1, 2 & 3 DECEMBER, 2010

S Ã O P A U L O - B R A Z I L

IRONIX- CONTINUING EDUCATION
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THE FINITE ELEMENT METHOD: WITH A FOCUS ON NONLINEAR SOLID MECHANICS
(BARS, BEAMS, PLATES, SHELLS AND COMPOSITE MATERIALS)

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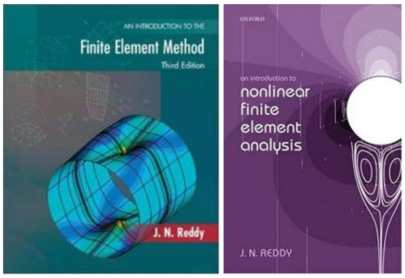
BACKGROUND

The Finite Element Method (FEM) is a numerical and computer-based technique of solving a variety of practical engineering problems that arise in different fields. It is recognized by developers and users as one of the most powerful numerical analysis tools ever devised to analyze complex problems of engineering. As applied to solid and structural problems, the finite element method is the leading technique for analyzing the behavior of structures when subjected to a variety of loads. The loads may be static or dynamic, and the structural responses can be linear or non-linear, with varying degrees of complexity. The underlying theory of the method is now well established, with many books and courses providing adequate explanations of the theory.

PRELIMINARY SUGGESTED READINGS:

J. N. Reddy,
AN INTRODUCTION TO THE FINITE ELEMENT METHOD,
3rd ed., McGraw-Hill, New York, 2006. It is now available an Asian or international edition and the participants may purchase it from local stores.

J. N. Reddy,
AN INTRODUCTION TO NONLINEAR FINITE ELEMENT ANALYSIS,
Oxford University Press, Oxford, UK (2004). The participants are encouraged to buy a personal copy or order it for their company's library.



WHO SHOULD ATTEND THIS COURSE?

The course is aimed at engineers/scientists who are involved with modeling of structures or coupled problems and who intend using commercially available finite element packages to analyze engineering problems of the aeronautical, automobile, mechanical, civil and other engineering industries.

The course will also enable participants to be able to write their own FEM software. Participants are assumed to have knowledge of the basic principles of structural mechanics, heat transfer, and fluid mechanics.

Some knowledge of the finite element method is an advantage, but not essential, as an overview as applied to linear problems will be included in the course.

COURSE MATERIALS

A copy of the overheads used in the presentation of the course will be provided as a part of the course material. The material used in the power point slides is largely taken from the authors following two books:

J. N. Reddy,
An Introduction to the Finite Element Method, 3rd ed., McGraw-Hill, New York, 2006.

J. N. Reddy,
An Introduction to Nonlinear Finite Element Analysis, Oxford University Press, Oxford, UK (2004).

COURSE OBJECTIVES

The major problem facing the analyst contemplating the use of the finite element technique (as a user of a commercial code) lies in acquiring appropriate knowledge to provide assurance that the finite element model produced gives a reasonably reliable representation of the "real life" system being analyzed. The present course is designed to bridge the gap between the theoretical finite element knowledge and its industrial applications by providing physical insights into the theory of the method and relationship between the physical data (e.g., loads, boundary conditions, constitutive behavior, etc) and the finite element model of a physical problem. The instructor will share his knowledge and experience to address some of the issues such as physical characteristics of elements, element selection, mesh design, convergence, boundary conditions, load representation, and response characteristics.

This course is intended to provide engineers working in aerospace, automotive, civil, and mechanical engineering industries as well as numerical analysts and materials scientists with the theory and applications of the linear and nonlinear finite element analysis of problems from solid and structural mechanics, including a coverage of composite materials and laminated composite plates and shells. At the end of the course one would have acquired knowledge of finite-element analysis linear and nonlinear analysis of structural problems as well as other field problems. Every attempt will be made to make the course as self-contained as possible overview as applied to linear problems will be included in the course.

BENEFITS OF ATTENDING THE COURSE

Persons who have attended the course and followed the material should benefit in strengthening their background in the following areas:

1. An understanding of the formulative steps involved in the finite element model development of the equations of solid mechanics, and composite materials.

2. Generation of finite element data (e.g., selection of elements and mesh, computation of nodal forces, imposition of boundary conditions, etc.) and proper imposition of boundary conditions, exploitation of problem symmetries, and interpretation and evaluation of the results.

3. The ability to write a finite element computer module for a physical problem (e.g., user-specified subroutine for a commercial program).

4. The ability to read and evaluate technical proposals/reports/papers on the finite element analysis of structural problems in engineering.

5. The knowledge to teach the finite element analysis procedures to others.

COURSE CONTENTS

(actual coverage and sequence may differ depending on the participants background)

BACKGROUND: INTRODUCTION TO NUMERICAL METHODS

- Overview – basic ingredients of the FEM
- Comparison with alternative numerical methods

BASIC CONCEPTS OF FEM – ONE-DIMENSIONAL PROBLEMS

- Axial deformations of a bar or one-dimensional heat transfer
- Strong and weak forms (variational and virtual work statements)
- Primary and secondary variables of the formulation
- Essential vs. natural boundary conditions
- Methods of approximations (weak-form Galerkin method)
- Finite element approximation functions (linear, quadratic, and cubic elements)
- Assembly of element equations
- Illustrative examples and discussion of results in light of physical response

