**Texas A&M University**  
**Departmental Request for a New Course**  
**Undergraduate • Graduate • Professional**

Submit original form and 25 copies. Attach a course syllabus to each.*

1. This request is submitted by the Department of *Mechanical Engineering*

2. Course prefix, number and complete title: **MEEN 673 Nonlinear finite element methods in structural mechanics**

3. Course description (not more than 50 words): Tensor definitions of stress and strain, finite strain, geometric and material nonlinearities; development of nonlinear finite element equations from virtual work; total and updated Lagrangian formulations; solution methods for nonlinear equations; computational considerations; applications using existing computer programs.

4. Prerequisite(s): **MEMA647/MEEN 670**  
   Cross-listed with **MEMA 648**  
   Cross-listed courses require the signatures of both department heads.

5. Is this a variable credit course? ☐ Yes ☑ No — If yes, from _______ to _______.

6. Is this a repeatable course? ☐ Yes ☑ No — If yes, this course may be taken _______ times. Will the course be repeated within the same semester/term? ☐ Yes ☑ No

7. Has this course been taught as a 489/689? ☐ Yes ☑ No — If yes, how many times? _______ Indicate the number of students enrolled for each academic period it was taught.

8. This course will be:
   a. required for students enrolled in the following degree program(s) (e.g., B.A. in history)
   b. an elective for students enrolled in the following degree program(s) (e.g., M.S., Ph.D. in geography)

9. If other departments are teaching or are responsible for related subject matter, the course must be coordinated with these departments. Attach approval letters.

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<th>Prefix</th>
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Do not complete shaded area.

Approval recommended by:

[Signature] 11/7/2007  
Head of Department  
Date  
Chair, College Review Committee  
Date

Head of Department (if cross-listed course)  
Date  
Dean of College  
Date

Submitted to Coordinating Board by:

[Signature] 11-26-07  
Dean of College  
Date

Director of Academic Support Services  
Date  
Effective Date

* Attach a syllabus according to the guidelines on the Internet site www.tamu.edu/admissions/oaras. To have this form reviewed, please send to Linda F. Lacey, Mail Stop 1265 or fax to 847-8737.
MEEN 673  Nonlinear Finite Element Analysis

COURSE DESCRIPTION: The primary objective of this advanced course on the finite element method is to study additional concepts in the finite-element-analysis and the application of these concepts to advanced topics, including nonlinear finite element formulations of problems in engineering. The course provides both formulative and computational background necessary to solve linear and nonlinear problems of heat transfer, fluid mechanics and solid mechanics. All theoretical formulations are also implemented on the computer. The background gained should allow formulation and analysis of other field problems. Alternative finite element formulations (e.g., Ritz, Galerkin, and least-squares models as well mixed models) will be discussed. Computer implementation of various finite element formulations will form an essential part of the course. At the end of the course one would have acquired knowledge of finite element analysis of many typical linear and nonlinear problems.

TEXTBOOK:  

INSTRUCTOR:  
J. N. Reddy, Mechanical Engineering Department, Room 210(O), ENPH, Tel: (979) 862 2417, jnreddy@tamu.edu

GOALS:  
The goals of the course include:

1. Understand the theory of the finite element method as applied to representative nonlinear differential equations arising in heat transfer, fluid mechanics, and solid mechanics.
2. Able to implement the finite element formulations on a computer and solve nonlinear problems of heat transfer, fluid mechanics, and solid mechanics.
3. Able to analyze nonlinear problems of engineering using finite element software.

PREREQUISITES:  
All students taking the course must have graduate standing in engineering or equivalent, a course on ordinary and partial differential equations, a first course on the finite element method (MEMA 646, MEMA 647 or equivalent), a working knowledge of FORTRAN and/or C++, and motivation to learn.

TOPICS:  
Week 1:  Introduction to variational formulations and methods.
Week 2:  Introduction to the finite element method as applied to two-dimensional linear field problems involving single variable (e.g., 2-D heat transfer).
Week 4:  Finite element models of Euler-Bernoulli beams and Timoshenko beams with geometric nonlinearity
Week 5:  Computer implementation. Test 1
Week 6:  Finite element models of 2-D nonlinear field problems with application to heat transfer problems. Computer implementation.
Week 7:  Finite element models of classical and shear deformable plate elements
Week 8:  Computer implementation.
Week 9:  Finite element models of 2-D Navier-Stokes equations; computer implementation.
Week 10:  Finite element models of nonlinear time-dependent problems. Test 2
Week 11:  Nonlinear mechanics of continua
Week 12:  Finite element models of nonlinear continua (2D elastic continua)
Week 13:  Finite element models of continuum shell element
Week 14:  Material nonlinear problems
Week 15:  Project reports and Review of the Course
Final Examination
Americans with Disabilities Act (ADA) Policy Statement

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities, in Room B118 of Cain Hall or call 845-1637.

Academic Integrity Statement

"An Aggie does not lie, cheat, or steal or tolerate those who do."

"The Aggie Code of Honor is an effort to unify the aims of all Texas A&M men and women toward a high code of ethics and personal dignity. For most, living under this code will be no problem, as it asks nothing of a person that is beyond reason. It only calls for honesty and integrity, characteristics that Aggies have always exemplified. The Aggie Code of Honor functions as a symbol to all Aggies, promoting understanding and loyalty to truth and confidence in each other."

http://student-rules.tamu.edu/aggiecode.htm