MATH 2221 A Mathematics Laboratory II

Lab Assignment 2

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 obtained from the **K:** drive. All the figures below are in MATLAB demos.

Instructions

1. Start MATLAB until you see a window with the MATLAB prompt ">>". This window is called the **Command Window**.

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

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

4. 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.

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

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

I declare that the assignment here submitted is original except for source material explicitly acknowledged. I also acknowledge that I am aware of University policy and regulations on honesty in academic work, and of the disciplinary guidelines and procedures applicable to breaches of such policy and regulations, as contained on the website http://www.cuhk.edu.hk/policy/academichonesty/

_____ _____

Signature Date

1 (10 marks)		4 (20 marks)	
2 (10 marks)		5 (20 marks)	
3 (20 marks)		6 (20 marks)	
		Total	/100 pts

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.
- 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. (10 marks) Perform the following operations: (Write down all the MATLAB command lines and the result.)

   (a) Create

$$A = \begin{pmatrix} 1 & 3 & 5 \\ 7 & 9 & 2 \\ 4 & 6 & 8 \end{pmatrix}$$

```
>> A=[1,3,5;7,9,2;4,6,8]

A =

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

   (b) Set $B = A$ and then modify B such that $B(2,2) = 5$.

```
>> B=A

B =

     1     3     5
     7     9     2
     4     6     8

>> B(2,2) = 5

B =

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

   (c) Compute $C = AB - BA$

```
>> C = A*B - B*A

C =

     0   -12     0
    28     0     8
     0   -24     0
```

(d) Compute $D = C^T - C$

```
>> D = C' - C

D =

     0    40     0
   -40     0   -32
     0    32     0
```

(e) Compute $E = (D + I_3)^{-1}$, where I_3 is 3×3 identity matrix.

```
>> E = inv(D+eye(3))

E =

    0.3905   -0.0152   -0.4876
    0.0152    0.0004    0.0122
   -0.4876   -0.0122    0.6099
```

2. (10 marks) Without using loops, find the remainder when $f(x) = \sum_{k=0}^{50} x^k$ is divided by $x + 2$ (Write down all the MATLAB command lines and the result.) **Hint:** Use remainder theorem.

```
>> p = ones(1,51)

p =

  Columns 1 through 7

     1     1     1     1     1     1     1

  Columns 8 through 14

     1     1     1     1     1     1     1

  Columns 15 through 21

     1     1     1     1     1     1     1

  Columns 22 through 28

     1     1     1     1     1     1     1
```

```
  Columns 29 through 35

     1     1     1     1     1     1     1

  Columns 36 through 42

     1     1     1     1     1     1     1

  Columns 43 through 49

     1     1     1     1     1     1     1

  Columns 50 through 51

     1     1

>> r = polyval(p,-2) %Remainder theorem

r =

   7.5060e+14
```

3. (20 marks) Given

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix} 5 & 7 & 11 \\ 2 & 5 & 3 \\ 1 & 4 & 7 \end{pmatrix}$$

(a) Let $\vec{a}$ be the third row of A and $\vec{b}$ be the second column of B. Find $\vec{a}$ and $\vec{b}$. (Write down all the MATLAB command lines and the result.)

```
>> A = [1,2,3;4,5,6;7,8,9]

A =

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

```
>> B = [5,7,11;2,5,3;1,4,7]

B =

     5     7    11
     2     5     3
     1     4     7

>> a = A(3,:)

a =

     7     8     9

>> b = B(:,2)

b =

     7
     5
     4
```

(b) Compute $\vec{c} = \vec{a} + \vec{b}^T$, and the second element of $\vec{c}$. (Write down all the MATLAB command lines and the result.)

```
>> c = a+b'

c =

    14    13    13

>> c(2)

ans =

    13
```

4. (20 marks)

(a) Use only `diag` and `ones` to create a 4×4 symmetric matrix

$$P = \begin{pmatrix} 2 & 2 & 2 & 2 \\ 2 & 3 & 2 & 2 \\ 2 & 2 & 4 & 2 \\ 2 & 2 & 2 & 5 \end{pmatrix}$$

Write down all the MATLAB command lines and the result.

```
>> P = 2*ones(4) + diag([0,1,2,3])

P =

     2     2     2     2
     2     3     2     2
     2     2     4     2
     2     2     2     5
```

(b) Given

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$$

Use **only** the function `triu` and matrix operations to create the following symmetric matrix

$$B = \begin{pmatrix} 0 & 2 & 3 \\ 2 & 0 & 6 \\ 3 & 6 & 0 \end{pmatrix}$$

Write down all the MATLAB command lines and the result. (Directly defining B is **not allowed**)

```
>> A = [1,2,3;4,5,6;7,8,9]

A =

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

```
>> C = triu(A,1)

C =

     0     2     3
     0     0     6
     0     0     0

B = C + C'

     0     2     3
     2     0     6
     3     6     0
```

5. (20 marks) Without using loops, define a column vector $\vec{x}$ such that

$$\vec{x}(n) = 2^n \quad \text{for } n = 1, 2, 3, \cdots, 20$$

Write down all the MATLAB command lines and the result.

```
>> n = 1:20  %Or n = linspace(1,20,20)

n =

  Columns 1 through 7

     1     2     3     4     5     6     7

  Columns 8 through 14

     8     9    10    11    12    13    14

  Columns 15 through 20

    15    16    17    18    19    20
```

```
>> x = 2.^n'

x =

           2
           4
           8
          16
          32
          64
         128
         256
         512
        1024
        2048
        4096
        8192
       16384
       32768
       65536
      131072
      262144
      524288
     1048576
```

6. (20 marks) A square matrix A is invertible if and only if the determinant of A is non-zero.

   (a) Is

   $$A = \begin{pmatrix} 1 & 3 & 7 \\ 4 & 5 & 8 \\ 6 & 2 & 3 \end{pmatrix}$$

   invertible? (Write down all the MATLAB command lines and the result to show how you get the conclusion.)

```
>> A = [1,3,7;4,5,8;6,2,3]

A =

     1     3     7
     4     5     8
     6     2     3

>> det(A)

ans =

  -47.0000

% Since det(A) is non-zero, it is invertible
```

(b) Solve the following system of equations:

$$\begin{cases} x + 3y + 7z = 1 \\ 4x + 5y + 8z = 2 \\ 6x + 2y + 3z = 3 \end{cases}$$

Write down all the MATLAB command lines and the result.

```
>> b = [1;2;3] %We have Ax = b now

b =

     1
     2
     3

>> x = A\b

x =

    0.5106
   -0.3830
    0.2340
```

(c) Use Cramer's rule to find x_1, where

$$A = \begin{pmatrix} 1 & 3 & 7 \\ 4 & 5 & 8 \\ 6 & 2 & 3 \end{pmatrix} \quad \vec{b} = \begin{pmatrix} 2 \\ 5 \\ 6 \end{pmatrix} \quad \vec{x} = \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

satisfy the equation $A\vec{x} = \vec{b}$. (Write down all the MATLAB command lines and the result.)

Remark: Cramer's rule tells you that $x_1 = \dfrac{\det(A_1)}{\det(A)}$, where A_1 is the matrix obtained by replacing the first column of A by $\vec{b}$.

```
>> b = [2;5;6]

b =

     2
     5
     6

>> A1 = A

A1 =

     1     3     7
     4     5     8
     6     2     3

>> A1(:,1) = b

A1 =

     2     3     7
     5     5     8
     6     2     3

>> x1 = det(A1)/det(A)

x1 =

    0.9149
```