Total No. of Questions : 8] *[Total No. of Printed Pages : 2*

Roll No .....

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

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

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

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.

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

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

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

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

$$x_1 = x_2 - x_1\left(x_1^2 + x_2^2\right); \; x_2 = -x_1 - x_2\left(x_1^2 + x_2^2\right)$$

Determine the system stability using Lyapunov method.

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

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

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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