

# CEE 3804 Exam1 (Spring 2023)

## Computer Applications in Civil Engineering

### Take Home Exam: Open Book and Notes

Your Name \_\_\_\_\_

Your Signature \* \_\_\_\_\_

\* The answers in this exam are the product of my own work. I certify that I have not received nor I have provided help to others while taking this examination.

#### **Directions:**

Solve the problems. Copy and paste the VBA code and solutions such as graphs in a Word Document and convert to a single PDF file. **Make sure your code is not too small for me to be able to read it.** Minimum font size 12 is acceptable.

### Problem 1 (40 points)

A common problem in Civil Engineering is to estimate the head loss inside a pipe due to friction using the Darcy-Weisbach equation.

$$h_{friction} = f_{coeff}LV^2/(2gD)$$

Where:

$h_{friction}$  is the head loss due to friction inside the pipe (in meters)

$f_{coeff}$  is the coefficient of friction inside the pipe (dimensionless)

$L$  is the length of the pipe in meters

$V$  is the speed of the fluid inside the pipe (in m/s)

$g$  is the gravity constant (9.81 m/s<sup>2</sup>)

$D$  is the diameter of the pipe in meters

For turbulent flow, the coefficient of friction is estimated using the following equation:

$$f_{coeff} = \frac{0.079}{R_e^{0.25}}$$

Where:

$R_e$  is the Reynold's number (dim)

The Reynold's number is defined by:

$$R_e = \frac{VD}{\nu}$$

Where:

$R_e$  is the Reynold's number (dim)

$V$  is the speed of the fluid inside the pipe (in m/s)

$D$  is the diameter of the pipe in meters

$\nu$  is the kinematic viscosity of the fluid (m<sup>2</sup>/s)

The units in this model are all consistent.

Table 1. Numerical Constants for Problem 1

Parameter	Value	Units
$V$	3.0	m/s
$D$	0.35	m
$L$	125	M
$\nu$	1.04E-06	m <sup>2</sup> /s (water)

- Create a VBA function (not a Subroutine)** to estimate the value of head loss in the pipe ( $h_{friction}$ ) given the parameters in Table 1. The parameters in Table 1 are arguments of the function. The function produces the value of  $h_{friction}$ . The values of the parameters in Table 1 are read from the spreadsheet. Please include a brief explanation in the spreadsheet of the problem, your name, and the parameters used (including units).
- Test the function created in part (a) with the values in Table 1.
- Create a table with values of  $h_{friction}$  for water flows ranging from 1.0 to 3.5 meters per second at steps 0.125 m/s. Write code to generate the table in VBA automatically.
- Use the values in the table generated in step (c) to make a plot in Excel. Label your plot accordingly. Show the calculated value of  $h_{friction}$  in your spreadsheet.
- Add Table 2 to your analysis allowing the user of the spreadsheet to select the value of kinematic viscosity of water at different temperatures. Modify the function to select the value of  $\nu$  as a function of the temperature selected.

Table 2. Water Kinematic Viscosity at Various Temperatures.

Temperature (deg. C)	$\nu$ (m <sup>2</sup> /s)
0	1.79E-06
5	1.52E-06
10	1.31E-06
20	1.04E-06

**Show me all your code in screen captures. Unreadable font size will not be accepted. Please make sure the equivalent font size of the screen capture is at least 12.**

## Problem 2 (30 points)

A file containing aircraft assets of four airlines are shown below. The file is provided in the assignments website.

<i>Airline</i>	<i>Aircraft Type</i>	<i>Cycles</i>	<i>Flight Hours</i>
Commodore Airways	Bombardier CRJ-900	9,481	10,016.5
Legend Airlines	Airbus A320	24,194	28,523.7
Star Airline	Airbus A320	15,961	16,359.7
Arrow Airlines	Airbus A320	33,798	33,373.8
Legend Airlines	Airbus A320	26,228	29,439.2
Arrow Airlines	Airbus A320	31,350	34,975.9
Commodore Airways	Boeing 737-800	15,292	12,686.2
Commodore Airways	Airbus A320	11,111	9,357.1
Commodore Airways	Bombardier CRJ-900	45,517	51,837.6
Arrow Airlines	Airbus A320	17,695	15,544.6
Commodore Airways	Boeing 737-800	21,014	22,518.6
Commodore Airways	Bombardier CRJ-900	17,716	21,156.8
Star Airline	Boeing 737-800	36,663	41,041.3

The fields in the file are explained below.

Airline - name of the airline

Aircraft Type - the name of the aircraft used

Cycles - the number of landings performed by the aircraft

Flight Hours - the cumulative number of hours flown by the aircraft

- Create a Pivot Table to summarize the number of cycles of each aircraft by airline (matrix)
- Create a Pivot Chart to summarize graphical part (a)
- Find the average number of cycles for Boeing 737-800 that belong to Arrow Air
- Plot the number of cycles against the number of hours. Estimate the best linear regression model to relate the two parameters.
- Using a pivot table, find the average number of cycles for Bombardier CRJ-900 in Commodore Airways fleet.
- Find the minimum number of cycles for Airbus A320 aircraft fleet (i.e., any of the airlines).

**Show me the Pivot Table, Pivot Chart, etc. Highlight the numbers with your answers.**

### Problem 3 (30 points)

Provide quick answers.

Question	Answer
What is the purpose of "Option Explicit" in VBA?	
The first computer by Apple that introduced a graphic user interface. The computer was a commercial failure.	
According to Moore's Law we double the number of transistors in a microchip every two years. Starting with the Intel 4004 chip, find the year when we could reach 10 billion transistors in a single chip.	
IBM launched the IBM System/360 Model 65 mainframe computer in 1964. Name two innovations of the system.	
An engineer calculates 10 million deflections of a bridge structure in a computer program. Each calculation involves three numbers: 1) the bridge element number (single precision), 2) the deflection at each bridge element (double precision), and 3) the stress value at each bridge element (double precision). Estimate the number of bytes of computer memory required to hold all the calculations.	
Magnetic tapes started a new trend in computers to save data. Name the company that introduced tape drives in computers in 1951.	
State one fundamental difference between a function and a subroutine in VBA.	
Write the version of Simulink installed in your computer. Show a screen capture.	
Why do most computers use base 2 to store numbers?	