Module V:

1. Make an estimate of the computational time on a tera-flop machine (which can do 10^{12} floating point operations per second) for the evaluation of steady flow field for the case of developing flow in a rectangular duct using SIMPLE scheme and using Gaussian elimination method wherever a system of algebraic equations is to be solved. You may assume that 500 iterations of the outer loop of the SIMPLE algorithm are required for convergence.
2. Use (a) Gaussian elimination and (b) LU decomposition to solve the set of six algebraic equations that were derived in Lecture 2.
3. Write a computer program to do problem #2,Module V above for a general NI x NJ number of grid points in the x- and y-directions, respectively and determine how the computational time increases as the number of grid points is increased.
4. Take advantage of symmetry of the problem in Lecture 2 and using one-sided difference approximations for evaluation of derivatives at the boundaries, repeat problem #3 above for only one-quarter of the duct.
5. Repeat problems #4 and #5,Module V using the basic iterative schemes and compare computational time. Use a residual reduction factor of 10^4.
6. Investigate numerically the convergence rate characteristics of the basic iterative methods for the Laplace equation with Dirichlet boundary condition.
7. Investigate numerically the effect of grid size on the rate of convergence for the simple case of Laplace equation with Dirichlet boundary conditions.
8. Investigate numerically the effect of the SOR parameter on its rate of convergence.for the case of Laplace equation with Dirichlet boundary conditions.
9. Repeat problem # 6,Module V with (a) the ADI scheme, (b) the SIP scheme, and (c) the Conjugate gradient method. Go through the literature for details of the methods.
10. Repeat problem # 6,Module V using the Multigrid method with (a) two, (b) three and (c) four grid levels on a V-cycle and monitor the residual reduction and the computational time.
11. Repeat problem #6,Module V with three grid levels and investigate the effect of V- and W-cycles on the evolution of the solution.
12. Make a consolidate table of the computational time, memory usage and degree of difficulty of programming for the various methods you have used so far.