EXTENSION TO OF FEM TO TWO-DIMENSIONAL PROBLEMS

- Membrane and heat transfer-like problems in 2D
- Elements types (triangular and quadrilateral elements)
- Axisymmetric problems
- Discussions of representative field problems to understanding modeling issues

EIGENVALUE AND TIME-DEPENEDENT PROBLEMS

- Free vibration of elastic systems (natural frequencies, modal response, etc)
- Transient Analysis
- Time integration procedures
- Explicit dynamic integration

NUMERICAL/COMPUTATIONAL ISSUES

- Subparametric, isoparametric, and superparametric formulations
- Numerical integration
- General modeling considerations

PLANE ELASTICITY

- Governing equations of plane elasticity problems
- Elements types (triangular and quadrilateral elements)
- Incompatible modes
- Discussion of example problems to bring out modeling issues

THREE-DIMENSIONAL PROBLEMS

- Heat transfer-type problems
- Elasticity problems
- Types of 3-D Finite elements (interpolation functions)

INTRODUCTION TO NON-LINEAR PROBLEMS

- Geometric and material non-linearity
- Nonlinear formulation of a 2-D Model problem
- Solution algorithms for the solution of non-linear algebraic equations
- Derivation of tangent stiffness coefficients
- Convergence criteria

NONLINEAR BENDING OF BEAMS

- Euler-Bernoulli beam theory
- Nonlinear finite element formulation of Euler-Bernoulli beam theory
- Tangent stiffness calculations
- Membrane locking
- Timsohenko beam theory and its finite element model
- Shear locking
- Numerical examples

NONLINEAR BENDING OF PLATES

- Nonlinear finite element formulation of the first-order shear deformation (Mindlin) plate theory
- Tangent matrix coefficients
- Shear and membrane locking
- Numerical examples

CONTINUUM FORMULATIONS

- Continuum equations
- Measures of stress and strain
- Total and Updated Lagrangian descriptions
- Degenerated thick shell element
- Applications

COMPOSITE MATERIALS AND STRUCTURES

- An Introduction to Fiber-Reinforced Composite Materials
- Equations of Anisotropic Elasticity
- Linear Finite Element Analysis of Composite Plates and Shells
- Nonlinear Analysis of Composite Plates and Shells

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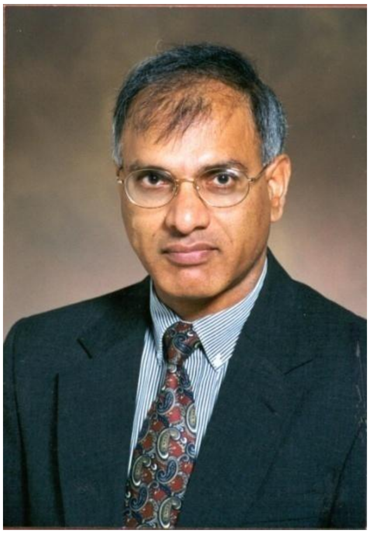

ABOUT THE COURSE INSTRUCTOR: J. N. REDDY

http://authors.isihighlycited.com/
and
http://www.tamu.edu/acml

Dr. JN Reddy is a Distinguished 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 numerous journal papers and text books on theoretical formulations and finite-element analysis of problems in solid and structural mechanics (plates and shells), composite materials, computational fluid dynamics, numerical heat transfer, and applied mathematics. Dr. Reddy's research centers on theoretical formulations and numerical simulations of problems in solid and structural mechanics, composite materials, computational fluid dynamics, numerical heat transfer, geology and geophysics, and computational biology. Dr. Reddy's research provides the cutting edge advances that enable others to adapt his accomplishments into sophisticated computer software used by design engineers world-wide. His novel theories and finite element models have been implemented into commercial finite element commercial softwares like ABAQUS, NISA and HyperForm. Such an eminent record of research has earned Dr. Reddy numerous national and international awards, including the 1998 Nathan M. Newmark Medal from the American Society of Civil Engineers; Award for Excellence in the Field of Composites and Distinguished Research Award from the American Society for Composites; and the 2003 Computational Solid Mechanics award from US Association for Computational Mechanics. He also won the AFS Award for Distinguished Achievement in Research, the Texas A&M Bush Excellence Award for Faculty in International Research, and Distinguished Research Award of the Sigma Xi. Dr. Reddy is one of the few researchers in engineering around the world (only one at TAMU) who is recognized by ISI Highly Cited Researchers with over 10,000 citations and H-index of over 46.

R E G I S T R A T I O N

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NOTE: THIS COURSE IS LIMITED TO A SMALL NUMBER OF PARTICIPANTS, RESERVE YOUR PLACE SOON!

REGISTRATION FEE: 980, EUR *

(*) Registration includes:

✓ 3 full days course,
✓ Printed Course Materials,
✓ Course Certificate,
✓ 2 refreshments daily,
✓ Lunch at Hotel (daily / 3 days).
✓ 10% discount voucher for the upcoming ACE-X 2011 conference (Portugal)
www.ace-x2011.com

Registration Fee:
Early registration = 980 EUR * (till 25.10.2010)
After= 1.280 EUR

CONTACT / INFO

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IRONIX - CONTINUING EDUCATION:

The Finite Element Method: with a Focus on Nonlinear Solid Mechanics
(Bars, Beams, Plates, Shells and Composite Materials)
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Early registration = 980,EUR * (till 25.10.2010)
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