MATH 2221B Mathematics Laboratory II

Lab Assignment 1

Name: _____   Student ID.: _____

Class: _____

In this assignment, you are asked to run **MATLAB** demos to see **MATLAB** at work. The color version of this assignment can be found in your own H:\ drive.

Instructions

1. Your first task is to set up your own password after logging in.

2. Start **MATLAB**, until you see a window with the **MATLAB** prompt "»". This window is called the Command Window.

3. After you started have **MATLAB**, you will automatically be in the directory H:\. Please enter "`diary on`" after the **MATLAB** prompt » only once to record all your work in H:\diary. No marks will be given if no diary is found.

4. Enter "demo" after the prompt ». You will see a new window with many things to play with. This is the Demo Window.

5. In the Demo Window, try to locate figures or problems similar to those in the exercises below. Then locate the commands that generate these figures or problems. Try them in the Command Window. Just enter (or cut and paste) the commands after » to see what happens.

6. You should write your results on the lab sheet provided, and save the figures in the H: drive, in your personal drive.

7. Please read and sign the following declaration before handing in your assignment. Otherwise, no marks will be given.

1 (30 marks)		6 (Optional)	
2 (30 marks)			
3 (25 marks)			
4 (15 marks)			
5 (Optional)			

Please read the following carefully:
General Guidelines for Lab Assignment Submission.

- Please sign and date the statement of Academic Honesty.

- Please go to the class and lab indicated by your registered course code via the CUSIS system. If you go to a different lab than the one you are registered for, you will not receive credit for the assignment even if you completed it.

- Write your COMPLETE name and student ID number legibly on the cover sheet (otherwise we will not take any responsibility for your lab). Please write your answers using a black or blue pen, NOT any other color or a pencil.

- Write your solutions on a double-sided printout of this pdf file. Try to fit your answers inside the available space.

- The use of computers/cellular phones/graphing calculators/iPads will NOT be permitted during tests and lab assignments. Please do not use our lab computer to recharge your cellar phone battery. No photo taking is allowed in the lab.

- In order to make it fair for all students, during the labs and tests, if you touch/press any icons on your cellular phone, our TA will check your phone to determine whether or not you are exchanging messages with another student. If you are found cheating (in the tests or in the lab or on homework assignments), you will automatically get an F grade in this course and your act will be reported to the Department for necessary disciplinary actions.

Exercises

1. (Arithmetic Operations, 30 marks)

   <u>What You Will Learn</u>

   - Arithmetic Operations: You can use MATLAB as a calculator in the command window at the command line.
   - Variables: MATLAB allows you to store case-sensitive variables.

Question

The mathematics calculations to be performed are typed directly into the Command Window, using the symbols $= +, -, *, /,$ and $\wedge$ for equals, addition, subtraction, multiplication, division, and exponentiation, respectively.

The distance traveled by a ball falling in the air is given by the equation

$$x = x_0 + v_0 t + \frac{1}{2} a t^2.$$

Use MATLAB to calculate the position of the ball at time $t = 5$ s if $x_0 = 20$ m, $v_0 = 24$ m/s, and $a = -9.81$ m/sec^2.

Write down all the MATLAB command lines.

```
>> x0 = 20; v0 = 24; a = -9.81; t = 5; x = x0 + v0*t + 0.5*a*t^2

x =

    17.3750
```

2. (Basic Matrix Operations, 30 marks)

What You Will Learn

- Linear Algebra: Examine the properties of matrices.

Question You can do either

```
>> A = [ 1 2; 6 3]; B = [ -1 2; 0 1]; C = [5; 2]; D = 6;
```

or

```
>> A = [ 2, 1; 3, 4]; B = [ -1, 2; 0, 1]; C = [2; 4]; D = 2;
```

and do not have to do both.

What is the result of each of the following expressions (try to read the message of MATLAB and find out the reason if any error occurs)?

(a) (5marks)	A+B	(b) (5marks)	A.*B
(c) (5marks)	A*B	(d) (5marks)	A*C
(e) (optional)	A+C	(f) (optional)	A+D
(g) (optional)	A.*D	(h) (optional)	A*D

Can you tell the difference between the MATLAB .* and * commands (10 marks)?

Write down all the MATLAB command lines.

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```
>> A = [ 1 2; 6 3]; B = [ -1 2; 0 1]; C = [5; 2]; D = 6;
>> A+B

ans =

     0     4
     6     4

>> A.*B

ans =

    -1     4
     0     3

>> A*B

ans =

    -1     4
    -6    15

>> A*C

ans =

     9
    36

>> A+C
Error using  +
Matrix dimensions must agree.

