Hall Ticket No | | | | | | | | | | | Question Paper Code: AEE009

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech IV Semester End Examinations(Regular) - May, 2018

Regulation: IARE – R16

CONTROL SYSTEMS

Time: 3 Hours **(Common to ECE | EEE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Classify different types of control systems with examples? **[7M]**

   (b) Derive the transfer function of the network given in Figure 1. **[7M]**

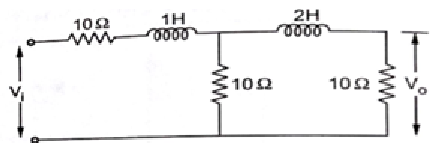

Figure 1

2. (a) What are the basic elements of translational and rotational mechanical systems and also write the required mathematical equations. **[7M]**

   (b) For the rotational mechanical system given in Figure 2, write the equilibrium equations and draw an equivalent diagram based on torque-current analogy. **[7M]**

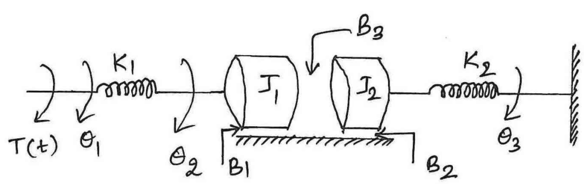

Figure 2

UNIT – II

3. (a) Reduce the block diagram given in Figure 3 by block diagram reduction technique and determine the transfer function. **[7M]**

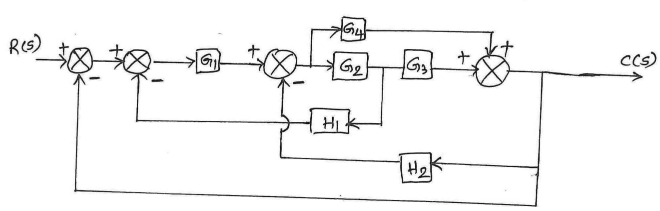

Figure 3

(b) Find C(s)/R(s) of the signal flow graph given in Figure 4 by Manson's gain formula. **[7M]**

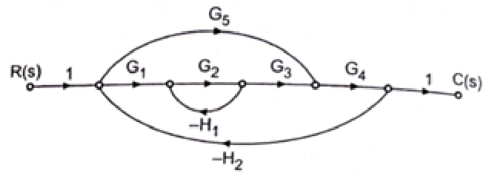

Figure 4

4. (a) Derive the unit step response of the second order system for underdamped case? **[7M]**

   (b) Find K_p, K_v, K_a and steady state error for a system with open loop function as $G(s)\ H(s) = \frac{10(S+2)(S+3)}{S(S+1)(S+5)}$; where input is $3 + t + t^2$. **[7M]**

UNIT – III

5. (a) What is BIBO system? Explain with example. **[7M]**

   (b) The open loop transfer function of the feedback system is $G(s)\ H(s) = \frac{K(S+5)}{S(1+TS)(1+2S)}$; Parameters K and T represents on a plane with K on x axis and T on y axis. Determine region in which a closed loop system is stable. **[7M]**

6. (a) Determine the stability of following cases, which represent characteristic equations of two different control system.

      i. $S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0$
      ii. $S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0$

   [7M]

   (b) A positional servomechanism is characterized by an open loop transfer function G(s)H(s) = K(S+2) / S(S-1).

      i. The value of the gain K when ζ of the closed loop system is equal to 0.707.
      ii. The value of the gain K when the closed loop system has two roots on the jw-axis.

   [7M]

UNIT – IV

7. (a) Explain what are the advantages and limitations of frequency domain approach? **[7M]**

   (b) The open loop transfer function of the feedback system is given by $G(s)\,H(s) = \frac{K(1+S)}{(1-S)}$; Comment on stability by using Nyquist plot? **[7M]**

8. (a) Differentiate between time domain and frequency domain. **[7M]**

   (b) Sketch the nature of Nyquist plot for the system with G(s)H(s) = 1 / S(1+2S)(1+S). Determine gain margin and phase margin. **[7M]**

UNIT – V

9. (a) A linear dynamic time invariant system is represented by A X(t)+BU(t); Where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \ and\ B = \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 1 & 0 \end{bmatrix}$$ find the system is completely controllable. **[7M]**

(b) With a neat block diagram and equation, explain **[7M]**

i. Lead compensator

ii. Lag compensator

10. (a) Consider the transfer function $\frac{Y(s)}{U(s)} = \frac{2S^2+2S+5}{S^3+6S^2+11S+4}$; Obtain the state equation by direct decomposition method. **[7M]**

(b) The vector matrix differential equation describes the dynamics of the system as

$$\overset{\bullet}{X} = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U \ and\ y = [5\ 0]\ X.$$ Determines the state transition matrix and transfer function of the system. **[7M]**

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