CBCS SCHEME

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15EE61

Sixth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Control Systems

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. What is control system? Compare open loop with closed loop control systems. **(04 Marks)**

b. For the mechanical system shown in Fig.Q.1(b). Draw the mechanical network and obtain the f-v analogous electrical systems.

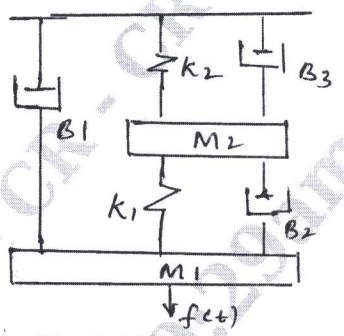

Fig.Q.1(b) **(07 Marks)**

c. Explain the A.C. servo motor. **(05 Marks)**

OR

2 a. Obtain the transfer function of electrical system shown in Fig.Q.2(a). **(05 Marks)**

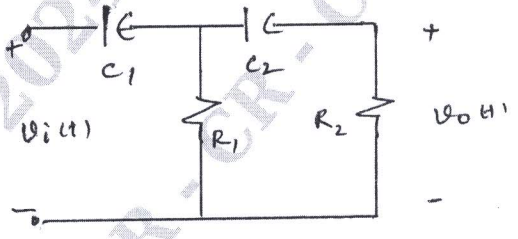

Fig.Q.2(a)

b. Explain the synchros as on error detector. **(04 Marks)**

c. For the mechanical network shown in Fig.Q.2(c), draw the F-i analogous electrical system. **(07 Marks)**

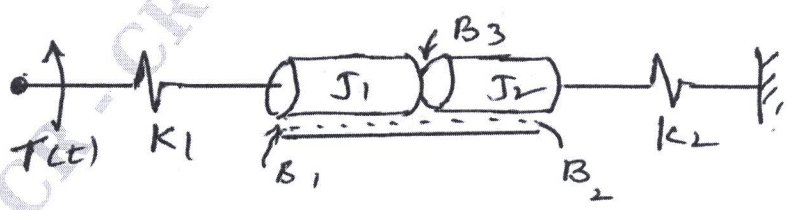

Fig.Q.2(c)

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).

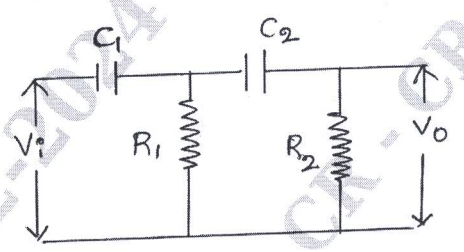

Fig.Q3(b) **(06 Marks)**

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

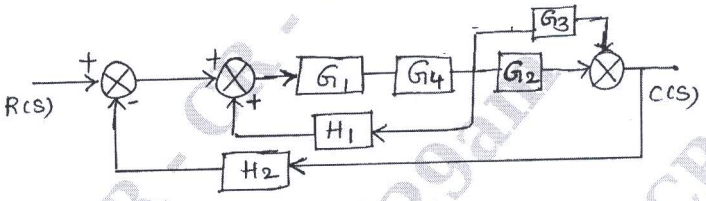

Fig.Q3(c) **(06 Marks)**

OR

4 a. Obtain $\frac{C(s)}{R(s)}$ using block diagram reduction rule. Refer Fig.Q4(a). **(08 Marks)**

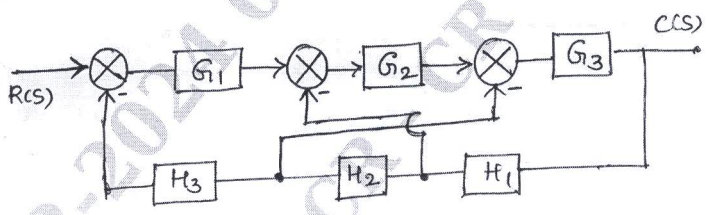

Fig.Q4(a)

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.

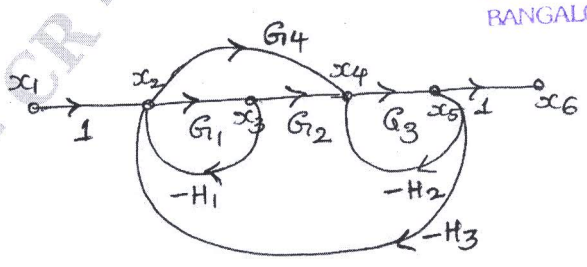

Fig.Q4(b) **(08 Marks)**

Module-3

5 a. Derive an expression for response of second order under damped system for unit step input. **(06 Marks)**

b. An unity FBCS has $G(S) = \frac{20(s+1)}{s(s^3 6s^2 + 8s)}$ calculate steady state error when the input $r(t) = 40 + 2t + 5t^2$. **(05 Marks)**

c. Check the stability of the give characteristic equation using R-H criterion $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. **(05 Marks)**

OR

6 a. State R-H Criterion. Explain the difficulties of R-H criterion and remedy. **(06 Marks)**

b. A unity FBCS has $G(S) = \frac{K(s+13)}{s(s+5)(s+7)}$. Using R-H criterion, calculate the range of 'K' for which the system is stable. **(05 Marks)**

c. A second order system is given by $\frac{C(s)}{R(s)} = \frac{25}{s^2 + 6s + 25}$. Find Rise time, peak time, peak overshoot and settling time for 2% tolerance. **(05 Marks)**

Module-4

7 a. Sketch the root locus for unity FBCS having $G(s) = \frac{K(s+1)}{S(s+2)(s^2 + 2s + 2)}$. Mark the salient points. **(12 Marks)**

b. Derive an expression for resonant peak M_r and resonant frequency W_r for a standard second order system. **(04 Marks)**

OR

8 a. A unity FBCS with $G(s) = \frac{10(s+10)}{s(s+2)(s+5)}$. Find gain and phase Margin using bode plot. **(12 Marks)**

b. Write note on:
i) Break away point
ii) Asymptotes. **(04 Marks)**

Module-5

9 a. The open loop transfer function of a control system is :

$$G(s)H(s) = \frac{1}{s^2(s+2)}$$

Sketch the Nyquist plot. Ascertain the stability. **(10 Marks)**

b. Explain giving equations, the function of integral control. **(06 Marks)**

OR

10 a. Explain PID controller and discuss the effect on the behavior of the system. **(10 Marks)**

b. Discuss the advantages of Nyquist plot. **(06 Marks)**

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