The Open University of Sri Lanka
Faculty of Natural Sciences
B.Sc/ B. Ed Degree Programme

Department	**: Mathematics**
Level	**: 05**
Name of the Examination	**: Final Examination**
Course Title and - Code	**: Introduction to MATLAB Software - ADU 5320**
Academic Year	**: 2019/2020**
Date	**: 20.12.2020**
Time	**: 09.30 a.m. – 11.30 a.m.**
Duration	**: 02 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This paper consists FIVE (05) pages.
3. This paper consists of **TWO** sections: Section **A** and Section **B**.
   - **Section A**
     - This section is compulsory
     - It consists of **FIVE (05)** Structured Essay Questions
     - Each question carries 20 marks.
     - Provide answer in the given space under each question.
   - **Section B**
     - This section consists of **FIVE (05)** Essay Type Questions
     - Answer only any **THREE (03) questions** of them in a separate answer booklet given by the University.
     - Each question carries 100 marks.
     - Answer for each question should commence from a new page.
4. Involvement in any activity that is considered as an exam offense will lead to punishment.
5. Use blue or black ink to answer the questions.

6. Clearly state your index number in your answer script.

7.. When submit the answer scripts to invigilator/ supervisor, **Attach Section A to the answer booklet of the Section B.**

SECTION A

(a) Write the code to evaluate the value of the following expression into MATLAB command window:

$$\frac{\left(a^3+b^3-c^{-2}\right)}{(a+b)^{-1}+(a+c)^2-(b+c)^{\frac{1}{2}}} \text{ when } a=1, b=-1, c=2.$$

(b) Consider the following MATLAB program:

```
>>A =

   1   2

   3   4

   5   6

>> B=[1 1 1;2 1 1]

B =

   1   1   1

   2   1   1

>> C=[B' ones(3,2) 2*A]
```

What is the output after this program executes?

(c) Consider the MATLAB function written in the Mfile fun.m:

```
function f=fun(x,y)

f=x^2+y^2+1;

end
```

To evaluate the function value of f when x=1 and y=2, write the code to call fun.m in command window.

(d) Consider the following program:

```
>> x = [-10:1:10];
>> y1 = exp( x );

>> y2=sin(x);

>> y3=x.^2;
```

What is the code to plot all three functions y1,y2 and y3 in one figure by displaying the functions values as points (".") with different colour for each functions.

(e) Consider the following matrices:

A1 =

1	2	3	4
-1	2	3	-4
0	1	0	2
3	0	4	0

A2 =

3 4

3 -4

0 2

Write the code to obtain matrix A2 from matrix A1.

SECTION B

Answer **THREE** Questions **ONLY**.

2.

(a) An object with an initial temperature T_0 is placed at time $t=0$ inside a chamber which has a constant temperature T_s will experience a temperature change according to the following equation:

$T=T_s+(T_0-T_s)e^{-kt}$ where T is the temperature of the object at time t (in hours) and k is a constant.

An aluminum can at a temperature of 120^0F is placed in the refrigerator where the temperature is 38^0F. Write a Matlab program to determine the temperature of the can after 3hours to the nearest degree. Assume $k=0.45$.

(b) In an experiment, a small steel ball is dropped and videoed against a checkered background. The video sequence is analyzed to determine the height of the ball as a function of time to give the data in the following table:

Time(s)	Height (in)
0.03	22
0.063	21.5
0.096	20.5
0.13	18.8
0.163	17
0.196	14.5
0.23	12
0.26	8
0.29	3

This experimental data is to be compared to the theoretically expected values given by the following equation: $h = 22in - \frac{1}{2}gt^2$ where h is in inches, t is in seconds, and g = 386.4 in s^{-2}. Write a Matlab program to create a graph that compares the measured data with the theoretically expected values. Plot the measured data using red circles and plot the theoretically expected values using a blue line.

3.

(a) Write a Matlab program using *for_end loop* to find the sum of squares of the integers from 1 to 10.

(b) Suppose student marks obtained for the three subjects; Mathematics, Science and English are provided. write a Matlab program to calculate the average mark by taking the inputs as marks obtained for each subject and label the student performance as follows:

when *average mark* $\geq$ 90 display as "*Excellent*"

when 75 $\leq$ *average mark* < 90 display as "*Good*"

when 45 $\leq$ *average mark* < 75 display as "*Moderate*"

when *average mark* < 45 display as "*Weak*"

4.

(a) Write a Mfile function to compute the total and average of four numbers.

(b) (i) The value P of a savings account with an initial investment of P_0, and annual interest rate r (in %) after t years is: $P = P_0\left(1+\frac{r}{100}\right)^t$.

Write a Mfile function to calculate the value of savings account.

(ii) Write the code to evaluate the value of a Rs. 20,000 investment at an annual interest rate of 5% after 15 years.

5.

(a) A ball falls from some height having the displacement function $x(t) = 272e^{-\frac{t}{4}} + 128t - 272$.

Write codes to evaluate the followings:

(i) To obtain the velocity function $v(t)$ and acceleration function $a(t)$.

(ii) To evaluate acceleration at $t = 5$.

(iii) To find the limiting velocity v_{limit} when t becomes infinite.

(b) Write the codes to evaluate the following integrals:

(i) $\int \cos(ax+b)+\sin bx dx$

(ii) $\int_0^{\infty} \frac{\sin x}{\sqrt{x}} dx$

6.

(a) The following Table shows the number of dengue patients in hundreds for a certain country from year 2012 to 2017.

Year	2012	2013	2014	2015	2016	2017
No of patients	12	21	23	36	39	45

Write the codes to evaluate the following using linear interpolation:

(i) To find an estimated number of dengue patients found in the third quarter of the year 2015.

(ii) To interpolate monthly from year 2012 to 2017 and plot the original data and the interpolated data in one figure.

(iii) To forecast the number of dengue patients monthly for three years (from 2017 to 2020) and obtain the plot of original data and extrapolated data in one figure.

(b) Consider the following second order ODE with initial conditions:

$$\frac{d^2y}{dx^2} - 3\frac{dy}{dx} = e^x \sin x, \quad y(0) = -1, y'(0) = 0.$$

Write Matlab code to solve the above initial value problem using *dsolve* command.