**CONTROL SYSTEMS (5th EE & IE)**

**COMPUTER LABORATORY**

**ASSIGNMENT 1**

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1. Matrix and Array Operations using MATLAB

(a) For a square matrix A (say, a 3 x 3 matrix) test the following commands:

**>> A = [1 2 3; 4 5 6; 7 8 9] % Providing Input as a matrix**

A =

1 2 3

4 5 6

7 8 9

**>> A^2 %For finding the square of a matrix**

Output:

30 36 42

66 81 96

102 126 150

**>> A' %For finding the transpose of the Matrix**

Output:

1 4 7

2 5 8

3 6 9

**>> A(2,3) %For displaying the element in the second row and third column of the Matrix**

Output:

6

**>> A(2,2) %For displaying the element in the second row and second column of the Matrix**

Output:

5

**>> A(1,:) %For displaying the first row of the matrix**

Output:

1 2 3

**>> A(:,1) %For displaying the first column of the matrix**

Output:

1

4

7

**>> A(:,1:2:3) %For displaying the columns with a step size of 2**

Output:

1 3

4 6

7 9

**>> A(2:1:3,2:1:3) % For displaying rows and columns with a step size of 2**

Output:

5 6

8 9

**>> inv(A) %For finding the inverse of a matrix**

Output:

-0.4504 0.9007 -0.4504

0.9007 -1.8014 0.9007

-0.4504 0.9007 -0.4504

**>> det(A) %For finding the determinant of a matrix**

Output:

6.6613e-16

**>> diag(A) %For displaying the diagonal elements of a matrix**

Output:

1

5

9

**>> rank(A) % For displaying the rank of a matrix**

Output:

2

**>> expm(A) % For displaying the exponential matrix**

Output:

1.1189 1.3748 1.6307

2.5339 3.1134 3.6929

3.9489 4.8520 5.7552

**>> size(A) % For displaying the size of the matrix in (row, column) format**

Output:

3 3

**>> length(A) % For displaying the largest dimension of a matrix**

Output:

3

**>> max(A) % For displaying the maximum elements of a matrix column wise**

Output:

7 8 9

**>> min(A) % For displaying the minimum elements of the matrix column wise**

Output:

1 2 3

(b) Consider two square matrices A and B and test the following operations:

**>> A = [1 2 3; 4 5 6; 7 8 9] % Taking input for matrix A**

A =

1 2 3

4 5 6

7 8 9

**>>B =[ 2 4 6; 1 3 5; 10 11 12] %Taking input for matrix B**

B =

2 4 6

1 3 5

10 11 12

**>> A+B %For adding two matrices**

Output:

3 6 9

5 8 11

17 19 21

**>> A-B %For subtracting two matrices**

Output:

-1 -2 -3

3 2 1

-3 -3 -3

**>> A\*B %For multiplying two matrices**

Output:

34 43 52

73 97 121

112 151 190

**>> A.\*B %Element wise Multiplication of two matrices**

Output:

2 8 18

4 15 30

70 88 108

**>> A/B % For division of two matrices**

Output:

0 0.4737 0.0526

0 0.3158 0.3684

0 0.1579 0.6842

**>> A./B %Element wise Division of two matrices**

Output:

0.5000 0.5000 0.5000

4.0000 1.6667 1.2000

0.7000 0.7273 0.7500

**>> [A B] %For concatenation of two matrices**

Output:

1 2 3 2 4 6

4 5 6 1 3 5

7 8 9 10 11 12

**>> [A' B'] %For concatenation of transpose of two matrices**

Output:

1 4 7 2 1 10

2 5 8 4 3 11

1. 6 9 6 5 12
2. Test the following commands:

**>> zeros(3) % creates zero matrix of dimension 3\*3**

Output:

0 0 0

0 0 0

0 0 0

**>> zeros(3,4) % creates zero matrix of dimension 3\*4**

Output:

0 0 0 0

0 0 0 0

0 0 0 0

**>> ones(5) % creates matrix of ones of dimension of 5\*5**

Output:

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

**>> ones(2,3) % creates matrix of ones of dimension of 2\*3**

Output:

1 1 1

1 1 1

**>> eye(4) % creates identity matrix of dimension of 4\*4**

Output:

