EML3041 Affidavit Sheet for Individual Projects

Important: Each student is expected to work independently on the computer program. Depending on the severity of the violation, offences of violating academic integrity can result in a penalty ranging from zero in computer project plus overall course grade reduction of 10 points, grade of F for the course, or a FF for the course, and brought to the attention of the Dean of academic affairs for further process. Check the current academic year undergraduate catalog on academic dishonesty and disruption of academic process.

I attest to the following. I have

1. worked independently,
2. received no help on this programming assignment from anybody (other than instructor or TA or discussion board), and
3. given no help to anybody in completing the programming assignment

during the semester of ___________________ (name semester and year) for the course - EML 3041-Computational Methods.

If I am found to be giving or receiving help, I will receive a penalty and will be brought to the attention of the Dean of academic affairs for further process. Check current undergraduate catalog on academic dishonesty and disruption of academic process. You always have the right to appeal the decision of the instructor.

You should not get help on the assignment while you writing the code and you should avoid working next to another person on the assignment when coding. Do not show or ask someone for their code for any reason.

Name of the Project: _____Water Flow Problem____________________________________

Dated ____________05/07/2020____

Signature __________Autar Kaw____

First Name _____Autar_________________ Last Name _____Kaw______ Last Name Initial K

Problem #1

Type in a word processor the velocity vs radial location data collected as well as any other data that is needed to conduct this project.

Data collected

Velocity vs. Radial Location Data

Radial location, r (ft)	0	0.083	0.17	0.25	0.33	0.42	0.50
Velocity, v (ft/s)	10	9.72	8.88	7.5	5.6	3.1	0

Radius of pipe= 6”

Table of Contents


```
% ALL COMMENTS IN CAPS ARE FOR GUIDING YOU TO WRITE A PROPER PROGRAM
% THE COMMENTS THAT ARE IN ALL CAPS ARE NOT EXPECTED WHEN YOU SUBMIT
% YOUR PROGRAM.

% SEE HOW THERE IS AN INTRODUCTION PART AND IT HAS THESE
% COMPONENTS OF REVISED, PURPOSE, KEYWORD, AUTHOR
```

Introduction

Revised: May 7, 2020

```
% Purpose
%       This program will demonstrate the appropriate format to be
%       used for submissions. This is not a MATLAB tutorial. In
 addition,
%       it demonstrates finding the flow rate in a pipe when
%       the velocity vs radius data is given.

% Keywords
%       Sample Format; Water Flow; Regression; Flow rate

% Author
%       Autar Kaw
%       Semester: Fall 2015

% SEE THE USE OF CLC, CLF AND CLEAR ALL
% SEE THE IDENTIFICATION OF THE AUTHOR AND PROJECT TITLE
clc
clf
clear all
disp ('Computational Methods')
disp ('EML3041')
disp ('Fall 2015')
disp ('Autar Kaw')
disp('Project Name: Flow rate in a pipe')
```

```
disp('*******************************************************************')
disp('   ')
```

Computational Methods
EML3041
Fall 2015
Autar Kaw
Project Name: Flow rate in a pipe
****

Problem 1

SEE HOW EACH PROBLEM IS IDENTIFIED EVEN IF IT IS NOT MATLAB RELATED DO NOT FORGET THE SPACE AFTER %% See attached sheet for typed input data

```
disp('Problem 1')
disp('See typed document in the report')
disp('*******************************************************************')
disp(' ')
% SEE HOW THE COMMENTS ARE WRITTEN AND THEY ARE SUFFICIENT BUT NOT
% REDUNDANT
% THEY ARE ALWAYS IN THEIR OWN LINE NOT APPENDED TO A MATLAB STATEMENT
```

Problem 1
See typed document in the report

```
*******************************************************************
```

Problem 2

Attached is the data taken in the lab velocity (ft/s) vs radial location (ft) data

```
radial =   [0  0.083  0.17  0.25  0.33  0.42  0.5];
velocity= [10  9.72   8.88  7.5     5.6      3.1    0];
% Radius of pipe (inches)
Radius=6;
% APPRECIATE THE IDENTIFICATION OF PROBLEM NUMBER AND
% USE OF DISP STATEMENTS
% ALL INPUT DATA IS DISPLAYED USING PROPER DISP AND FPRINTF STATEMENTS
disp ('Problem 2')
disp('_________________________________')
disp('   Radial     Velocity' )
disp('  Location       ' )
disp('    (ft)       (ft/s)' )
disp('_________________________________')
dataval=[radial;velocity]';
disp(dataval)
disp('_________________________________')
fprintf('The radius of the pipe is =%g inches',Radius)
disp('   ')
disp('*******************************************************************')
disp ('  ')
```

```
Problem 2
_________________________________
   Radial     Velocity
  Location
    (ft)       (ft/s)
_________________________________
         0   10.0000
    0.0830    9.7200
    0.1700    8.8800
    0.2500    7.5000
    0.3300    5.6000
    0.4200    3.1000
    0.5000         0

_________________________________
The radius of the pipe is =6 inches
*******************************************************************
```

