Structural and Computational Mechanics for Aerospace Applications

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 9-Jan-23

Course outline

- Fundamental concepts in solid mechanics
  - displacement, strain and stress
- Mechanics of laminated structures
- Variational principles in mechanics of solids and structures
- Classical/technical beam and plate theories
  - Practical applicability limits
  - Finite element approximations
- First-order shear deformation theories for beam, plate, and shell analysis of composite and sandwich laminates
  - Basic assumptions
  - Finite element approximations
  - Shear locking phenomenon and resolution
- Higher-order shear deformation theories for laminated composites
  - Basic assumptions
  - Finite element approximations

Course outline (cont.)

- Zigzag theories for laminated composite and sandwich laminates
- Refined Zigzag Theory (RZT) derived from virtual work principle
- Mixed-field Refined Zigzag Theory ($RZT^{(m)}$) derived from Reissner's variational theorem
- RZT based finite elements for beam, plate and shell structures
  - Laminated composites
  - Sandwich construction
  - Delamination modeling
- Full-field recovery methods for improved predictions of interlaminar stresses and strains
  - Smoothing Element Analysis (SEA)
- Inverse finite element methods (iFEM) for prognostic and diagnostic and structural health monitoring systems for
  - Beam and frame structures
  - Plate and shell structures

Course summary

Dr. Alexander Tessler, a distinguished research associate at NASA Langley Research Center in Hampton, Virginia, will present a course on the state-of-the-art in the field of structural and computational mechanics of advanced laminated and sandwich composite structures for application to civil, mechanical and aerospace structures. The lectures will be aimed at graduate-level students and researchers who are engaged in the research activities associated with the analysis and testing of composite plate and shell structures under the action of static, dynamic, and thermal loads. The lectures will discuss advanced theoretical concepts and modeling schemes together with closed-form solutions, numerical results, and comparisons to experimental measurements. A further aim is to engage university researchers to enable future collaborative work in the area of dynamic behavior of multilayered composite and sandwich beam, plate, and shell structures.

Textbook: (please note that 2nd edition of book is available online through Grainger Library)

Mechanics of Laminated Composite Plates Theory and Analysis

Reddy, J.N. (Author)

Publisher: CRC Press

Expected Learning Outcomes

The objective of this course is to familiarize graduate-level students with a number of advanced concepts and analysis methods in the field of multilayered composite and sandwich structures. The course material will enable the student to expertly apply and further advance the novel techniques and modeling concepts in the areas of static and dynamic behavior of multilayered composite and sandwich beam, plate, and shell structures.

Prerequisites

A graduate student should have a solid background in the fundamental principles of solid and structural mechanics for static, dynamic and thermal loadings, including the basic practical knowledge of variational principles, finite element analysis, and finite element approximations.