MIE1804: Finite Element Method in Mechanical Engineering
Mechanical and Industrial Engineering
University of Toronto

Instructor: Professor S A Meguid

Ph.D., P.Eng., CEng, FIMechE, FASME FEIC LTSM-AIAA

Course Description:

Finite Element Method (FEM) is a very powerful numerical tool that has wide applications in a multitude of real engineering problems. The main focus of the course is to provide graduate students with a fundamental understanding of the principles upon which FEM is based. Specifically, participants will learn how the principles governing discretization of a continuum. synthesize and apply the method to physical problems, scrutinize their discretized model, assess the accuracy of the model predictions and avoid the pitfalls of this elegant numerical approach. The instruction is designed around understanding and applying FEM to a broad range of engineering problems with the focus being structural mechanics.

Course Content:

- Fundamental concepts of continuum discretization.
- Trial functions, Rayleigh Ritz and weighted residual methods.
- Element formulations: Bar, Truss, Beam, Plane, shell and 3D Elements.
- Consistent Mass and Loading and Gauss Quadrature.
- Element Stiffness Matrices and Assembly of Element Matrices.
- Reduction of Element Equations.
- Stress Recovery, compatibility and equilibrium.
- Applied finite element and accuracy of FEM.
- Project: Participants will be required to model a physical problem either developing their own FE code or use a commercial code,

Outcomes of Course:

Upon completion of the course work, students will develop:

- Comprehensive understanding of the fundamental formulations upon which FE is based.
- Fundamental understanding of domain discretization, its equilibrium and continuity.
- Ability to construct FEM models of real engineering problems
- Ability to apply varied loads and enforce appropriate constraints to their models.
- Critical thinking in interpreting FE model predictions.
- Complete FEM solution strategy for the analysis of mechanical systems.
- Determine the effect of discretization inaccuracies on model predictions.
- Validation of FE predictions.

This is a graduate level course open to aerospace, mechanical, Material Science, Civil,

and biomedical engineering students.

Prerequisites

Solid grasp of fundamentals of engineering sciences, computing, calculus and Mechanics of solids.

S A Meguid
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