D 70299 (Pages : 3)

Name.....

Reg. No.....

FIFTH SEMESTER B.TECH. (ENGINEERING) (09 SCHEME) DEGREE EXAMINATION, NOVEMBER 2014

AI 09 503—CONTROL ENGINEERING

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *the questions.*
Each question carries 2 *marks.*

1. When a system is said to be linear ?
2. Define rise time.
3. What are the advantages of Bode plot ?
4. Write the State equations for linear systems.
5. When a system is said to be completely controllable ?

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

6. Describe about the effect of feedback on overall gain and stability.
7. Find the Steady state error for unit step, unit ramp and unit acceleration input for

$$\frac{10}{s(0.1s+1)(0.5s+1)}.$$

8. Explain briefly the Nyquist Stability Criterion.
9. Find the Gain Margin and Phase Margin for the system with transfer Function

$$G(S) = \frac{k}{s(1+sT_1)(1+sT_2)}.$$

10. Obtain the State Space representation of system whose differential equation is given by :

$\dddot{y} + 2\ddot{y} + 3\dot{y} + 6y = \ddot{u} - \dot{u} + 2u$. Also draw the signal flow graph for the system.

11. Give the standard state equation and draw the state diagram for MIMO system.

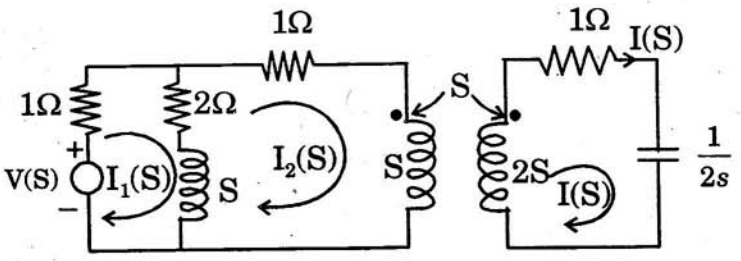
(4 × 5 = 20 marks)

Turn over

Part C

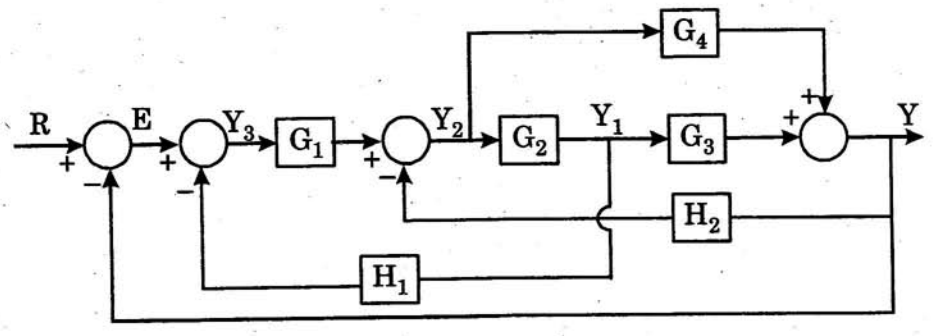
Answer the following.

12. (a) Obtain the Transfer Function I(S) / V(S) for the network shown :



Or

(b) Convert the Block Diagram to Signal Flow Graph and Obtain the transfer function using Mason's Gain Formula



13. (a) Derive the response of a second order system for underdamped case when the input is unit step.

Or

(b) Sketch the root locus of unity feedback with $G(S) = \frac{k(s+2)}{s(s+1)(s+4)}$.

14. (a) Obtain the Magnitude and Phase angle from Bode plot for the system

$$G(S) = \frac{20\,(0.1\,s+1)}{s^2\,(0.2\,s+1)\,(0.02s+1)}.$$

Or

(b) An Unity Feedback system has an Open loop transfer function $G(S) = \frac{20}{s\,(s+2)\,(s+5)}$. Using Nichols chart, determine the closed loop frequency response and estimate M_r, w_r and w_b.

15. (a) Reduce the given state model into its canonical form by diagnolizing matrix A

$$\dot{X}(t) = \begin{bmatrix} 0 & 1 & -1 \\ -6 & -11 & -6 \\ -6 & -11 & 5 \end{bmatrix} X(t) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$

$$y(t) = [1 \quad 0 \quad 0]\,X(t).$$

Or

(b) For the following system, determine the controllability using :

(i) Kalman's test. (ii) Gilbert's test

$$\dot{X} = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 3 & 1 \end{bmatrix} X + \begin{bmatrix} 0 & 1 \\ 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}.$$

(4 × 10 = 40 marks)