CBCS SCHEME

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18EC43

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

Time: 3 hrs. Max. Marks: 100

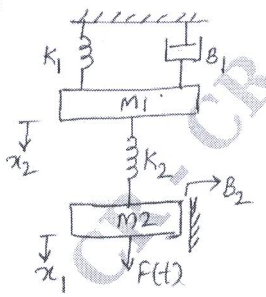
Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Differentiate between Open loop and Closed loop control systems. **(06 Marks)**

b. For a mechanical system shown in Fig. Q1(b), obtain analogous electrical network by F – V analogy. **(14 Marks)**

Fig. Q1(b)

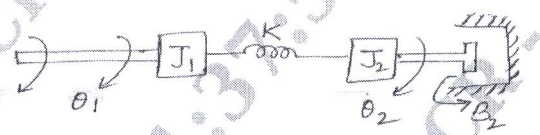


OR

2 a. Explain the terms : i) Physical system ii) Physical model iii) Mathematical model iv) Transfer function. **(08 Marks)**

b. For a mechanical system shown in Fig. Q2(b), obtain analogous electrical network by T – V analogy. **(12 Marks)**

Fig. Q2(b)

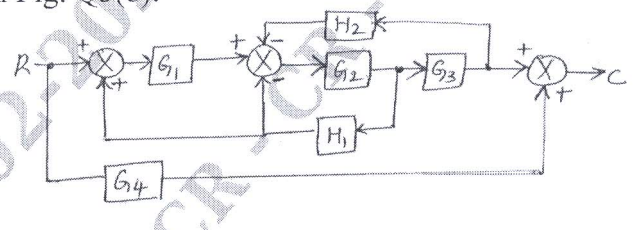


Module-2

3 a. Explain with block diagram, Reduction rules. **(08 Marks)**

b. Using the block diagram, reduction techniques, find the Closed – loop transfer function of the system shown in Fig. Q3(b). **(12 Marks)**

Fig. Q3(b)

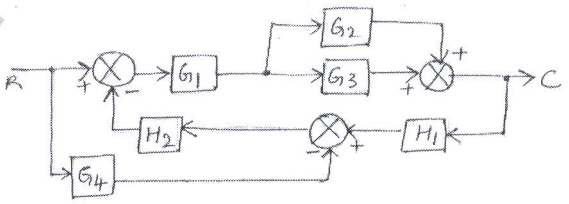


OR

4 a. Write Mason's gain formula for signal flow graph and indicate the each term. **(05 Marks)**

b. Draw the signal flow graph for the system shown in Fig. Q4(b) and find $\frac{C(s)}{R(s)}$. **(15 Marks)**

Fig. Q4(b)



Module-3

5 a. Derive the time response of a critically damped second order system subjected to unit step input. **(10 Marks)**

b. For a unity feedback control system with $G(s) = \frac{64}{S(s+9.6)}$, write the output response to a unit step input. Determine i) the response at $t = 0.1S$.
ii) Maximum value of the response and the time at which it occurs.
iii) Settling time at 2% tolerance. **(10 Marks)**

OR

6 a. Obtain the steady state errors of Type – 0 , Type – 1 and Type – 2 systems for unit step input and unit ramp input. **(12 Marks)**

b. Derive expressions for rise time and peak time of a under damped second order system. **(08 Marks)**

Module-4

7 a. Examine the stability of a system with characteristic equation $S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0$. **(06 Marks)**

b. Consider a feedback system with characteristic equation $1 + \frac{K}{S(s+1)(s+2)} = 0$. Draw the root locus and show clearly i) Breakaway points ii) The frequency at which root locus crosses imaginary axis and corresponding vale of K. **(14 Marks)**

OR

8 a. For the Bode plot shown in Fig. Q8(a), find the transfer function : **(10 Marks)**

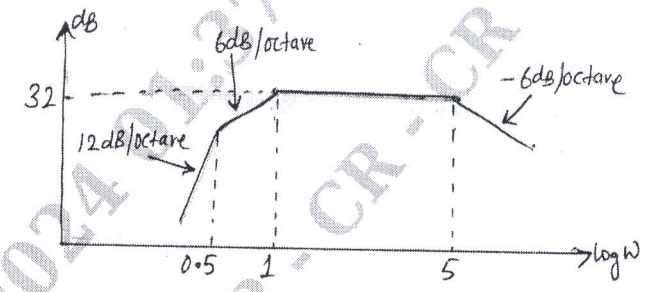


Fig. Q8(a)

b. Consider a Closed loop feedback system shown in Fig. Q8(b). Determine the range of K for which the system is stable using Routh criteria. Find the value of K that will cause sustained oscillation in the system. Also find frequency of sustained oscillation. **(10 Marks)**

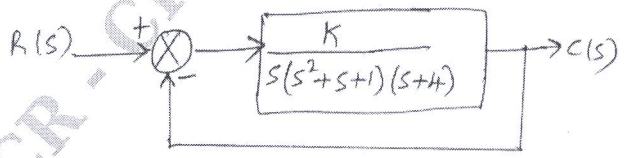


Fig. Q8(b)

Module-5

9 a. Draw the Polar plot for a system with Open loop transfer function $G(s)\,H(s) = \frac{1}{1+Ts}$, where T is constant. **(06 Marks)**

b. A unity feedback system has $G(s) = \frac{10}{S(s+1)(s+2)}$. Draw the Nyquist plot and comment on Closed – loop stability. **(14 Marks)**

OR

10 a. Define State and State Variable. Explain the State model of linear systems. **(08 Marks)**

b. For a mechanical system shown in Fig.Q10(b), obtain the state model by choosing displacement x(t) and velocity v(t) as state variable. **(12 Marks)**

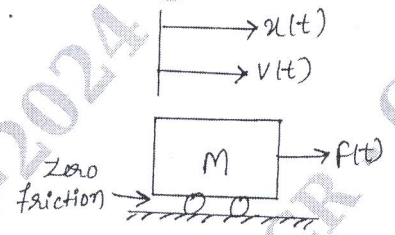


Fig. Q10(b)

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