CHEN 320

Homework 1

This is an INDIVIDUAL assignment. You may work in groups, but you must submit your own homework individually.

Instruction of homework submission

1. For MATLAB problem, you can copy the results in the command window, paste them in a word document, and format the printout in the Word processing software.
2. If homework assignments ask you to develop a MATLAB code, you have to upload the ".m file" to the Canvas.
3. Please follow the homework instruction described in the syllabus.

Homework Problem

Special instruction for Homework 1: For Question 1 ~ 6, you don't need to upload .m file, but you still need to copy-paste your MATLAB codes to the Word processing software, and upload the PDF file.

1. **[You have to upload the MATLAB file (.m file)]**

   The friction factor for incompressible flow through a smooth pipe is given below. The friction factor is used to calculate the pressure drop in a pipe. Write a MATLAB code that calculates the friction factor, *f*, given the Reynolds number (Re) using 'IF' statements.

$$Re \leq 2100 \qquad f(Re) = 16/Re$$
$$2100 < Re < 10^5 \qquad f(Re) = 0.0791/Re^{0.25}$$
$$Re \geq 10^5 \qquad f(Re) = 0.004$$

   Reynolds number of the pipe, $Re = \rho u d_h / \mu$, where
   ρ = *density*
   u = *flow velocity (m/s)*
   μ = *dynamic viscosity*
   d_h = *inner diameter (m)*
   (1) Create a MATLAB program that can calculate the friction factor when you give a specific flow velocity. (Consider water flow in the pipe with 0.5m diameter at 25°C)
   (2) Use the program to calculate the friction factors at various velocities and plot the velocity (x axis) vs. friction factor (y axis). Plot friction factor at velocity = 0.001 m/s to 1m/s with 0.05 m/s spacing.

2. The power series for π is shown below. Write a MATLAB code that applies this series until the last term divided by the current estimate of π is less than 10^{-8} using a 'WHITE' loop.

$$\pi = \sqrt{12} \sum_{k=0}^{\infty} \frac{(-3)^{-k}}{2k+1}$$

3. Develop an m-file that plots $y = sinx$ for $0 < x < \pi$ without a title, $x -$ or $y -$labels or without any modifications to the plot. Plot the same function with a title, $x -$ and $y -$labels and further modifications to enhance your plot.

4. Develop an m-file that plots $y_1 = sinx$ and $y_2 = cosx$ in the same plot for $0 < x < \pi$ with a title, $x -$ and $y -$labels, a legend and further modifications to enhance your plot.

5. Develop an m-file that factors the following expressions.

$$x^2 + 9x + 8$$

6. Develop an m-file that symbolically performs the following indefinite integral.

$$\int \frac{dx}{a^2 + b^2x^2}$$