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## **EE/EX-7005(4)-CBGS**

### **B.E. VII Semester**

Examination, December 2020

## **Choice Based Grading System (CBGS)**

### **Advanced Control System**

*Time : Three Hours*

*Maximum Marks : 70*

- Note:** i) Attempt any five questions.  
ii) All questions carry equal marks.

1. a) Obtain the transfer function for the system described by the state model

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -1 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 1 & 2 \\ 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

- b) Solve the difference equation by means of Z-transform  
 $x(n+2) - x(n)=0$ ;  $x(0)=1$ ,  $x(1)=0$
2. Determine the state space technique and what is the development of feedback control laws through state space technique?
3. Describe variable structure control and its applications in detail.

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4. a) Determine whether the following system is controllable and observable or not?

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ -2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

- b) Explain the effect of adding a pole to a second-order system. When is it useful to add a zero to the system?
5. The dynamics of control system is represented by  
 $\dot{x}_1 = x_2 - x_1(x_1^2 + x_2^2); \dot{x}_2 = -x_1 - x_2(x_1^2 + x_2^2)$   
Determine the system stability using Lyapunov method.

6. Obtain the time-response of the following system:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 3 \\ -2 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u(t)$$

7. Explain the following :
- a) Pontryagin's maximum principle
  - b) Transversality condition
8. Write a short notes on
- a) Euler-Lagrange equations.
  - b) Phase plane technique.
  - c) Effect of load disturbance upon control action.

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