AE675/AE675A INTRODUCTION TO FINITE ELEMENT METHODS

L-T-P-D: 3-0-0-0 Units: 9
Course Instructor: Dr. P. Chakraborty
Office: 210/F NWTF
Ph: 7951
Email: cpritam@iitk.ac.in

Topics:

- Functional; Method of Variation; Principle of Minimum Potential Energy and Virtual Work.
- Bilinear form; Ritz Method; Method of Weighted Residual; Weak.form.
- 1d stress equilibrium; Lagrange polynomial; Parametric element; Numerical Integration.
- Truss elements; Assembly; Application of boundary conditions.
- Euler-Bernoulli beam; Finite element representation; Hermite shape functions.
- Frame elements.
- Error analysis and convergence of Finite element solution.
- 2-D single variable PDE; Development of shape functions (triangle and quadrilateral).
- Static stress equilibrium; Finite element representation.
- Overview on 3-D elements (Tetrahedral and Hexaheral).
- Demonstration of stress analysis using finite element method software.
- Time dependent problem; Numerical time integration; Error Analysis; Mass lumping.
- Eigen Value Analysis.
- Introduction to nonlinear FEM (if time permits).

References:

1. An Introduction to the Finite Element Method. Author: J. N. Reddy.
2. Introduction to Finite Elements in Engineering. Authors: T. R. Chandrupatla and A. D. Belegundu.
3. Concepts and Applications of Finite Element Analysis. Authors: R. D. Cook, D. S. Malkus, M. E. Plesha and R. J. Witt.
4. Finite Element Method: Its Basis and Fundamentals: Authors: O. C. Zienkiewicz, R. L. Taylor and J. Z. Zhu.
5. Finite Element Procedures. Author: K. J. Bathe.
6. Finite Element Analysis. Authors: B. Szabó and I. Babuška.

Marks Distribution:

- *Home Work Problems* (0%)
- *2 Quiz* (7%+8%) – Both the quiz before Mid Semester
- *Assignments:*
  - Code development (2D frame) (20%) – After Mid Semester
  - Stress analysis using FE software in groups of 2 (15%) — After Mid Semester
- *Examinations:*

- Mid-semester: 20%
- End-semester: 30%

Attendance Policy:

Attendance is compulsory and will be monitored regularly. If the attendance is below a certain minimum, then instructor reserves the right to de-register student(s) from this course.

Grading Policy: Relative grading.

Evaluation of Assignments:

Code development:
- Implement in MATLAB.
- A report has to be submitted.
- The code should be emailed.
- 10-15 minutes' oral examination in my office. Have to explain part of the code and the results. During the oral examination, you can be asked to run the code on a different problem (random selection).

Stress analysis using FE software:
- A 10-15-minute presentation will be required for oral examination in my office. Questions will be asked specific to the problem as well as FEM in general.

Important:

No Makeup Quiz.
Dropping of course after Mid Semester Exam won't be permitted.