ENG1060: COMPUTING FOR ENGINEERS

PASS 7 – Week 9

2020 OCT NOV

TASK 1

The following 4th order polynomial has 4 distinct real roots:

$$x^4+6x^3+7x^2-6x-8=0$$

A. Plot the function and identify by eye where all four roots are located. Use a line width of 2.
B. Create a function for the false-position method then use it to find the 4 different roots. Use a precision of 0.001.
C. Plot the roots on the figure from part A as blue squares with a marker size of 10.

TASK 2

You are given an equation:

$$f(x) = \sin(x) + \cos(1 + x^2) - 1$$

where x is in radians. Create a **function** for the secant method and use it to find the converged root with initial guesses of:

A. $x_{i-1} = 3.0$ and $x_i = 1.0$,
B. $x_{i-1} = 1.5$ and $x_i = 2.5$,
C. $x_{i-1} = 1.5$ and $x_i = 2.2$.

Plot $f(x)$ and the roots found from A, B and C. Use a precision of 0.1 and ensure that you have a legend.

TASK 3

The total head loss h (m) in a piping system can be represented by:

$$h = \frac{\left(f\frac{L}{D} + K_v + K_e\right)v^2}{2g}$$

where f is the friction factor, defined as:

$$f = \frac{16\mu}{\rho D v}$$

and L is the pipe length, D is the pipe diameter, K_v is the valve friction constant, K_e is the elbow friction constant, v is the linear velocity in pipe, g is the gravitational acceleration (9.8 m/s^2), μ is the fluid viscosity and ρ is the fluid density.

Experiments indicate that K_v and K_e are 4.5 and 0.6, respectively. The fluid viscosity is 1.7×10^{-3} Pa.s and the density is 1800 kg/m^3. The pipe diameter and length are 0.025 m and 25 m, respectively.

A. Plot the total pressure loss against linear velocity values between 0 and 30 m/s
B. Use the secant method to determine the linear velocity that results in a total head loss of 50 m
C. Mark the linear velocity that provides a total head loss of 50 m on the figure from part A using a red asterisk. Use sprintf() in the legend to indicate that the asterisk represents head loss = 50.
D. Use fprintf() to print the required linear velocity that provides a total head loss of 50 m. An example output is provided below.

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A linear velocity of xx.xx m/s provides a total head loss of 50 m
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TASK 4

In a chemical engineering process, water vapor (H_2O) is heated to sufficiently high temperatures that a significant portion of the water dissociates, or splits apart, to form oxygen (O_2) and hydrogen (H_2):

$$H_2O \leftrightarrow H_2 + \frac{1}{2}O_2$$

If it is assumed that this is the only reaction involved, the mole fraction, *x*, of H_2O that dissociates can be represented by:

$$K = \frac{x}{1-x}\sqrt{\frac{2p_t}{2+x}}$$

Where *K* is the reaction's equilibrium constant and p_t is the total pressure of the mixture.

A. Write two **function** files which perform the bisection and modified secant methods separately.
B. Assume p_t to be 3.5 find the value of *x* when *K*=0.04. Plot the function that you are solving. Then prompt the user to enter a lower and upper limit. If the initial guesses do not bracket a root, your m-file should display an error mesage. Perform the bisection method using the function file written in part A with a precision of 1e-4 to find the root of the profile and print the root value.
C. Repeat part B but using the modified secant method function file written in part A. Prompt the user for an initial guess and use a perturbation of 0.05. The precision remains as 1e-4.