## 10th International Congress of Serbian Society of Mechanics

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# J. N. Reddy, Ph.D.

**Hosted by the Serbian Society of Mechanics at the Faculty of Mechanical Engineering and the Faculty of Civil Engineering and Architecture, University of Niš**

### Short Professioal details and affiliation:

Dr. Reddy is a Distinguished Professor, Regents' Professor, and the holder of the O'Donnell Foundation Chair IV in Mechanical Engineering at Texas A&M University, College Station, Texas. Dr. Reddy, an ISI highly-cited researcher, is known for his significant contributions to the field of applied mechanics through the authorship of a large number of textbooks (25) and journal papers (>800). His pioneering works on the development of shear deformation theories have had a major impact and have led to new research developments and applications. In recent years, Reddy's research has focused on the development of locking-free shell finite elements and nonlocal and non-classical continuum mechanics problems dealing with architected materials and structures and damage and failures in brittle solids.

## Plenary Lecture

# *A ROBUST SHELL FINITE ELEMENT AND NONLOCAL APPROACHES IN MECHANICS*

**Abstract:** The lecture consists of the speaker's recent research in: (1) the development of higher-order, locking-free shell finite element for large deformation of laminated and functionally graded plate and shell structures (G.S. Payette and J.N. Reddy, *Computational Methods in Applied Mechanics and Engineering*, **278**, 664-704, 2014) and (2) nonlocal approaches for modeling architected materials and structures and fracture in brittle solids (Praneeth Nampally, Anssi Karttunen, and J.N. Reddy, *European Journal of Mechanics, A/Solids*, **74**, 431-439, 2019; P. Thamburaja, K. Sarah, A. Srinivasa, J.N. Reddy, *Proceedings of the Royal Society A*, **477** (2021) 20210398). The seven-, eight-, and twelve-parameter shell elements developed are based on modified first-order and third-order thickness stretch kinematics, and they require the use of fully three-dimensional constitutive equations. Through the numerical simulation of carefully chosen benchmark problems, it is shown that the developed shell elements are insensitive to all forms of numerical locking and are the best alternative to 3-D finite elements in saving computational resources while predicting accurate stresses. A non-local continuum model that account for material and/or structural length scales in a phenomenological way through the micromorphic plate theory to model architected materials and structures (e.g., web-core sandwich panels) is also discussed and its accuracy compared to 3D finite elements is brought out through numerical examples. In addition, a thermodynamically-consistent fracture model for brittle and quasi-brittle solids based on **Gra**ph-based **F**inite **E**lement **A**nalysis (GraFEA) with appliocations to concrete structures.