Problem 3

Changing units of needed variables to USCS

```
Radius_ft=Radius/12;
```

```
% SEE HOW LINES ARE SKIPPED SO THAT THE MFILE CAN BE READ NICELY AS
 WELL
```

Problem 4

SEE HOW THE PROGRAM IS WRITTEN CLEARLY WITH VARIABLE NAMES THAT MAKE SENSE, COMMENTS PRECEEDING NEW VARIABLES, ETC THIS PROBLEM IS AN EXAMPLE OF A CALCULATION PROBLEM Using regression formula to find the velocity profile

```
n=length(radial);
% Using the regression formula for velocity profile
C_Numer=sum(velocity.*(1-radial.^2/Radius_ft^2));
C_Denom=sum((1-radial.^2/Radius_ft^2).^2);
C=C_Numer/C_Denom;
disp('Problem 4')
fprintf('The velocity profile is %g(1-r^2/%g)',C,Radius_ft^2)
disp('    ')
disp('********************************************************************')
disp ('   ')
```

```
Problem 4
The velocity profile is 10.0132(1-r^2/0.25)
*******************************************************************
```

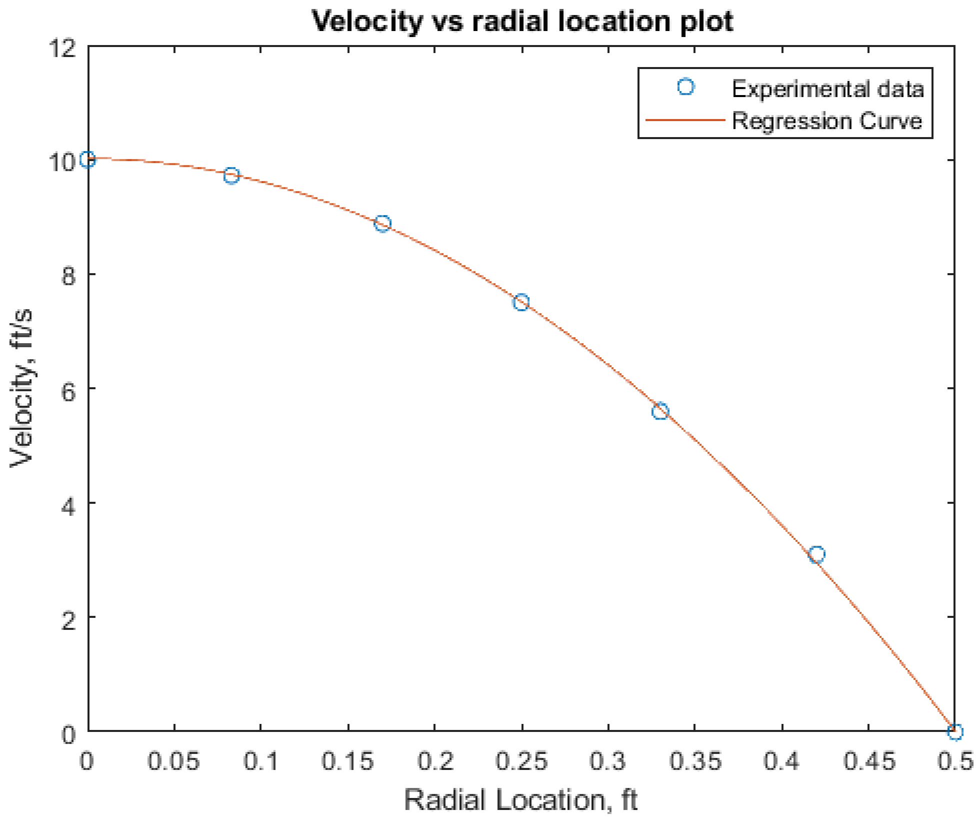
Problem 5

Plot of velocity profile as a function of radial location defining radial locaton, r as a symbolic variable

```
syms r

% Velocity profile
vel_profile=C*(1-r^2/Radius_ft^2);

% Determing points for the plot
r_val=radial(1):(radial(n)-radial(1))/1000:radial(n);
v_val=subs(vel_profile,r,r_val);

% LOOK AT HOW THE PLOT IS LABELED WITH AXES AND LEGEND
% plotting radial location vs velocity
plot(radial,velocity,'o',r_val,v_val,'-');
xlabel('Radial Location, ft')
ylabel('Velocity, ft/s')
title ('Velocity vs radial location plot')
legend('Experimental data','Regression Curve')

disp('Problem 5')
disp('See Figure 1 for velocity profile')
disp('********************************************************************')
disp ('   ')
```

```
Problem 5
See Figure 1 for velocity profile
```

```
**********************************************************************
```



