ME-504 Introduction to Computational Mechanics
Spring Semester, 2000

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Lectures T Th 3:00 – 4:15 PM, Room 220, Mechanical Engineering

Office Hours T Th 4:15 – 5:00 PM, TBA

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Text Book J. N. Reddy, An Introduction to the Finite Element Method, McGraw-Hill, 1993 (UNM Bookstore)

References

- K.-J. Bathe, Finite Element Procedures, 1995.
- E. Becker, G. F. Carey and J. T. Oden, Finite Elements an Introduction, Prentice Hall, 1981.
- T. J. R. Hughes, The Finite Element Method, Prentice-Hall, 1987.
- P. M. Gresho and R. L. Sani, Incompressible Flow and the Finite Element Method, Wiley, 1998.
- G. Strang and G. J. Fix, An Analysis of the Finite Element Method, Wellesley-Cambridge Press, 1997.
- O. C. Zienkiewicz and R. L. Taylor, The Finite Element Method, 4th Ed., vol. 1, McGraw-Hill, 1994.
- O. C. Zienkiewicz and R. L. Taylor, The Finite Element Method, 4th Ed., vol. 2, McGraw-Hill, 1994.

Grading

- Homework Problems – 10%
- 5 Programming Exercises & Reports – 45%
- Mid Term Exam – 20%
- Final Exam – 25%

Topics

1. Finite Element Fundamentals
   - Introduction & Background (Ch. 1)
   - Weighted Residual Formulations (2.1–2.2)
   - Variational Method, Calculus of Variations (2.3–2.4)
   - FE Matrix Equations, Anatomy of an FEM Code
   - Linear Algebra Review
2. Natural Coordinates, Shape Functions & Quadrature
   - 1-D Approximation Functions (3.1–3.2)
   - Shape Functions, Natural Coordinates
   - Gaussian Quadrature (7.1)
3. Applications & Formulations
   - Advection-Diffusion
   - Generalized ODE Formulation
   - Axis-symmetric formulations (3.3–3.4)
   - Heat Transfer & Stress Analysis
4. Eigenvalue & Time Dependent Problems
   - Eigenvalue Analysis (6.1)
   - Parabolic Problems – Transient Heat Conduction (6.2–6.3)
   - Hyperbolic Problems – Wave Propagation
   - Error Analysis for Transient Problems
5. Multi-Dimensional Formulations & Elements
   - Weak Form for Boundary Value Problems (8.1–8.2)
   - Interpolation Functions Derivatives
   - Surface Integration, & BC's
   - Multi-Dimensional Elements, Quadrature (9.1–9.2)
   - Post-Processing Solutions
6. Advanced Topics – Time Permitting
   - Patch Test, Reduced Integration, Stabilization
   - Projections – Galerkin Revisited
   - Mixed Methods (11.1–11.4)
   - Beams (4.1–4.2)
   - Plane Stress, Strain, Axisymmetric Formulations (10.1–10.4)