Q1. For matrix A below, write suitable MATLAB statement(s) to:

$$A = \begin{pmatrix} 4 & 3 & 2 \\ -1 & 6 & 0 \\ 3 & 0 & -2 \end{pmatrix}$$

1. Find the maximum value of the matrix A.
2. Find the minimum value of the matrix A.
3. Find the maximum value of the second row of the matrix A.
4. Find the minimum value of the third column of the matrix A.
5. Square the elements of the matrix A.
6. Find the sum of the diagonal elements of the matrix A.
7. Find the transpose of the matrix A.
8. Find the determinant of the matrix A.
9. Find the inverse of the matrix A.
10. Create a matrix of the same size as A in which all columns are the same as the second column of A.
11. Find the sum of the first row of A.
12. Extract the submatrix B from A in which its elements are those of the second and third rows of A and second and third columns of A.
13. Extract a submatrix like B from a that includes all rows of the second and third columns.

Sol.

Input A to MATLAB

```
>> A=[4 3 2;-1 6 0;3 0 -2];
```

1. >>Max(A(:))
2. >>Min(A(:))
3. >>Max(A(2,:))
4. >>Min(A(:,3))
5. >>A.^2
6. >>Sum(diag(A))
7. >>A’
8. >>Det(A)
9. >>A^-1

10. >> B=[A(:,2) A(:,2) A(:,2)];
11. >>AR1=A(1,:)
    >>Sum(AR1)
12. >>B=A(2:3,2:3);
    Or
    >>B=A([2 3],[2 3]);
13. >>B=A(:,2:3);

Q2. Write MATLA statement(s) to find x and y coordinates of the intersection point of the following two equations:

$$h(x) = 0.5x + 1.2$$
$$j(x) = -0.4x + 2$$

Sol.

>> syms x;

>>x1= solve('0.5*x+1.2=-0.4*x+2');

Now, either substitute this value in the first or second equation to get y

>>y=0.5*x1+1.2

Or

>>y=-0.4*x1+2

You should get the same answer.

Q3. Plot the graph of the function $f(x) = 1.2x$ *on the interval* [0,2].

Sol.

>>syms x;

>>ezplot('1.2*x',[0,2])

Or, one may write:

>>f=1.2*x;

>>ezplot(f,[0,2])

Q4. Write MATLAB statements to draw the sin(x) and cos(x) in the interval [0,2π] with an increment of π/100 in one window. Use blue color for the sin(x) and red color for the sin(x)

Sol.

>>x=0:pi/100:2*pi;

>>y1=sin(x);

>>y2=cos(x);

>>plot(x,y1,'b',x,y2,'r')

Or,

>>hold on

>>plot(x,y1,'b')

>>plot(x,y2,'r')

Q5. Write MATLAB statements to plot three functions $of\ x: y1 = 2\cos(x), y2 = \cos(x), y3 = 0.5\cos(x)\ in\ the\ interval\ 0 \leq x \leq 2\pi$. Use the symbols (--,-,:) respectively to represents the previous functions. Create a legend to show the relevancy of each symbol, and titles of the x-axis and y-axis.

Sol.

>>x=0:pi/100:2*pi;

>> y1=2*cos(x);

```
>> y2=cos(x);

>> y3=0.5*cos(x);

>> plot(x,y1,'--',x,y2,'-',x,y3,':')

>> xlabel('0 leq x leg 2\pi');

>> ylabel('Cosine functions');

>> legend('2Cos(x)','Cos(x)','0.5 Cos(x)');
```

Q6. Write MATLAB statements to solve the following system of linear equations by the use of:

1. Inverse of a matrix
2. Grammar rule

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

Sol.

Two matrices must be define first. The matrix A is a 3×3 matrix contained the coefficients of the variables of the system. The second B is a 3×1 matrix contained the coefficients of the right hand side of the system.

```
>>A=[1 2 3;4 5 6;7 8 0];

>>B=[1;1;1];
```

1.

```
>>AINV=A^-1;

>>var=AINV*B;
```

2.

```
>>AC1=A(:,1);
```

>>AC2=A(:,2);

>>AC3=A(:3);

>>A1=[B AC2 AC3];

>>A2=[AC1 B AC3];

>>A3=[AC1 AC2 B];

x=det(A1)/det(A)

y=det(A2)/det(A)

z=det(A3)/det(A)

Q7. Plot the function of the circle $x^2 + y^2 = 10$?

