The University of Melbourne
ENGR30002 Fluid Mechanics

Workshop 04 – *Fanning friction factor*

Part A

Question 01

What is the value of x at the end of execution of the following MATLAB scripts? Trace through each script by hand before checking your result in MATLAB.

(1)
```
x=1;
for i=1:5
x = x*i;
end
```

(2)
```
n=17; x=0;
while (n > 1)
n = n/2;
x = x + 1;
end
```

Question 02

Leibniz discovered that π can be approximated using the formula

$$\frac{\pi}{4} = \sum_{k=0}^{\infty} \frac{(-1)^k}{(2k+1}$$

This is called a sum of a series. For example, the first six terms of the series are

$$\pi = \frac{4}{1} - \frac{4}{3} + \frac{4}{5} - \frac{4}{7} + \frac{4}{9} - \frac{4}{11} + \cdots$$

Write a MATLAB function **Pi_Approx1(n)** that returns the approximation of π using the first **n** terms of the Leibniz series above.

Part B

Question 01

First, write a function that takes three inputs (Re, ϵ, D) using the following numerical expressions for estimating fanning fraction factors and return one output, f_F.

$$f_F = \begin{cases} \frac{16}{Re} \quad \text{for} \quad Re < 2100 \\ \{-1.737 \ln[0.0269\frac{\epsilon}{D} - \frac{2.185}{Re} \ln(0.269\frac{\epsilon}{D} + \frac{14.5}{Re})]\}^{-2} \quad \text{for} \quad Re > 2100 \end{cases}$$

Next, call that function into a new m-script and plot the Fanning fraction factors using for three values of roughness ratio ($\frac{\epsilon}{D} = 0.000001, 0.001, and\ 0.05$). Set a range of Re, $100 \sim 2000$ for laminar flow and $2300 \sim 10^7$ for turbulent flow.

Question 02

Water at 15°C is flowing in a 30-m-long horizontal pipe made of stainless steel. If it flows at a rate of 9 litre/s, what is an effect of the pipe diameter on the pressure drop? Vary the pipe diameter from 1 to 10 cm in increments of 1 cm. Plot a graph of ΔP (kPa) vs diameter (m).

END OF WORKSHOP