Fall 2007 ME-310 Numerical Methods Homework Assignment 2 Program Due: 24 October 2007 Report Due: 25 October 2007 @ 13:30

Viscous frictional losses in pipe flow result in pressure drops that must be overcome. These are expressed in terms of a friction factor, f, For turbulent flows in pipes, f is calculated from the Colebrook equation:

$$\frac{1}{\sqrt{f}} = -2 \ln \left(\frac{e / D}{3.7} + \frac{2.51}{(Re) \sqrt{f}} \right)$$

where e is the roughness, D is the diameter of the pipe, and Re is the Reynolds number.

Write a computer program to solve this equation for f, using fixed-point iteration method when Re = $2 \, 10^4$ and e / D = 0.004.

Suggested algorithm:

- Read NMAX, Re, e / D ratio, maximum number of iterations from an input file and starting estimate of f from the terminal;
- Use a starting estimate for $f \le 0.2$;
- Calculate iteration function, f = g(f) in a sub-procedure;
- Stop iterations when the estimated relative error (ERE) is smaller than 10⁻⁵ percent, or when the number of iterations exceeds NMAX;
- Write the number of iterations, N, the calculated final value of f, and the estimated relative error to the terminal and a data file.

Run the program for at least two different choices of g(f), tabulate and discuss the results. One of the choices could be

g(f) =
$$\frac{1}{4 \left[\ln \left(\frac{e / D}{3.7} + \frac{2.51}{(Re) \sqrt{f}} \right) \right]^2}$$

Note: Input and output files should be created in "C:/temp/" directory as "idno-hw02input.txt" and "idno-hw02-output.txt"