Problem 6

Finding the flow rate from the regression curve Integrating to find the flow rate from Equation (1)

```
flow_rate=vpaintegral(2*pi*r*vel_profile,r,0,Radius_ft);
flow_rate=double(flow_rate);
disp('Problem 6')
fprintf ('The flow rate from the regression curve is=  %g  ft^3/s',...
    flow_rate)
disp('  ')
disp('**********************************************************************')
disp ('  ')
```

```
Problem 6
The flow rate from the regression curve is=  3.93216  ft^3/s
**********************************************************************
```

Problem 7

Finding the flow rate from the average velocity x Area method Average Velocity

```
avg_vel=mean(velocity);
```

```
% Area of pipe
Area=pi*Radius_ft^2;
flow_rate=avg_vel*Area;
flow_rate=double(flow_rate);
disp('Problem 7')
fprintf('The flow rate from the average velocity method is= %g ft^3/
s',...
    flow_rate)
disp('  ')
disp('*********************************************************************')
disp ('  ')
```

```
Problem 7
The flow rate from the average velocity method is= 5.02655 ft^3/s
*******************************************************************
```

Problem 8

Using trapezoidal rule with unequal segments to find flow rate Using equation (1) to find te integrand

```
flow_rate_alt=0;
for i=1:1:n-1
    fun_up=2*pi*radial(i+1)*velocity(i+1);
    fun_low=2*pi*radial(i)*velocity(i);
    flow_annulus=(radial(i+1)-radial(i))/2*(fun_up+fun_low);
    flow_rate_alt=flow_rate_alt+flow_annulus;
end

disp('Problem 8')
disp('Using trapezoidal rule with unequal segments to find flow rate')
fprintf ('The flow rate from an alternative method is=  %g  ft^3/
s',...
    flow_rate_alt)
disp('  ')
disp('**********************************************************************')
disp ('  ')
```

```
Problem 8
Using trapezoidal rule with unequal segments to find flow rate
The flow rate from an alternative method is=  3.84767  ft^3/s
********************************************************************
```

Problem 9

See typed document in the report

```
disp('Problem 9')
disp('See typed document in the report')
disp('*********************************************************************')
disp ('  ')
```

```
Problem 9
```

```
See typed document in the report
*******************************************************************
```

Published with MATLAB® R2018b

Problem 9

Did you expect the flow rates to be similar in value from #7, #8 and #9? If yes, why? If not, why? In 50-100 words, type out your response on a separate sheet(s) of paper. The response should be complete including defining all the variables, using appropriate equation editors of your word processor.

Solution

The flow rate Q in a pipe is given by

$$Q = \int_0^a v(r)dA = \int_0^a 2\pi r v(r)dr \qquad (1)$$

where

$v(r)$= velocity along the radial location, *r*

a = radius of the pipe.

Three methods were used to find the flow rate.

1. In the first case, the velocity vs radial location data was regressed to a special second order polynomial and then substituted in equation (1).
2. In the second method, the average velocity $\bar{V}$ was found and the flow rate was simply given by

   $$Q = \bar{V} \times A$$

   where *A* is the cross-sectional area of the pipe.
3. In the method of my choice, I chose the Trapezoidal rule with unequal segments.

So why are the results from methods (1) and (3) so different from method (2)? This is because the integrand in equation (1) is $2\pi r v(r)$ and not *v(r)*. If I had averaged $2\pi r v(r)$ instead in Method (2), I would get a better estimate of the flow rate, if not as accurate as in Methods (1) and (3).

Checklist for submission

Name _Autar Kaw____________________

Semester _Fall 2015____________________

Project Number __One______________

- ✓ I submitted this submission as a SINGLE pdf file.
- ✓ I followed the general format as given in the sample project.
- ✓ I uploaded the mfile as a separate submission.
- ✓ I attached the affidavit sheet.
- ✓ I wrote the code only by myself.
- ✓ I did not show my code to anyone else.
- ✓ I attached any handwritten pages if asked for.
- ✓ I attached any typed pages if asked for.
- ✓ I followed the section format as given in the sample project.
- ✓ I published the mfile in published format.
- ✓ I wrote proper and reasonable comments.
- ✓ I put the comments on their own lines, as seen in the sample project mfile (not at the end of a code line).
- ✓ I identified my methods for each problem.
- ✓ I suppressed all statements.
- ✓ I showed input and output variables using fprintf/sprintf/disp statements for all exercises unless specified otherwise.
- ✓ I checked for cut off errors in the published file.
- ✓ I avoided all hard-coding (i.e., the program should still work if ANY of the input data is changed).