C 1133 (Pages : 2) Name.....

Reg. No.....

SIXTH SEMESTER B.TECH. (ENGINEERING) [09 SCHEME] DEGREE EXAMINATION, APRIL 2016

AI 09 604 – ADVANCED CONTROL THEORY

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *questions.*

1. Draw the structure of a full order observer.
2. Distinguish between observable and unobservable systems.
3. List out the properties of a state transition matrix.
4. Write down the transfer function of a PID controller.
5. Define System sensitivity.

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

6. Explain the effects of Pole-Zero cancellation.
7. Consider the system :

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} (-1)^k$$

$x_1(0) = 1$, $x_2(0) = 1$ and $y(k) = x_1(k)$.

Find $y(k)$ for $k \geq 1$.

8. Obtain the state model in Jordar canonical form for the transfer function :

$$G(z) = \frac{4z^3 - 12z^2 + 13z - 7}{(z-1)^2 (z-2)}.$$

9. Mention the effects of PD control action.
10. Determine whether the following quadratic form is negative definite :

$$V(x) = -x_1^2 - 3x_2^2 - 11x_3^2 + 2x_1x_2 - 4x_2x_3 - 2x_1x_3.$$

11. Draw the graphical representation of stable, asymptotically stable and unstable systems in sense of Lyapnov.

(4 × 5 = 20 marks)

Turn over

Part C

Answer **all** *questions.*

All questions carry equal marks.

MODULE I

12. (a) Consider the system :

$$\dot{x} = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

and $y = [2 \; -1] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$.

Design a reduced order state observer so that estimation error will decay atleast as fast as e^{-10t}.

Or

(b) design a state feedback controller for system $\dot{x} = \begin{bmatrix} 1 & -1 \\ 1 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 2 \end{bmatrix} u$ to place the poles at $-1, -2$.

MODULE II

13. (a) Obtain the transfer function for the following system :

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} 2 & -5 \\ 0.5 & -1 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(k) \text{ and } y(k) = 2x_1(k).$$

Or

(b) Consider the characteristic equation $z^3 + 2.1z^2 + 1.44z + 0.32 = 0$. Determine whether or not any of the roots of the characteristic equation lie outside unit circle centered at origin of z-plane.

MODULE III

14. (a) Explain in detail about Ziegler Nichols tuning rules.

Or

(b) Discuss in detail about the effects of composite PID control modes on response of a controlled process.

MODULE IV

15. (a) Consider the system described by $\dot{x}_1 = x_2$ and $\dot{x}_2 = x_1 x_2$. Determine the stability of the system by Lyapunov method.

Or

(b) Explain the design procedure for Robust PID control systems.

(4 × 10 = 40 marks)