CBCS Scheme

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15EE61

Sixth Semester B.E. Degree Examination, June/July 2018

Control System

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing one full question from each module.*

Module-1

1 a. With the help of neat block diagram, define open loop and closed loop control system. Mention any four difference between open loop and closed loop control system. **(08 Marks)**

b. Construct mathematical model for the mechanical system shown in Fig. Q1 (b). Draw electrical equivalent network based on force voltage analogy. **(08 Marks)**

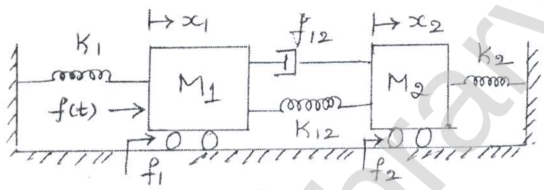

Fig. Q1 (b)

OR

2 a. Draw an equivalent mechanical network using force voltage analogy as shown in Fig. Q2 (a). **(08 Marks)**

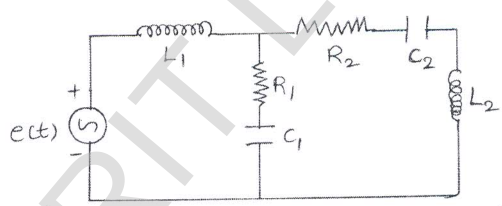

Fig. Q2 (a)

b. For the mechanical translation system as shown in Fig.Q2 (b). Draw the electrical network based on torque current analogy. Write its performance equations. **(08 Marks)**

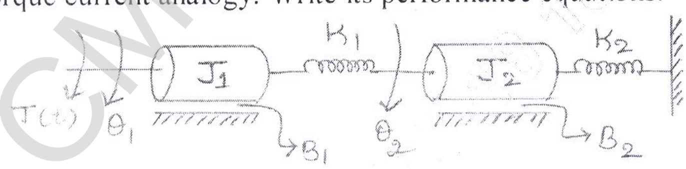

Fig. Q2 (b)

Module-2

3 a. Illustrate how to perform the following connection with block diagram reduction technique, (i) Shifting summing point after a block (ii) Shifting take off point ahead of a block. **(04 Marks)**

b. Draw a signal flow graph and find its transfer function as shown in Fig. Q3 (b). **(06 Marks)**

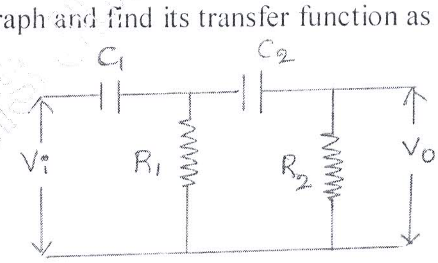

Fig. Q3 (b)

c. Determine the transfer function, $\frac{C(s)}{R(s)}$ of a system shown in Fig. Q3 (c). **(06 Marks)**

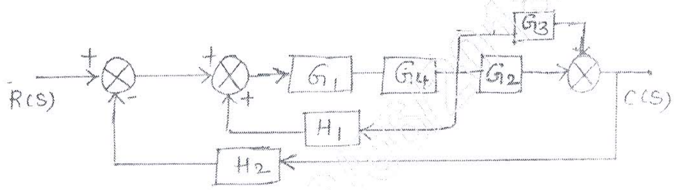

Fig. Q3 (c)

OR

4 a. Obtain $\frac{C(s)}{R(s)}$ using block diagram reduction rule. **(08 Marks)**

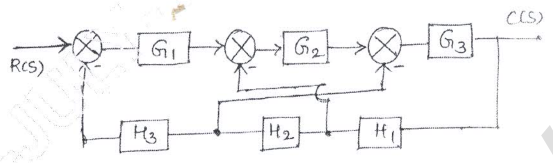

Fig. Q4 (a)

b. Find the transfer function $\frac{x_5}{x_1}$ to the signal flow graph shown in Fig. Q4 (b). Apply the Mason's gain formula. **(08 Marks)**

