Summary
This course will cover major topics of importance and value for the application and understanding of Solid Mechanics, aiming especially at the micromechanical analyses of problems that connect small scale phenomena to macroscopic engineering performance.

Content
The course will be topical but evolving in a natural flow. Topics will include:
- Anisotropic Elasticity: beyond isotropic elasticity
- Homogenization methods: the connection between microstructure of a material and the macroscopic effective properties that can be used in continuum analyses
- Inclusions and Eshelby analysis: stresses and strains around particles embedded in a matrix and undergoing transformations that affect functional performance and failure, with connections to homogenization theory.
- Laminate theory: the special case of fiber composites as layered anisotropic materials, connecting fiber/matrix properties to macroscopic structural response.
- Fracture mechanics: basic understanding of the driving forces for crack growth, from both energy and stress perspectives, with advanced concepts for implementation in numerical methods.
- Contact mechanics: basic analysis of bodies in contact and the generation of local stresses, and implications for friction and wear.
Other topics may be covered as interest and time permit.

Keywords
Mechanics, Elasticity, Homogenization, Laminate theory, Composites, Fracture, Contact, Dislocations, Applied Mechanics, Theory, Computational Mechanics

Learning Prerequisites
Required courses
ME-331: Solid Mechanics, or equivalent course using tensor-based mechanics analyses

Important concepts to start the course
Definitions of stress and strain
Mechanical equilibrium
Isotropic elasticity (Hooke's Law)
Boundary value problems in small-strain elasticity
Second-rank tensors: properties and applications in mechanics
Index notation

Learning Outcomes
By the end of the course, the student must be able to:
- Estimate elastic moduli of two-phase materials
- Analyze stress and strains around inclusions
- Compute stresses in laminated structures
- Integrate concepts for failure
- Design materials/microstructures with specified properties

Transversal skills
- Set objectives and design an action plan to reach those objectives.
- Use a work methodology appropriate to the task.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Demonstrate the capacity for critical thinking
- Write a scientific or technical report.

Teaching methods
Lectures on mechanics theory
Examples to illustrate theory and application
Exercises for cementing and applying new knowledge
Course may include:
Mini-projects to perform analyses
Project on topic of student interest

Expected student activities
In-class participation
Collaborative problem solving
Execution of mini-projects

Assessment methods
Graded mini-projects
Final written exam

Supervision
Office hours Yes
Assistants Yes
Forum Yes

Resources
Virtual desktop infrastructure (VDI)
No

Notes/Handbook
To be provided