CBCS SCHEME

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21EE52

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
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. Explain briefly the classification of control systems. **(08 Marks)**

b. Draw the force voltage analogous circuit for the mechanical system shown in Fig Q1(b).

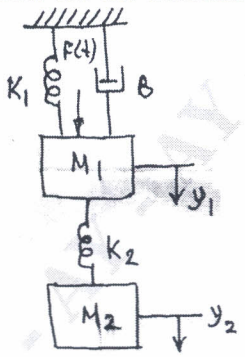

Fig Q1(b) **(08 Marks)**

c. What is a synchro pair? What for it is used? **(04 Marks)**

OR

2 a. Derive the transfer function of armature controlled dc servomotor. **(08 Marks)**

b. For the electrical network shown in Fig Q2(b), find the transfer function $V_2(s)/V_1(s)$.

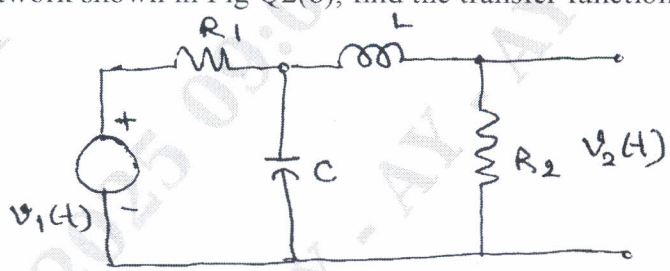

Fig Q2(b) **(08 Marks)**

c. What are gear trains? What for gear trains are used in control systems? **(04 Marks)**

Module-2

3 a. For the system shown in Fig Q3(a), find C(s)/R(s) using block diagram reduction technique.

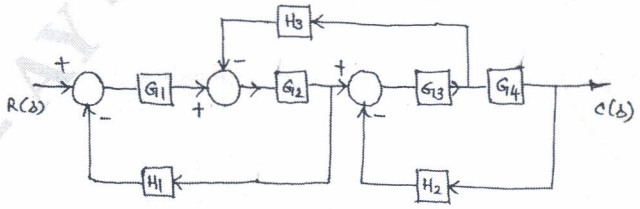

Fig Q3(a) **(10 Marks)**

b. Draw the block diagram for the network shown in Fig Q3(b).

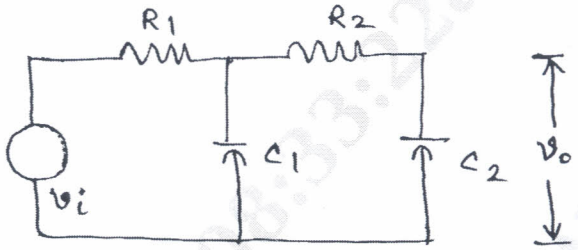

Fig Q3(b) **(10 Marks)**

OR

4 a. Find C(s)/R(s) for the system whose signal flow graph is shown in Fig Q4(a).

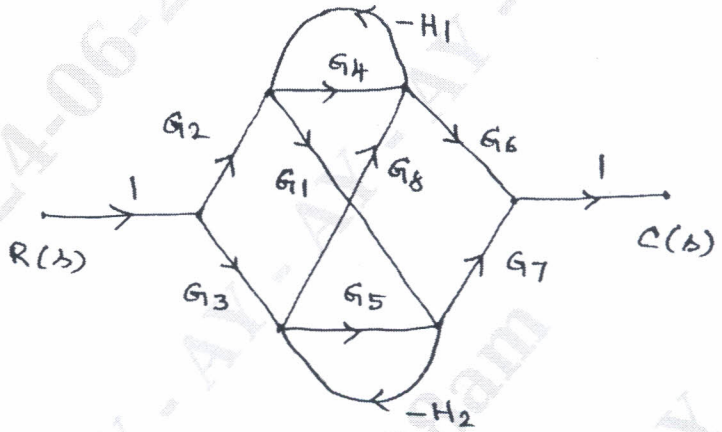

Fig Q4(a) **(10 Marks)**

b. Draw the signal flow graph for the system shown in Fig Q4(b) and hence find the overall gain using Mason's gain formula.

