Course Number: 28042

Course Name: Finite Element

Course Type:	Type & Max Unit: 3
Prerequisite:	Corequisite:
Level: Graduate	First Presentation: 78-1
Group: Energy Conversion	Last Edition:

Objectives: This course in offered annually especially for PhD students. The course covers the basics and fundamentals of Finite Element Method as well as its application to solve the incompressible Navier-Stokes equations.

Topics:

1- Introduction

- Direct Method
- Stiffness Matrix
- Virtual Work
- Minimum Potential Energy
- Variational Formulation
- Ritz Method
- Method of Weighted Residuals

2- Galerkin Approximation Method

- Weak Formulation
- Space of trial and test functions
- Bubnov and Petrov Galerkin Method
- Discretization using Finite Elements
- Matrix Presentation

3- Error and Approximation Property

- Best Approximation Property
- Error Estimation and Stability

4- Element Definition

- One Dimensional (linear, quadratic)
- Lagrangian and Hermitian Interpolation
- Two dimensional Quadrilateral and Triangular (Isoparametric) Elements
- Transition Elements
- Jacobian of Transformation
- Numerical Integration

5- Diffusion Equations

- Steady state Conduction Heat transfer
- Transient Conduction Heat transfer
- Stability Analysis

- Lumped Mass Matrix

6- Convection Diffusion Equation

- SUPG and GLS Method
- Taylor- Galerkin Method

7- Stokes Equation

- Mired Formulation
- Penalty Method
- Error Estimation and stability

8- Incompressible Navier- Stokes Equations

- SUPG and GLS Method
- Solution of non- linear equations

References:

- The Finite Element Method, Basic Concepts and Applications, Pepper and Hienrich, 2006
- Intermediate Finite Element Method, Fluid Flow and Heat Transfer Application, Heinrich and Pepper, 1999
- The Finite Element Method, T.J.R. Hughes, 1987