Code: 13A02402

R13

B.Tech II Year II Semester (R13) Regular Examinations May/June 2015

CONTROL SYSTEMS ENGINEERING

(Electrical and Electronics Engineering)

Time: 3 hours | Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) What is the feedback? What are the characteristics of negative feedback?

(b) Define transfer function. Write the Mason's gain formula to find transfer function and explain each term in it.

(c) The open loop transfer function of a unity feedback system is $G(s) = 20/(s(s+10))$. What is the nature of response of closed loop system for unit step input?

(d) Give the relation between generalized and static error coefficients.

(e) What are asymptotes? How will you find the angle of asymptotes?

(f) In Routh array what conclusions you can make when there is a row of all zeros.

(g) Draw the polar plot of $G(s) = 1/(1+ST)$.

(h) Mention the advantages of Bode plot.

(i) What is meant by state, state variable and state model?

(j) Define state transition matrix and explain its significance on stability of the system.

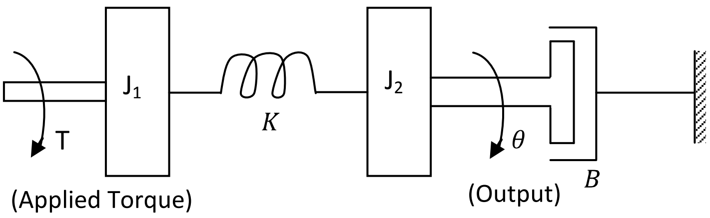
PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) What are the various types of control systems? Give an example of each. What are the advantages and disadvantages of open loop and closed loop systems?

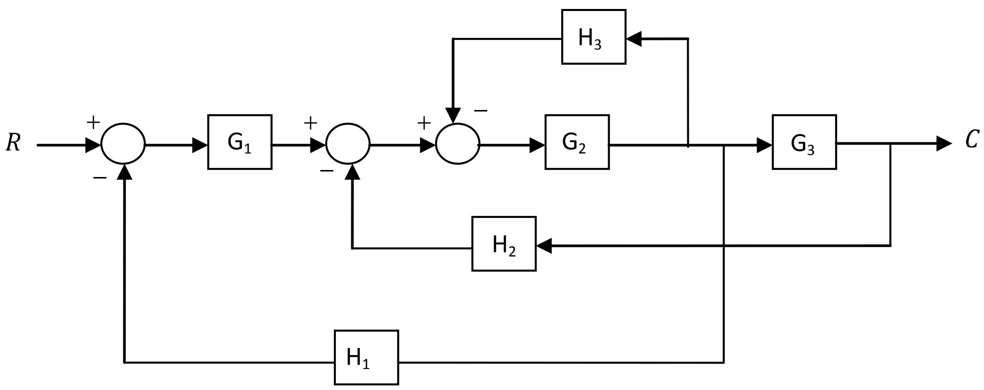
(b) Find the transfer function $\frac{\theta(s)}{T(s)}$ for the figure given below.



OR

3 (a) Derive the transfer function of AC servomotor.

(b) Using block diagram reduction technique, obtain closed loop transfer function of the figure give below.



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UNIT – II

4 (a) Obtain the time response of un-damped second order system for unit step input.

(b) A unity feedback system has the forward transfer function: $G(s) = \frac{K_1(2S+1)}{S(5S+1)(1+S)^2}$. The input $r(t) = 1 + 6t$ is applied to the system. Determine the value of K_1 if the steady error is to be less than 0.1.

OR

5 (a) A unity feedback control system has an open loop transfer function: $G(s) = \frac{10}{S(S+2)}$. Find the time domain specifications for a step input of 12 units.

(b) Explain the effect of PI and PD controllers on transient response of the system.

UNIT – III

6 (a) The open loop transfer function of a unity feedback system is given by $G(s) = \frac{K_1(s+1)}{S^3+aS^2+2S+1}$. Determine the value of K and so that the system oscillates at a frequency of 2 rad/sec.

(b) Explain the effect of adding poles and zeros to characteristic equation on stability of the root loci.

OR

7 Sketch the root locus of the system whose open loop transfer function is $G(S) = \frac{K}{S(S+2)(4+S)}$. Find th value of K so that the damping ratio of the closed loop system is 0.5.

UNIT – IV

8 (a) Explain the frequency response specifications.

(b) The transfer function of a phase-lead controller is given as $G(s) = \frac{1+aST}{1+TS}, a > 1$ and T is constant depending on the circuit parameters. Determine the maximum value of the phase load which can be obtained from this controller.

OR

9 Sketch the bode plot and find gain margin & phase margin of the systems represented by:

$$G(s)H(s) = \frac{75(0.2S+1)}{S(S^2+16S+100)}.$$

UNIT – V

10 (a) Discuss about the properties of state transition matrix.

(b) The state equation of a linear-time invariant system is given:

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} 0 & 5 \\ -1 & -2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u \text{ and } Y = [1 \quad 1]X$$

Determine state transition matrix.

OR

11 (a) Determine the transfer function for following system given below:

$$[\dot{X}] = \begin{bmatrix} 0 & 3 \\ -2 & -5 \end{bmatrix} [X] + \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} [U] \text{ and } Y = \begin{bmatrix} 2 & 1 \\ 1 & 0 \end{bmatrix} X$$

(b) A state model of a system is given as:

$$[\dot{X}] = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -3 & -3 \end{bmatrix} [X] + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} U \text{ and } Y = [1 \quad 0 \quad 0]X$$

Determine: (i) The Eigen values. (ii) The state transition matrix.

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