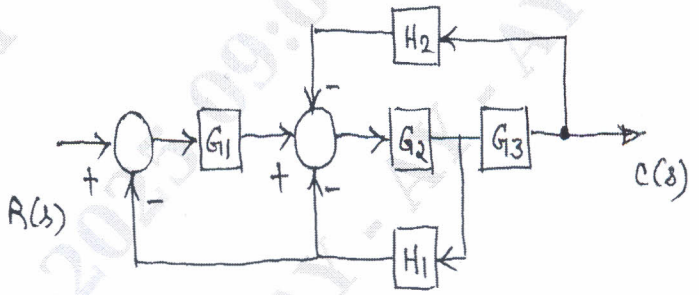

Fig Q4(b) **(06 Marks)**

c. Define the following terms as referred to signal flow graphs.
i) Forward path ii) Non – touching loops iii) Output node iv) Loop gain. **(04 Marks)**

Module-3

5 a. Define the following terms as referred to unit step response of a typical under damped second order system.
i) Rise time ii) Settling time iii) Steady state error iv) Peak time. **(04 Marks)**

b. Derive an expression for i) Peak time ii) Peak over shoot for a typical second order underdamped system. **(08 Marks)**

c. The open-loop transfer function of a unity feedback system is $G(s) = \frac{4}{s(s+1)}$. Determine:
i) Damping ratio ii) Rise time iii) Peak time iv) Peak overshoot v) Settling time. **(08 Marks)**

OR

6 a. What are the difficulties which may arise in the formation of the Routh table? How to overcome these difficulties? **(08 Marks)**

b. Examine the stability of the system having the characteristics equation
i) $2s^5 + 6s^4 + 2s^3 + 4s^2 + 3s + 7 = 0$ ii) $s^5 + 9s^4 + 43s^3 + 101s^2 + 156s + 90 = 0$. **(06 Marks)**

c. For the feedback system shown in Fig Q6(c), find the range of K for which the system is stable. Also, determine the value of K for which the system response is oscillatory and the value of frequency of oscillations at this value of K.

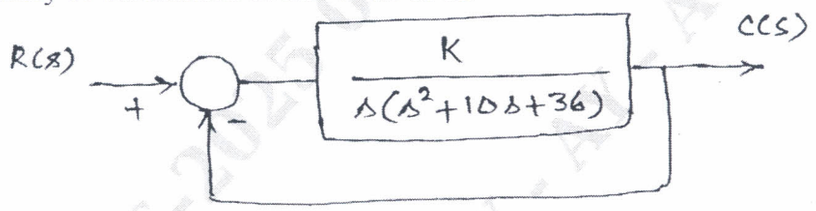

Fig Q6(c) **(06 Marks)**

Module-4

7 a. Sketch the root locus for the unity feedback system having
$G(s) = \frac{K}{s(s+2)(s+4)}$. Where K is varied from 0 to ∞. **(10 Marks)**

b. Sketch the asymptotic Bode plot for the system having
$G(s) = \frac{20}{s(1+0.1s)}$. **(10 Marks)**

OR

8 a. Find the centroid and angle of asymptotes of the root locus of a system with open loop transfer function
$G(s)\,H(s) = \frac{K}{s(s+1)(s+2)}$. **(06 Marks)**

b. Sketch the Bode plot showing the magnitude in db and phase angle in degrees as a function of log frequency for the transfer function.
$G(s)\,H(s) = \frac{2000}{s(s+2)(s+100)}$. Determine the gain cross – over frequency phase cross over frequency, gain margin and phase margin. **(14 Marks)**

Module-5

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

b. With the help of a polar plot, explain gain margin and phase margin. **(06 Marks)**

OR

10 a. What is a PID controller? Write the procedure for the design of a PID controller. **(12 Marks)**

b. What are the steps to design lead compensator? **(08 Marks)**

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