WPE 1993

Question in the area of

*Computational Mechanics*

Your entire answer to this question should not exceed three pages.

Consider the Navier-Stokes equations for three-dimensional unsteady incompressible flows. Assume that the fluid is Newtonian. Furthermore, assume that the spatial domain is fixed.

A. Write down the Galerkin variational (weak) form of the governing equations. Be precise and complete in defining the type of boundary conditions and the function spaces involved.

B. Let us assume now that you are faced with solving a three-dimensional unsteady incompressible flow problem by using the finite element method. Your starting point is the correct answer to part A. Discuss what computational challenges you expect to encounter, what known solutions to these challenges you are aware of, and what solutions of your own you offer to these challenges. In discussing these challenges and solutions, group them into the following categories:

1. Stability and accuracy of the formulation
2. Spatial discretization
3. Computational speed and efficiency

and any other category you may want to add.