- **MAP-5935 Computational Finite Elements(First presented 2006)**

- Code and data for the training fem code BBMEFN serving as introduction to finite element method.
- Finite element solution using Galerkin method with both linear and quadratic interpolation.
- Two dimensional flow in a rectangular duct.
- Resulting equations are solved iteratively using the successive overrelaxation method (SOR).

- Input and typical output files are provided.
- Solution is compared with exact solution for both linear finite elements and finite difference options.
- **One dimensional Burgers equation using linear finite elements**
- Program burg4.f contains code necessary to solve and illustrate the propagating shock problem governed by Burgers equation with high Re No. using 3 discretization options:
- 1.linear finite element,
- 2. quadratic finite element and
- 3. 3 point finite difference method
- **One dimensional and 2-D Heat conduction equation discretized by finite element linear and quadratic finite elements**
- **A FORTRAN program is presented for the solution of the shallow-water equations in 2-D space and time. An efficient solution of the Galerkin equation is achieved by factorizing in the X- and Y-horizontal directions. A direct method is used to solve the mass matrix equation efficiently as only one side diagonal occurs.**
- **The model is applied to the computation of a Rossby wave propagation. A special combination of weights and internal projections makes the scheme energy conserving**.
- Survey of FEM methods for solution of the Shallow Water equations.
- **Outline of methods of weighted residuals:**
- **Galerkin,**
- Ritz,
- Collocation
- and Least Squares
- **Shape Functions in Natural Coordinates**
- **Linear Shape Functions**
- **Quadratic shape functions**
- **Lagrange Polynomials**
- **Reference: Hughes, T. J. R., 1987, *The Finite Element Method: Linear Static and Dynamic Finite*
- *Element Analysis*, Chapter 1, Prentice-Hall, Inc**
- **Finite Element solution of Stefan's problem**

- **Shallow Water equations using triangular finite elements**
- **h- Adaptive mesh refinement in 1-D**
- Illustration by code of Sod's problem
- Ref:
- G.A. Sod, J. of Comp. Phys., 27, (1978), pp.1-31.
- * R. Lohner, Comp. Meth. in Appl. Mech. and Engrg., 61, (1987) pp.323-338.
- **Adaptive mesh refinement 2-D Euler equations**
- **Illustrative Examples of finite Element codes :**

- **Viscous Laminar Flow in a duct**
- **2-D Navier Stokes equations finite element code**
- **Two Dimensional Burgers Equation Numerical Solution via FEM**
- **Finite element method illustrated for solution of Poisson's equation**
- **PLTMG Adaptive fem code for solution of general elliptic PDE's in 2-D**
- **Codes in MATLAB and Fortran by Examples in FEM Book by Kythe and Wei**
- **Ref: An introduction to linear and nonlinear finite element analysis : a computational approach**
- **Prem K. Kythe, Dongming Wei. Published: Boston : Birkhäuser, c2004**
- **Isoparameteric finite elements- a gentle Introduction**

- Petrov Galerkin solution of the 1-D Burgers equation

- **Advanced finite element analysis of heat transfer with examples**

- **REF: Hou-Cheng Huang and Asif S. Usmani**
- **Finite Element Analysis for Heat Transfer Theory and Software, Springer Verlag 1994**