LAB PRACTICE # 4

State Space Representation

Subject: - Feedback Control Systems

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Transfer function to state space

$$G(S) = \frac{12S + 59}{S^2 + 6S + 8}$$

```
num = [12  59];
den = [1  6  8];
[A,B,C,D] = tf2ss(num,den);
printsys(A,B,C,D)
```

Exercise#1

Find the state space representation of the following transfer functions.

$$G(S) = \frac{S + 2}{S^2 + 7S + 12}$$

$$G(S) = \frac{(S+1)(S+2)}{S(S^2+3S+1)}$$

State space to transfer function

$$\begin{pmatrix} dx_1/dt \\ dx_2/dt \end{pmatrix} = \begin{pmatrix} -5 & -1 \\ 3 & -1 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + \begin{pmatrix} 1 \\ 0 \end{pmatrix} U$$

$$y = \begin{pmatrix} 1 & 2 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$$

```
A = [-5   -1;3   -1]
B = [1 ;  0];
C = [1   2];
D = [0];
[num,den]= ss2tf(A,B,C,D);
printsys(num,den);
```

Exercise

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

$$C = \begin{pmatrix} 1 & 1 & 1 \end{pmatrix} \qquad D = 0$$

Contd….Exercise

$$A = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{pmatrix} \qquad B = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

$$C = \begin{pmatrix} 1 & 0 & 0 \end{pmatrix} \qquad D = 0$$

Eign values

$$A = \begin{pmatrix} 0 & 2 & 0 & 0 & 0 \\ 0.1 & 0.35 & 0.1 & 0.1 & 0.75 \\ 0 & 0 & 0 & 2 & 0 \\ 0.4 & 0.4 & -0.4 & -0.4 & 0 \\ 0 & -0.03 & 0 & 0 & -1 \end{pmatrix}$$

eig(A)

State Transition Matrix

The state transition matrix Φ(t) can be computed using the built function *expm(A*t)*.