Question: 2. For each system shown in Figure 2, write the state equation...

2. For each system shown in Figure 2, write the state equations and the output equation for the phase-variable representation.

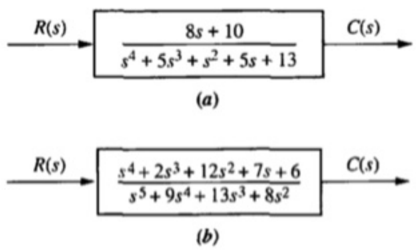


Figure 2.

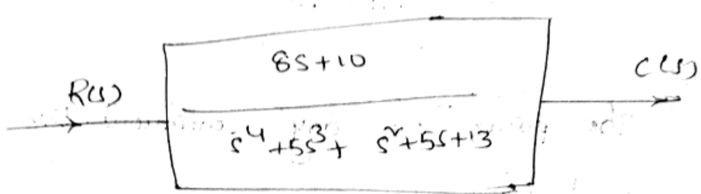
Show transcribed image text

Expert Answer

Anonymous answered this
110 answers

Was this answer helpful? 0 1

(a) Given phase variable representation of a transfer function



this can be solved simply by using MATLAB commands

write the following code in MATLAB script

```
{ n = [8 10]; numerator
  d = [1 5 1 5 13]; denominator
  T = tf(n,d); transfer function
  [A,B,C,D] = tf2ss(n,d) }
```

Now we can see the values of A, B, C, D.

(2)

$$A = \begin{bmatrix} -5 & -1 & -5 & -13 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

$$B = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$C = \begin{bmatrix} 0 & 0 & 8 & 10 \end{bmatrix}$$

$$D = \begin{bmatrix} 0 \end{bmatrix}$$

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \\ \dot{x}_4 \end{bmatrix} = \begin{bmatrix} -5 & 1 & -5 & -13 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix} u$$

$$y = Cx + Du$$

$$y = \begin{bmatrix} 0 & 0 & 8 & 10 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + [0]u$$

$$R(s) \rightarrow \boxed{\frac{s^4+2s^3+12s^2+7s+6}{s^5+9s^4+13s^3+8s^2}} \rightarrow C(s)$$

MATLAB script code:

```
{ n = [1 2 12 7 6];
d = [1 9 13 8 0 0];
T = tf(n,d);
[A,B,C,D] = tf2ss(n,d) }
```

we get

$$A = \begin{bmatrix} -9 & -13 & -8 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix}$$

$$B = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$C = \begin{bmatrix} 1 & 2 & 12 & 7 & 6 \end{bmatrix}$$

$$D = [0]$$

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \\ \dot{x}_4 \\ \dot{x}_5 \end{bmatrix} = \begin{bmatrix} -9 & -13 & -8 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} u$$

$$Y = Cx + Du$$

$$Y = \begin{bmatrix} 1 & 2 & 12 & 7 & 6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_6 \end{bmatrix} + [0]\,u$$

```
4 -    [A,B,C,D] = tf2ss(n,d)
```

Command Window

```
          8 s + 10
  ----------------------------
  s^4 + 5 s^3 + s^2 + 5 s + 13

Continuous-time transfer function.


A =

    -5    -1    -5   -13
     1     0     0     0
     0     1     0     0
     0     0     1     0


B =

     1
     0
     0
     0


C =

     0     0     8    10


D =

     0

fx >>
```

sss.m sss2.m

```
1 -    n= [1 2 12 7 6];
2 -    d= [1 9 13 8 0 0];
3 -    T= tf(n,d)
4 -    [A,B,C,D] = tf2ss(n,d)
```

Command Window

```
T =

  s^4 + 2 s^3 + 12 s^2 + 7 s + 6
  ------------------------------
   s^5 + 9 s^4 + 13 s^3 + 8 s^2

Continuous-time transfer function.


A =

    -9   -13    -8     0     0
     1     0     0     0     0
     0     1     0     0     0
     0     0     1     0     0
     0     0     0     1     0


B =

     1
     0
     0
     0
     0


C =

     1     2    12     7     6


D =

     0
```

Comment

Up next for you in Electrical Engineering

will yield zero steady-state

Prelab

1. What system types will yield zero steady-state error for step inputs?
2. What system types will yield zero steady-state error for ramp inputs?
3. What system types will yield infinite steady-state error for ramp inputs?
4. What system types will yield zero steady-state error for parabolic inputs
5. What system types will yield infinite steady-state error for parabolic inpu

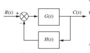


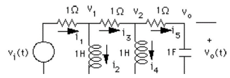
FIGURE P7.33

6. For the negative feedback system of Figure P7.33, where $G(s) = \frac{K(}{(s+4)(s+7}$ and $H(s) = 1$, calculate the steady-state error in terms of K for the follo $5u(t)$, $5tu(t)$, and $5t^2u(t)$.
7. Repeat Prelab 6 for $G(s) = \frac{K(s+6)(s+8)}{s(s+4)(s+7)(s+9)(s+12)}$ and $H(s) = 1$.
8. Repeat Prelab 6 for $G(s) = \frac{K(s+1)(s+6)(s+8)}{s^2(s+4)(s+7)(s+9)(s+12)}$ and $H(s) = 1$.

See answer

P3.1
in state space, where vo(t)

Problem 3:
Represent the electrical network shown in Figure P3.1 in state space, where $v_o(t)$ is the output. [Section: 3.4]



See answer

See more questions for subjects you study

Questions viewed by other students

Q: Figure 1 2. For each system shown in Figure 2, write the state equations and the output equation for the phase-variable representation R(s) C(s) 8s 10 45s3 +s +5s +1:3

A: See answer 100% (1 rating)

Q: For the system shown in Figure P2, write the state equations and the output equation for the phase-variable representation. 2. (s 24) 69+ 10

A: See answer

Show more