THE UNIVERSITY OF MELBOURNE
ENGR30002 Fluid Mechanics

Workshop 02 – *Conservation of mass*

Part A

The three functions y_1, y_2, and y_3 are defined as follows:

$$y_1(x) = \sin x$$

$$y_2(x) = 0.25x$$

$$y_3(x) = \tan x$$

Question 01

(1) Use the *linspace* function to generate an array X that contains 100 x-values spanning the domain $[0,\ 2\pi]$. Using matrix manipulation of your array X, generate a new array Y_1 that contains corresponding values according to the function y_1. Feed your X and Y_1 arrays into the *plot* function to generate a lot for y_1.

(2) The graph you generate is technically incomplete without labels and various accountrements. Explore the following fuctions (use MATLAB's *help* function where necessary):

   (a) Use `xlim` to force the x-axis to be bound between 0 and 2 π.

   (b) Use `ylim` to force the y-axis to be bound between -2 and 2.

   (c) Use `xlabel` to label the x-axis as x.

   (d) Use `ylabel` to label the y-axis as y.

   (e) Use `title` to give your graph a title, e.g. "Graph of $y_1(x) = \sin x$".

Question 02

(1) Using matrix manipulation of your array X generated in Question 01, generate new arrays y_2 and y_3. In three separate windows, plot graphs for the functions y_1. y_2, and y_3 (one function per window). Use what you have learned to make your graphs complete (axes labels, titles, and limits if necessary).

(2) Turn the `hold` property on and generate an overlaid plot of the functions y_1. y_2, and y_3.

(3) Generate sub-plots of y_1. y_2, and y_3 stacked on the top of each other (i.e., a 3×1 sub-plotting arrangement) in the same window.

Part B

Question 01

A tapered pipe is used to connect pipes of different sizes. Generally, the tapered pipe has two different areas. One side of the pipe is larger than the other side, so it is used to increase or decrease fluid velocity depending on how it is connected. Assume a light crude oil with a density of 761 kg/m^3 at 50°C enters the pipe at 20 m/s and leaves at 150 m/s.

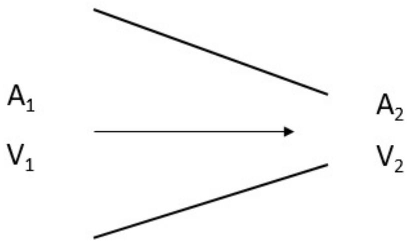

Figure 1: A tapered pipe

(1) If the inlet area increases from 50 cm^2 to 100 cm^2 in increments of 10 cm^2 while the inlet and outlet velocities are maintained, how does the exit area change? Plot a graph of A_1 vs. A_2 and comment on your result.

(2) If V_1 increases from 20 m/s to 80 m/s in increments of 10 m/s while the outlet velocity is kept constant, how does the exit area change? Plot a graph of V_1 vs. A_2 and comment on your result.

Question 02

To meet a daily water usage in a town, you are in a position to install different diameters of pipes to transport water from three reservoirs located far away. As shown in Figure 2, three pipes steadily deliver water at 20°C.

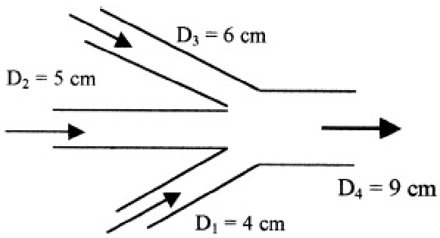

Figure 2: Multiple pipes

(1) Due to a harsh underground condition, you may need to change a diameter of Pipe 3. If you vary a diameter of Pipe 3, How does V_3 change when the exit flow rate Q_4 is 120 m^3/h with the condition that increasing Q_3 by 20 % would increase Q_4 by 10 %. Plot a graph and provide your explanation.

(2) If you change D_2, how does it affect V_1 while maintaining the same exit flow rate ? Plot a graph and provide your explanation. Use v_3 when D_3=6.

END OF WORKSHOP