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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.

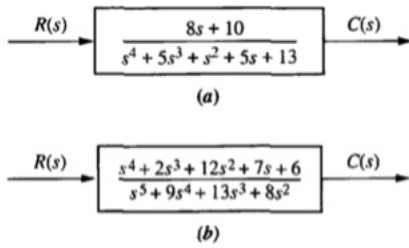


Figure 2.

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Expert Answer



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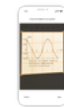
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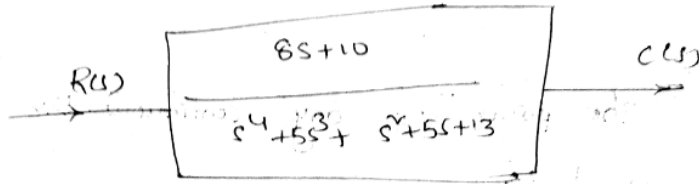
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(a) Given phase variable representation of a transfer function



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.

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

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

$$C = [0 \ 0 \ 8 \ 10]$$

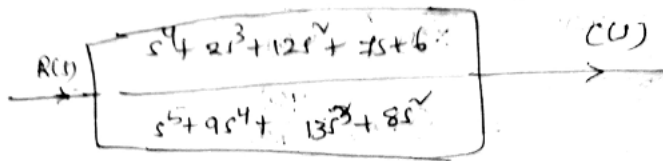
$$D = [0]$$



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

$$\dot{y} = Cx + Du$$

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



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

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

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

$$C = [1 \ 2 \ 12 \ 7 \ 6]$$

$$D = [0]$$



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

$$Y = CX + DU$$

$$Y = [1 \ 2 \ 12 \ 7 \ 6] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix} + [0] u$$

```

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)
    
```

```

1 -

      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

fx
    
```

Comment >

Up next for you in Electrical Engineering

will yield zero steady-state

state

FIGURE P7.23

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 inputs?

6. For the negative feedback system of Figure P7.23, where $G(s) = \frac{K}{s(s+1)}$ and $H(s) = 1$, calculate the steady-state error in terms of K for the following inputs: (a) a step of magnitude 1, (b) a ramp of slope 1, and (c) a parabolic input of magnitude 1.

7. Repeat Prelab 6 for $G(s) = \frac{K(s+2)}{s(s+1)(s+3)}$ and $H(s) = 1$.

8. Repeat Prelab 6 for $G(s) = \frac{K(s+2)(s+4)}{s(s+1)(s+3)(s+5)}$ and $H(s) = 1$.

[See answer](#)

P3.1

in state space, where $v_o(t)$

is the output.

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](#)

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Q: Figure 1.2. For each system shown in Figure 2, write the state equations and the output equation for the phase-variable representation $R(s) C(s) 8s 10 45s^3 + s + 5s + 1:3$

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](#)

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