Homework #6	**Computational Fluid Dynamics I**	Prof. V. Esfahanian
Due Date: 1/9/97		TA: A.Bahrami & M.Fazli

1. Consider flow over a flat plate with zero pressure gradient. Blasius found that by definition of following variables (He used $\alpha = 1$):

$$\psi(x,y) = \sqrt{\alpha\nu x U}\ f(\eta) \qquad \text{and} \qquad \eta = y\sqrt{\frac{U}{\alpha\nu x}}$$

the boundary layer equations reduce to

$$f''' + \frac{\alpha}{2} f f'' = 0$$

with the following boundary conditions:

$$f = f' = 0 \qquad \text{at} \qquad \eta = 0$$

$$f' = 1 \qquad \text{as} \qquad \eta \to \infty$$

Required:

(a) Write a computer program to solve the Blasius equation using the Keller-Box scheme. Carry out the computations for two values of step size $\Delta\eta$=0.5 and $\Delta\eta = 0.1$, and the stretching grid mentioned in the class. For each case, apply the outer boundary condition at a distance from the wall such that $\eta_{\max} = 12.0$.

(b) Make a table of quantities f, f', and f'' for all the η locations for each case.

(c) Plot the velocity profile in the form of u/U vs $y\sqrt{U/\alpha\nu x}$ for each case.

(d) Compute $C_f Re_x^{1/2}$ for each case.

(e) Prepare a report describing your program and discussing your results.