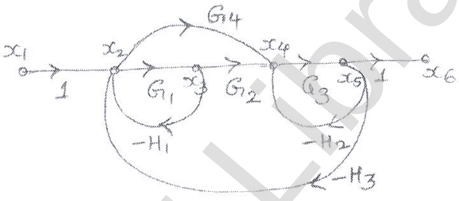

Fig. Q4 (b)

Module-3

5 a. What are necessary and sufficient condition for a system to be stable according to RH criteria. **(04 Marks)**

b. Determine the stability of the system represent by following characteristic equation, $s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$. **(04 Marks)**

c. The system shown in Fig. Q5 (c) when subjected to a unit step input gives an output response shown in Fig. Q5 (c). Determine the value of K and T from response curve. **(08 Marks)**

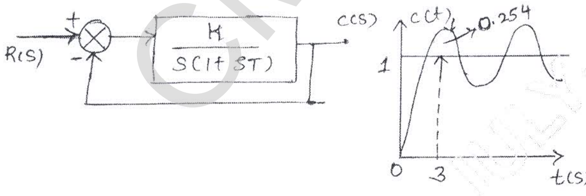

Fig. Q5 (c)

OR

6 a. A system oscillate with frequency "ω" if it has a pole at $s = \pm j\omega$ and no pole in right half of s plane. Determine the value of K and 'a' so that the system shown in Fig. Q6 (a). Oscillate at a frequency of 2 rad/sec. **(08 Marks)**

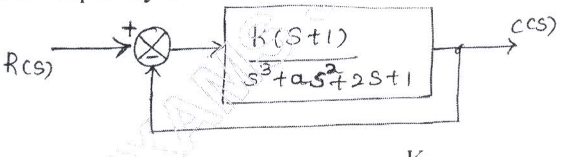

Fig. Q6 (a)

b. For the system $G(s)H(s) = \frac{K}{s^2(s+2)(s+3)}$ find the value of K to limit steady state error to 10 unit when input to the system is $1 + 10t + \frac{40t^2}{2}$. **(08 Marks)**

Module-4

7 a. For a single loop unity feedback system whose open loop transfer function is $G(s) = \frac{K(s+3)}{s(s+2)}$ show that complex part of root locus is a circle and identify center and radius. **(06 Marks)**

b. Draw the bode plot for the system having $G(s) = \frac{10}{s(1+0.01s)(1+0.1s)}$, $H(s) = 1$.

Determine :
(i) Gain crossover frequency and phase margin.
(ii) Phase cross over frequency and gain margin. **(10 Marks)**

OR

8 a. Sketch complete root locus of system having $G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$. **(10 Marks)**

b. Find the open loop transfer function of a system whose approximate plot is as shown in Fig. Q8 (b). **(06 Marks)**

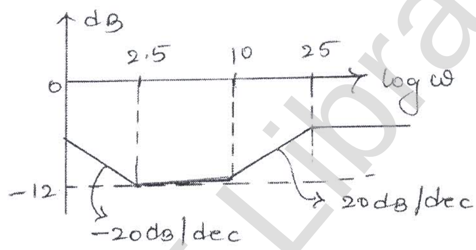

Fig. Q8 (b)

Module-5

9 a. Explain the step by step design procedure of lead compensation network. **(08 Marks)**

b. Sketch the Nyquist plot by unity feedback system whose open loop transfer function, $G(s) = \frac{5}{s(1-s)}$. Determine stability of a system using Nyquist stability criteria. **(08 Marks)**

OR

10 a. Explain Nyquist stability criteria. **(04 Marks)**

b. What is controller? Explain the effect of PI and PD controller on second order system. **(06 Marks)**

c. Explain the principle of Argument in Nyquist stability criteria. **(06 Marks)**

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