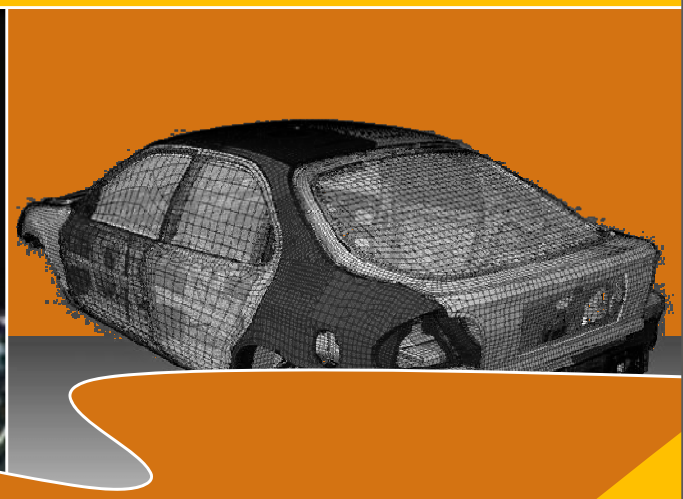
8 - 10 FEBRUARY 2010
KUALA LUMPUR, MALAYSIA



Course Instructor/Lecturer
Professor J. N. Reddy
Texas A&M University, USA

THE FINITE ELEMENT METHOD – AN ADVANCED COURSE

with applications to solid and structural mechanics, heat transfer, and fluid mechanics

LOCAL ADVISOR:
Prof. Dr. M.N. Tamin
Universiti Teknologi Malaysia,
Malaysia
taminmn@fkm.utm.my

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ABOUT THE COURSE

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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.

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.

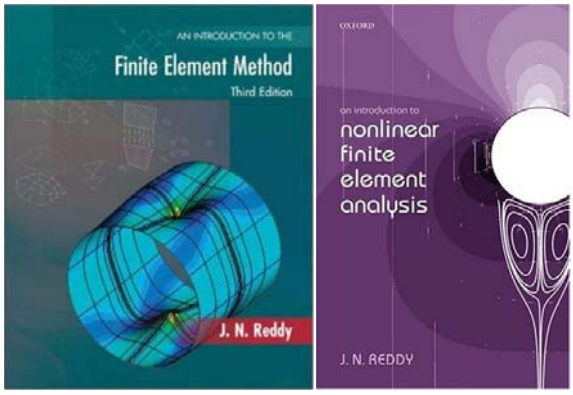
Participants are assumed to have knowledge of the basic principles of structural mechanics, heat transfer, and fluid mechanics.

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

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.



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COURSE OBJECTIVES

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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 as well as a brief treatment of heat transfer and fluid dynamics. At the end of the course one would have acquired knowledge of finite-element analysis of many typical linear and nonlinear problems of structural mechanics, heat transfer, and fluid mechanics.

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:

- A strong understanding of the formulative steps involved in the finite element model. Finite element development of the governing equations of solid and structural mechanics and certain heat transfer and fluid flow problems.

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

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COURSE CONTENTS

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)

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COURSE CONTENTS

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

FLOWS OF VISCOUS INCOMPRESSIBLE FLUIDS (NAVIER-STOKES EQUATIONS)

- ✓Governing equations (Navier-Stokes Equations)
- ✓Mixed finite element model (2D)
- ✓Penalty finite element model (2D)
- ✓Coupled fluid flow and heat transfer formulations
- ✓Applications

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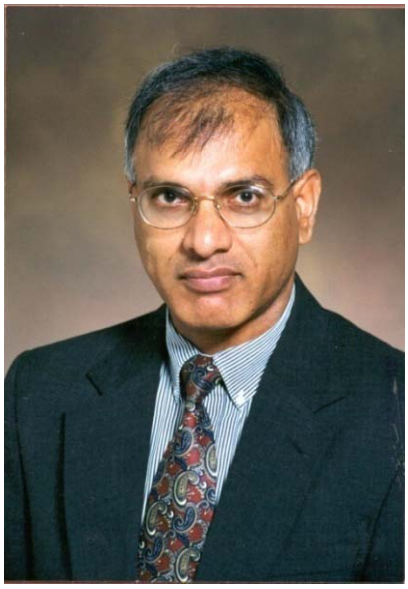
ABOUT THE INSTRUCTOR

ABOUT THE COURSE INSTRUCTOR: J. N. REDDY

http://authors.isihighlycited.com/

and

http://www.tamu.edu/acml



Dr. Reddy is a Distinguished Professor and holder of the Oscar S. Wyatt Endowed Chair in Mechanical Engineering at Texas A&M University, College Station, Texas. Dr. Reddy is the author of over 375 journal papers and 16 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. The books authored by Dr. Reddy include: *An Introduction to Continuum Mechanics* (Cambridge University Press, 2008); *An Introduction to Nonlinear Finite Element Analysis*, Oxford University Press, 2004; An *Introduction to the Finite Element Method*, McGraw-Hill, 1984 (3rd ed., 2006); *The Finite Element Method in Heat Transfer and Fluid Dynamics,* coauthored with D. K. Gartling, CRC Press (3rd ed., 2010), *Energy Principles and Variational Methods in Applied Mechanics*, John Wiley, l984 (2nd ed., 2002); *Applied Functional Analysis and Variational Methods in Engineering*, McGraw-Hill, 1986; *Mechanics of Laminated Composite Plates and Shells: Theory and Analysis*, CRC Press, 1997 (2nd ed., 2004); and *Theory and Analysis of Elastic Plates and Shells*, Taylor & Francis, (2nd ed., 2007). Dr. Reddy serves on the editorial boards of about two-dozen journals, and he is the Editor-in-Chief of *Applied Mechanics Reviews* (ASME), *Mechanics of Advanced Materials and Structures*, *International Journal of Computational Methods in Engineering Science and Mechanics*, and *International Journal of Structural Stability and Dynamics*. Dr. Reddy is one of the selective few researchers in engineering around world who are recognized by ISI Highly Cited Researchers with over 10,000 citations and H-index of over 40.

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REGISTRATION

REGISTRATION FEE: 980 EUR *

(*) Registration includes:

✓ 3 full days course,

✓ Printed Course Materials,

✓ Course Certificate,

✓ 2 refreshments daily,

✓ Lunch at The Ritz Carlton Hotel (daily / 3 days).

✓ 10% discount voucher for the upcoming ACE-X 2010 conference (Paris)

www.ace-x2010.com

Registration Fee:
Early registration = 980 EUR * (till 15.12.2009)
After= 1.280 EUR

CONTACT:

Dr. Meire Gomes

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NOTE: this course is limited to a small number of participants, reserve your place soon!

IRONIX - CONTINUING EDUCATION: FEM –Advanced course
Feb. 8-10 2010 / Kuala Lumpur – Malaysia
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Please print or type all information on this form and send us back by Fax or e-mail: **FAX: ++00 351 234 410 097**
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REGISTRATION FORM

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Department
Institution / Company Name
Mailing Address
City **Zip / Postal Code**
Country

Registration Fee:
Early registration = 980 EUR * (till 15.12.2009)
After= 1.280 EUR *

PAYMENT CAN BE DONE BY BANK TRANSFER or BY CREDIT CARD:

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Signature / Date (AUTHORIZATION)

(*) Registration cancellations must be received by January 10, 2010 for a refund and note that a 100 EURO administrative fee is not refundable. Please note that refunds will be done after the EVENT for administrative reasons.