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

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

2. Course prefix, number and complete title: MEEN 618 Energy Methods

3. Course description (not more than 50 words): Principles of virtual work, minimum total potential energy and extremum mixed variational principles; energy theorems of structural mechanics; Hamilton's principle for dynamical systems; Rayleigh- Ritz Galerkin, and weighted-residual methods; applications to linear and nonlinear problems in mechanics (bars, beams, frames, plates and general boundary value problems).

4. Prerequisite(s): MATH 601 or registration wherein. Cross-listed with MEMA 605

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.

10. Prefix: MEEN
    Course #: 618
    Title (exclude punctuation): ENERGY METHODS

    | Lect. | Lab | SCH | Subject Matter Content Code | Admin. Unit | Acad. Year | FICE Code |
    |-------|-----|-----|-----------------------------|-------------|------------|-----------|
    | 0     | 3   | 0   | 31 14 19 01 00 06 19 20 08 - 09 | 0           | 1          | 0 3 6 6   |

    Do not complete shaded area.

Approval recommended by:

Head of Department: [Signature] 11/8/07

Chair, College Review Committee: [Signature] 11/26/07

Head of Department (if cross-listed course): [Signature] 11/26/07

Dean of College: [Signature] 11/26/07

Submitted to Coordinating Board by:

Dean of College: [Signature] Date

Director of Academic Support Services: [Signature] Date

Effective Date: [Signature] Date

* Attach a syllabus according to the guidelines on the Internet site www.tamu.edu/admissions/oras. To have this form reviewed, please send to Linda F. Lacey, Mail Stop 1265 or fax to 845-8737.
MEEN 618  Energy Principles and Variational Methods

COURSE DESCRIPTION: There are two approaches to developing governing equations of problems in applied mechanics: the vector approach and energy or variational approach. The vector approach uses Newton's laws, whereas the energy/variational approach uses energy/variational principles. The energy/variational approach also allows us to determine the type of boundary conditions for the problem. A variational method also presents a natural means to determine approximate solutions of the governing equations. The present course has the objective of studying the energy principles of solid and structural mechanics and variational methods, such as the Galerkin, Ritz, and least-squares methods of approximation. Applications of these topics to general field problems as well as elastic deformations of straight bars and beams, trusses and frames, torsion of cylindrical members, and bending of circular and rectangular plates will be covered. As an off-shoot of the traditional variational methods, the finite element method will be introduced briefly.

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. Learn the concepts of work and energy, virtual displacements, and virtual work.
2. Learn to utilize the principle of virtual work and its special forms, unit dummy displacement and force methods and Castigliano's theorems to determine reactions and displacements of discrete structures (e.g., trusses, beams, and frames).
3. Learn to develop variational principles of mechanics and their use in the solution of simple problems of heat transfer, fluid mechanics, and solid mechanics.

PREREQUISITES: 
All students taking the course must have a senior or graduate standing in engineering, MATH 601 or equivalent (ordinary and partial differential equations), and a course on mechanics of deformable bodies or elasticity, and motivation to learn.

TOPICS:  
Week 1: Review of vectors and tensors.
Week 2: Review of basic equations of bars, beams, and elasticity
Week 3: Concepts of work and energy with applications to solid and structural problems
Week 4: Elements of variational calculus, Euler equations, essential and natural boundary conditions
Week 5: Principles of minimum total potential energy  Test 1
Week 6: Principles of virtual displacements and their applications
Week 7: Castigliano's Theorems I and II and Unit-Dummy displacement and load methods
Week 8: Hamilton's principle and its applications
Week 9: Weak formulations and the Ritz method
Week 10: Applications. Test 2
Week 11: Weighted residual methods (Petrov-Galerkin method, Galerkin method, least-squares method)
Week 12: Application of variational methods to the solution of plate problems
Week 13: An introduction to the finite element method (1-D problems)
Week 14: Finite element analysis of beams and plane elasticity
Week 15: Applications of FEM 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