ME 670 Advanced Computational Fluid Dynamics (3-0-0-6)

Pre-requisite: ME 602/ MA 573 or equivalent

Brief review of the governing equations in fluid dynamics; Compact and explicit convection schemes; Linear iterative solver – introduction to Conjugate Gradient method, Geometric multigrid technique; Structured Grid generation - algebraic methods, elliptic techniques; Finite difference technique - Convection-diffusion equation, Projection method, coordinate transformation. Finite volume method - integral approximations, flows in simple and complex geometries, introduction to unstructured grid computations; Parallel computations - Need for vectorization, domain decomposition technique, MPI libraries; Introduction to Turbulent flow computations – ideas behind Direct Numerical Simulation (DNS), Large Eddy Simulation (LES) and turbulence modeling.

Textbooks:

[1] J. H. Ferziger and M. Peric, *Computational Methods for Fluid Dynamics*, Springer, 2002.

[2] J. C. Tannehill, D. A. Anderson and R. H. Pletcher, *Computational Fluid Mechanics and Heat Transfer*, Taylor & Francis, 1997.

References:

[1] S. V. Patankar, *Numerical Heat Transfer and Fluid Flow*, Hemisphere, 2000.

[2] J. D. Anderson Jr, *Computational Fluid Dynamics*, McGraw-Hill International Edition, 1995.

[3] K.Muralidhar and T. Sundararajan, *Computational Fluid Flow and Heat Transfer*, Narosa Publishing House, 1995.

[4] S. B. Pope, *Turbulent Flows*, Cambridge University Press, 2000.[1] S. V. Patankar, *Numerical Heat Transfer and Fluid Flow*, Hemisphere, 2000.

[5] Pierre Sagaut, *Large Eddy Simulation for Incompressible Flows*, Springer, 1998.

[6] Tapan K. Sengupta, *Fundamentals of Computational Fluid Dynamics*, Universities Press, 2004.

[7] J. H. Ferziger, *NumericalMethods for Engineering Application*, John Wiley & Sons,1998.