1 0 0 0

0 1 0 0

0 0 1 0

0 0 0 1

**>> eye(4,6) % creates identity matrix of dimension of 4\*6**

Output:

1 0 0 0 0 0

0 1 0 0 0 0

0 0 1 0 0 0

1. 0 0 1 0 0
2. Solve for x in the equation Cx = D, where C=[1 2 1;2 3 2;-1 0 1] and D=[1; 1; 0]

**>> C=[1 2 1; 2 3 2;-1 0 1]**

C =

1 2 1

2 3 2

-1 0 1

**>> D=[1;1;0]**

D =

1

1

0

**>> inv(C)\*D**

Output:

-0.5000

1.0000

-0.5000

1. Common MATLAB functions
   1. Consider, x = pi/3 and find sin(x), cos(x), tan(x), exp(x), log(x), sqrt(x), round(x)

**>> X=pi/3**

X =

1.0472

%The following commands performs Trigonometric operations i.e sinx, cosx ,tanx

**>> sin(X)**

Output:

0.8660

**>> cos(X)**

Output:

0.5000

**>> tan(X)**

Output:

1.7321

**>> exp(X) %calculate the exponential of x**

Output:

2.8497

**>> log(X) %calculate the logarithm of x**

Output:

0.0461

**>> sqrt(X) %calculate the square root of x**

Output:

1.0233

**>> round(X) %print the round off value of x**

Output:

1

* 1. Consider, z = 3+4 \* i (a complex number) and find abs(z), angle(z)

**>> Z= 3+(4\*i) %assign the complex number to Z**

Z =

3.0000 + 4.0000i

**>> abs(Z) %For displaying the magnitude of the complex number**

Output:

5

**>> angle(Z) %For displaying the argument of a complex number in radians**

Output:

0.9273

* 1. Consider, a = 0.866 and find acos(a), asin(a), atan(a)

**>> a =0.866**

**%The following functions calculate the inverse trigonometric functions:**

a =

0.8660

**>> acos(a)**

Output:

0.5236

**>> asin(a)**

Output:

1.0471

**>> atan(a)**

Output:

0.7137

1. Consider two polynomials: p(s) = 3s2+2s+1 and q(s) = s+4, after multiplication it gives

n(s) = 3s3+14s2+9s+4. In MATLAB, this is done in following way:

**>> X=[1 3 -2 5 1]**

X =

1 3 -2 5 1

**>> Y=[5 4 -2]**

Y =

5 4 -2

**>> Z=[5 0 -6 7]**

Z =

5 0 -6 7

**>> A= conv(X,Y) % For calculating the product of two polynomials**

A =

5 19 0 11 29 -6 -2

**>> conv(A,Z)**

Output:

25 95 -30 -24 278 -96 -107 239 -30 -14

**>> X=[1 4 4]**

X =

1 4 4

**>> Y=[ 1 -4 3 ]**

Y =

1 -4 3

**>> conv(X,Y)**

Output:

1. 0 -9 -4 12
2. Test the following:

x = [0:1:10]

x’

p = [1:0.001:1]

p’

If x = [0 pi/2 pi 3\*pi/2 2\*pi] find y = sin(x)

If z = [0:pi/6:pi] find zz = cos (z) and zzz = cos(z/2)

**>> X = [0:1:10] %Display number from 1 to 10 with a step size of 1**

X =

0 1 2 3 4 5 6 7 8 9 10

**>> X'**

Output:

0

1

2

3

4

5

6

7

8

9

10

**>> P =[0:0.001:1] %%Display number from 0 to 1 with a step size of 0.001**

P =

1

**>> P'**

Output:

1

**>> x= [ 0 pi/2 pi 3\*(pi/2) 2\*pi]**

x =

0 1.5708 3.1416 4.7124 6.2832

**>> y=sin(x)**

y =

0 1.0000 0.0000 -1.0000 -0.0000

**>> z=[0:pi/6:pi]**

z =

0 0.5236 1.0472 1.5708 2.0944 2.6180 3.1416

**>> zz = cos(z)**

zz =

1.0000 0.8660 0.5000 0.0000 -0.5000 -0.8660 -1.0000

**>> zzz =cos(z/2)**

zzz =

1.0000 0.9659 0.8660 0.7071 0.5000 0.2588 0.0000