

A two-day course on

THEORY AND ANALYSIS OF LAMINATED COMPOSITE AND FUNCTIONALLY GRADED STRUCTURES

16-17 June 2012

A preconference course presented during the

The first International Conference on Mechanics of Nano, Micro and Macro

Composite Structures (<http://paginas.fe.up.pt/~icnmmcs>), 18-20 June 2012

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by

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BACKGROUND

The dramatic increase in the use of composite and functionally graded materials in a variety of engineering structures (e.g., aerospace, automotive, off-shore, and underwater structures, as well as in medical prosthetics and sports equipment) and the number of journals and conferences held in the last four decades attest to the fact that there has been a major effort to develop modern composite and functionally graded material systems for a variety of applications, and analyze and design structural components made from composite materials. The subject of composite materials is truly an interdisciplinary area where chemists, material scientists, chemical engineers, mechanical engineers, and structural engineers contribute to the overall product. The present course is primarily intended for structural engineers from aerospace, civil, and mechanical engineering as well as off-shore industries as well as researchers from academia.

COURSE OBJECTIVES

The course is aimed at providing engineers with the theory, analysis and design considerations in dealing with composite structural components in the form of beams, plates, and shells laminated of fiber-reinforced materials. Theoretical formulations and applications will be presented to illustrate the concepts. Developments in nano-composites and multiscale modeling will also be covered briefly. Persons who have taken the course and understood the material should benefit in strengthening their background in the following areas:

1. Anisotropic elasticity and functionally graded materials.
2. Theories governing the bending, buckling and vibration behavior of beam, plate and shell structural elements.
3. Analysis methods - analytical as well as the finite element method - to determine bending, buckling and vibration response of structural elements.
4. Functionally graded structures and nanocomposites.
5. Failures and damage in composites – an overview
6. General design considerations in dealing with composite materials.

The participants of the course must have a background in mechanics of materials and structures and a course on differential equations (i.e., at least an undergraduate degree in engineering is

required). A review of the basic equations of engineering will be presented as necessary for completeness.

COURSE OUTLINE

First Day:

- Composite Materials: An Introduction
- Anisotropic Elasticity and Functionally Graded Materials
- Structural Theories of Composite Laminates and FGM Plates (CLPT and FSDT)
- Analytical Solutions of rectangular laminates for bending, vibration and buckling

Second Day:

- Finite Element Models of Composite Laminates and FGM Structures
- Applications to bending, vibration, buckling, and transient response of laminated plate and shell structures
- Failures in composites and Design Considerations
- Nanocomposites and Multiscale Modeling – an Overview

COURSE MATERIAL

Much of the material for the course will come from the book, *Mechanics of Laminated Composite Plates and Shells* by J. N. Reddy (CRC Press, 2004; second edition); however, it will not be included as the course material. A copy of all overheads used in the course will be distributed to the participants.

ABOUT THE INSTRUCTOR

Dr. Reddy is a Distinguished Professor, Regents Professor, and inaugural holder of the Oscar S. Wyatt Endowed Chair in Mechanical Engineering at Texas A&M University, College Station, Texas. He is the author of nearly 450 journal papers and 17 text books on energy principles, variational methods, plates and shells, composite materials, and the finite element method and its applications to problems in solid and structural mechanics, composite materials, computational fluid dynamics, numerical heat transfer, and applied mathematics, and modeling of biological cells and nanosystems. Dr. Reddy has delivered over 100 plenary, keynote, or invited lectures at international conferences and institutions, taught numerous short courses on finite elements and composite materials. As a result of his extensive publications of archival journal papers and books in wide range of topics in applied sciences and engineering, Dr. Reddy is one of the selective researchers in engineering around world who is recognized by ISI Highly Cited Researchers with over 11,500 citations (10,650 without self-citations) with H-index of 52 (50 papers with at least 50 citations each). A more complete resume with links to journal papers can be found at <http://apps.isiknowledge.com/> or <http://www.tamu.edu/acml>.