D 90156 (Pages : 3) Name.....

Reg. No.....

FIFTH SEMESTER B.TECH. (ENGINEERING) [09 SCHEME] DEGREE EXAMINATION, NOVEMBER 2015

AI 09 503—CONTROL ENGINEERING

Time : Three Hours **Maximum : 70 Marks**

Part A

Answer **all** *questions.*

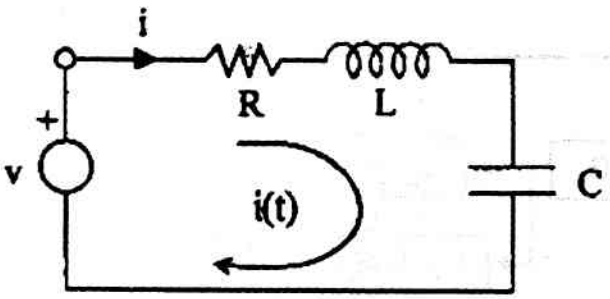
1. Distinguish between closed loop and open loop control.
2. Define Step signal. Write the mathematical relation.
3. List out the advantages of frequency response analysis.
4. What is minimum phase system?
5. When a system is said to be state observable?

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

6. Consider the network shown. Obtain the Transfer Function between the applied voltage and current.



7. List the rules in the Block Diagram Reduction Technique.
8. Derive the response for first order system for unit step input.
9. Obtain the response of unity feedback system whose open loop transfer function is $G(s) = \frac{4}{s\,(s+5)}$ when the input is unit step.
10. Distinguish between Time domain and frequency domain analysis.

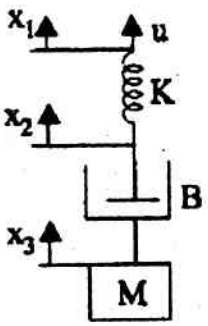
Turn over

11. Obtain state transition matrix $\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X$, $X_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$.

(4 × 5 = 20 marks)

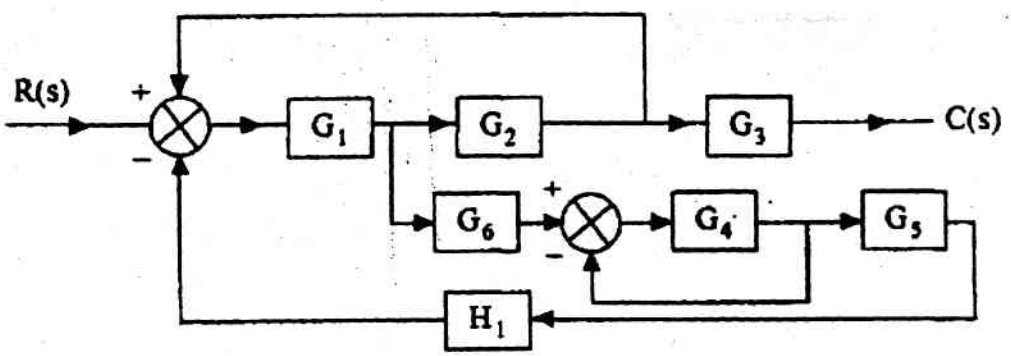
Part C

12. (a) Obtain the Force-Voltage and Force-Current analogous circuits for the mechanical system shown. Also write down the equilibrium equations.



Or

(b) Reduce the Block Diagram and obtain the Transfer Function.



13. (a) The open loop transfer function of unity feedback system is given by $G(s) = \frac{K}{s(sT + 1)}$ where K and T are positive constant. By what factor should the amplifier gain K be reduced so that the peak overshoot of unity step response of the system is reduced from 75 % to 25 %.

Or

(b) (i) Explain in detail about Routh Hurwitz Stability criterion.

(ii) Construct Routh array and determine the stability of the system represented by the characteristic equation $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$. Comment on the location of roots of characteristic equation.

14. (a) The open loop transfer function of a unity feedback system is given by $G(s) = \frac{1}{s\,(s + 1)\,(2s + 1)}$. Sketch the polar plot and determine the Gain Margin and Phase Margin.

Or

(b) What is Nichols chart ? How to do Gain Adjustment using Nichols chart ?

15. (a) Obtain the Transfer Function matrix for the following system having state model.

$$\dot{X} = \begin{bmatrix} 2 & -1 & 0 \\ 1 & 1 & 2 \\ -1 & 0 & 1 \end{bmatrix} X + \begin{bmatrix} -1 & 0 \\ 1 & 0 \\ 0 & 2 \end{bmatrix} U$$

$$Y = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} X .$$

Or

(b) A Feedback system is characterized by the closed loop transfer function $T(s) = \frac{s^2 + 3s + 3}{s^3 + 2s^2 + 3s + 1}$. Draw a suitable Signal Flow Graph and obtain the state model.

(4 × 10 = 40 marks)