Sol.

>>ezplot('x^2+y^2=10')

Q8. Plot the function y=x+2 in the range [0,5]?

Sol.

>>ezplot('y=x+2',[0,5])

Q9. Write MATLAB statement(s) to solve the following system of linear equation by the use of the function solve?

$$x + y = 0$$
$$x + 2y = -1$$

Sol.

>>syms x y;

```
>>f1=x+y;

>>f2=x+2*y+1;

>>xy_solution=solve(f1,f2,'x,y');

>>x=xy_solution.x;

>>y=xy_solution.y;
```

Q10. Assume A and B are two square matrices of the same size. Regarding MATLAB programming environment, what each of the following expressions used for?

1. A.*B?
2. A.^B?
3. B.^2?
4. A*B;
5. A'*A;
6. A*A';

Q11. Write MATLAB statement(s) to plot the graph of the functions in one window:

$$f(x) = \cos(x) + e^{-2x}, g(x) = \sin(x), h(x) = 0.5x - 1, in\ the\ interval\ [1,5]$$

Sol.

```
>>syms x f g h;

>>f=cos(x)+exp(-2*x);

>>g=sin(x);

>>h=0.5*x-1;

>>ezplot(f,1,5)

>>hold on
```

>>ezplot(g,1,5)

>>hold on

>>ezplot(h,1,5)

Q12. Consider the following function:

$$f(x) = ax^2 + bx + c, use\ MATLAB\ to\ solve\ it\ with\ respect\ to\ c.$$

Sol.

>>syms a b c x;

>>solve('a*x^2+b*x+c','c')

Q13. Use MATLAB to produce 3-D plot by considering a variable t lies in the interval $0 \leq t \leq 10\pi, and\ that: x = e^{-0.05t}\sin(t), y = e^{-0.05t}\cos(t), z = t.$

Sol.

>>t=[0:pi/50:10*pi];

>>x=exp(-0.05*t).*sin(t);

>>y=exp(-0.05*t).*cos(t);

>>z=t;

>>plot3(x,y,z)

>>xlabel('x')

>>ylabel('y')

>>zlabel('z')

>>grid on

Q14. Use MATLAB to find the first and second derivative of:

$$f(x) = \ln(x) + 2\sin(x)$$

Sol.

```
>>syms x f;
>>f=log(x)+2*sin(x);
>>fprime=diff(f,x)
>>fdprime=diff(f,x,2)
```

Q15. What is the value of the second derivative in the example above at x=2?

Sol.

```
>>syms x f;
>>f=log(x)+2*sin(x);
>>fprime=diff(f,x)
>>fdprime=diff(f,x,2)
>>x=2;
>>eval(fdprime)
```

Q16. Use MATLAB to evaluate the following integral:

$$\int_0^1 xe^x \sin(x)\, dx$$

Sol.

```
>> syms x f;
>> f=x*exp(x)*sin(x);
```

>> int(f,0,1)

ans =

(exp(1)*sin(1))/2 – 1/2

>>(exp(1)*sin(1))/2 – 1/2

0.6437

Q17. Consider the normal probability density function with μ=12 and $\sigma^2 = 2$. Use MATLAB to calculate and plot y for x={3 6 7 9 11 12 14 18 19 21 23}, given that:

$$y = \frac{1}{\sqrt{2\pi\sigma^2}}\, e^{-\frac{1}{2}(x-\mu)^2/\sigma^2}$$

Sol.

>>x=[3 6 7 9 11 12 14 18 19 21 23];

>>y=(1/(2*pi*2)^0.5)*exp(-0.5*(x-12).^2/2);

>>plot(x,y)

Q18. Use the information of Q17 and change the value of σ^2such that $\sigma^2 = 4$. Produce the old and new plots of y on the same window. What difference can you realize between the two plots? What such difference referred to from your point of view?

Q19. Use MATLAB to find and plot the Poisson probability density function y such that:

$$y = \frac{e^{-\mu}\mu^{x}}{x!}, where\ \mu = 2.\ Assume\ x = \{0\ 1\ 3\ 4\ 5\ 6\ 8\ 10\}\ .$$

Sol.

```
>>x=[0 1 3 4 5 6 8 10];

>>y=(exp(-2)*2.^x)./factorial(x);

>>plot(x,y)
```

Q20. Use the information of Q19 and change $\mu = 3$ instead of 2. Discuss all possible changes that may happened when producing the two plots in one window.