>> A+D

ans =

     7     8
    12     9

>> A.*D

ans =

     6    12
    36    18

>> A*D
```

```
ans =

     6     12
    36     18

The MATLAB command .* computes element-wise
multiplication, and the * is for standard matrix
multiplication.
```

3. (Exponents and Logarithms, 25 marks)

   <u>What You Will learn</u>

   - Exponents and Logarithms: Type

     ```
     >> help exp
     >> help log
     >> help log10
     >> help sqrt
     ```

   <u>Question</u>

   The following problems can be solved by writing commands in the Command Window, or by writing a program in a script file and then executing the file.

   (a) $\dfrac{3 \cdot 5}{3^2 + 6/2} + e^{\log_{10}(4)}$;

   (b) $\dfrac{12.6^2 + 5.5^3}{3.8^{3/2}} + \dfrac{65}{\sqrt{3} + 14} + e^5 \log_{10}(32)$.

   Write down all the MATLAB command lines.

   ```
   >> (3 * 5 )/( 3^2 + 6/2) + exp(log10(4))

   ans =

       3.0759

   >> (12.6^2 + 5.5^3)/(3.8^(3/2)) + 65/(sqrt(3) + 14) + exp(5)*log10(32)

   ans =

     271.4081
   ```

4. (Images, 15 marks)

   MATLAB can read a greyscale or color image from graphic files using the command `imread(fillename)`. For example, the command `A=imread('antennaegalaxy.jpg')` reads the image from the file named "antennaegalaxy.jpg" and stores it in A.

Figure 1: Antennae galaxy. Source http://science.nationalgeographic.com

Try to use the file "antennaegalaxy.jpg" which can be found in the H: drive
and do the following

- (5 marks) Read the image from the file (put the file in MATLAB current
  folder first, if it is not).

- (5 marks) Display the image in MATLAB.

- (5 marks) Convert the image to grayscale and then show it again.

Hint: MATLAB demo provides many useful MATLAB Examples. Type `demo`
in the command line and try to find something you need.

Write down all the MATLAB command lines.

```
A = imread('antennaegalaxy.jpg');

imshow(A);

B = rgb2gray(A);
imshow(B);
```

5. (MATLAB Built-in Functions, optional)

   What You Will Learn

   - Built-in functions: the MATLAB ones and zeros commands.
   - Help for functions in the Command Window: Type

   ```
   >> help ones
   >> help zeros
   >> help linspace
   ```

   Question

   Use the MATLAB ones and linspace commands and basic matrix operations to create the following matrix:

   $$
   H = \begin{bmatrix}
   1 & 2 & 3 & 4 & 5 & 6 \\
   2 & 3 & 4 & 5 & 6 & 7 \\
   3 & 4 & 5 & 6 & 7 & 8 \\
   4 & 5 & 6 & 7 & 8 & 9 \\
   5 & 6 & 7 & 8 & 9 & 10
   \end{bmatrix}.
   $$

   ```
   >> H = ones(5,1)*linspace(1,6,6) + linspace(0,4,5)'*ones(1,6)

   H =

        1     2     3     4     5     6
        2     3     4     5     6     7
        3     4     5     6     7     8
        4     5     6     7     8     9
        5     6     7     8     9    10
   ```

6. (Operator Precedence, optional)

   Question

   MATLAB executes the calculations according to the order of precedence displayed below. This order is the same as used in most calculators.

First	Parentheses. For nested parentheses, the innermost are are executed first.
Second	Exponentiation.
Third	Multiplication, Division (equal precedence).
Fourth	Addition and Subtraction

   Variables $a, b, c,$ and d have been initialized to the following values:

   $$a = 3; \quad b = 2; \quad c = 5; \quad d = 3.$$

Evaluate the following MATLAB assignment statements:

(a) $\texttt{output} = a * b + c * d$ (b) $\texttt{output} = a * (b + c) * d$
(c) $\texttt{output} = (a * b) + (c * d)$ (d) $\texttt{output} = a \wedge b \wedge c$
(e) $\texttt{output} = a \wedge (b \wedge c)$

```
>> a = 3; b = 2; c = 5; d = 3;
>> a*b+c*d

ans =

    21

>> a*(b+c)*d

ans =

    63

>> (a*b)+(c*d)

ans =

    21

>> a^b^c

ans =

       59049

>> a^(b^c)

ans =

   1.8530e+15
```