branch of mechanics focused on the behavior of solid materials.
- Studies deformation, stability, failure, and motion of solids.
- Combines physics, mathematics, and materials science.
- Foundational for structural and mechanical engineering.

Fundamental Theories of Material Behavior

- **Mechanics of Materials:** Stress, strain, internal forces.
- **Elasticity:** Reversible deformation.
- **Plasticity and Damage:** Irreversible deformation and material degradation.

Time-Dependent and Failure Phenomena

- **Creep:** Deformation over time under constant stress.
- **Fatigue:** Failure due to cyclic loading.
- **Fracture Mechanics:** Crack formation and propagation.

Modern Materials and Structural Behavior

- **Composites and Multiphase Materials:** Tailored material systems.
- **Micromechanics:** Link between microstructure and bulk behavior.
- **Metamaterials:** Engineered for unusual properties.
- **Soft Matter and Robotics:** Highly deformable solids.

Dynamics, Vibrations, and Stability

- **Buckling and Stability:** Structural failure due to instability.
- **Vibrations:** Oscillatory response of structures.
- **Waves in Solids:** Propagation of disturbances.

Mechanics at Interfaces

- **Contact Mechanics:** Forces at interfaces between bodies.
- **Friction and Wear:** Surface degradation and energy loss.

Coupled Problems and Multiphysics

- **Thermomechanics:** Mechanical response under temperature changes.
- **Multiphysics Coupling:** Interactions with electric or magnetic fields.

Applications in Engineering and Technology

- **Biomechanics:** Mechanics of soft and hard tissues.
- **MEMS and Microsystems:** Micro-scale solid mechanics.
- **Optimization and Design:** Structural performance enhancement.
- **Parameter Identification:** Extracting material properties.