



Course Name:

Introductory Finite Elements

Course Number: 20-007	Credit: 3
Program: Undergraduate	Course Type: Technical elective
Prerequisite: -	Corequisite: -

Course Description (Objectives):

The course covers the basic materials in Finite Elements Method.

Course Content (outline):

- **Chapter 1. The concepts of finite element**
Principle of virtual work for solid mechanics problems; Principle of minimum potential energy; Displacement based FE formulation; The concepts of shape functions; One-dimensional finite element; Stiffness matrix and force vectors for truss and beam elements.
- **Chapter 2. Finite elements for two-dimensional problems**
The shape functions of triangular and quadrilateral elements (linear and higher orders); Stiffness matrix for plane stress/strain problems (triangular and rectangular elements).
- **Chapter 3. Finite elements for three-dimensional problems**
The shape functions of tetrahedral and hexahedral elements (linear and higher orders); Stiffness matrix for three-dimensional problems (tetrahedral and hexahedral elements).
- **Chapter 4. Isoparametric elements and Numerical integration**
Serendipity elements; Curved and isoparametric elements; Jacobian matrix for isoparametric elements; Numerical integration for 1D, 2D and 3D problems; Gauss integration points.

Application Softwares

- **Chapter 1. MATLAB software**
A multi-paradigm numerical computing environment (**Matrix Laboratory**); Introducing the structural data type, MATLAB functions, graphical user interface.
- **Chapter 2. ABAQUS software**



A software for finite element analysis and computer-aided engineering; *Pre-processing* or modeling for creating an input file; *Processing* or finite element analysis; *Post-processing* for generating image, animation, etc. as the output file.

- **Chapter 3. TecPlot software**

A visualization software for plotting and animation simulation; A *post-processing* tool.

References:

- **Finite Element Modeling for Stress Analysis** (R.D. Cook), Wiley, New York, 1995.
- **MATLAB** Software,
<http://www.mathworks.com/products/matlab/>
- **ABAQUS** User's Guide and Reference Manual,
<http://www.3ds.com/products-services/simulia/>
- **Tecplot** Visualization & Analysis Tools,
<http://www.tecplot.com/>