CBCS SCHEME

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17MT34

Third Semester B.E. Degree Examination, July/August 2021
Control Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

1 a. Define control systems. Explain open loop and closed loop control systems with neat diagram. **(10 Marks)**

b. In the circuit shown in Fig.Q.1(b), K is the gain of ideal amplifier. Determine the transfer function $I(s)/V_i(s)$.

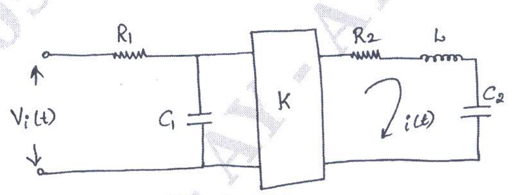

Fig.Q.1(b) **(10 Marks)**

2 a. Draw the equivalent mechanical system of the given system in Fig. Q2 (a). Hence write the set of equilibrium equation for it and obtained electrical analogous circuit using, i) F-V analogy ii) F-I analogy.

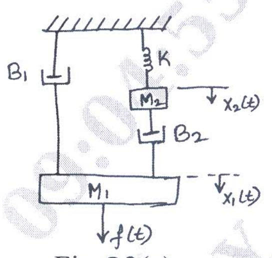

Fig.Q2(a) **(10 Marks)**

b. Determine the transfer function C(s)/R(s) of the system shown in the Fig.Q.2(b).

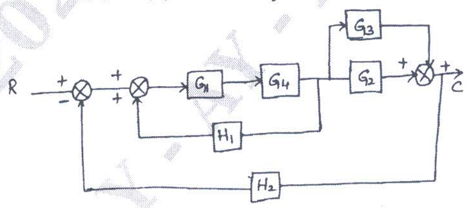

Fig.Q2(b) **(10 Marks)**

3 a. Draw signal flow graph for the block diagram shown in Fig.Q3(a) below and find $\frac{C(s)}{R(s)}$.

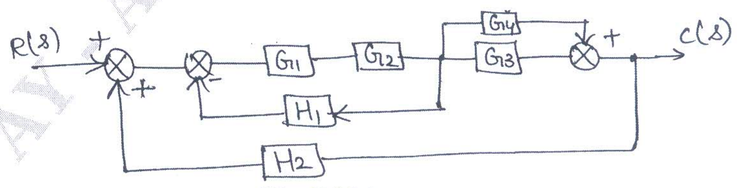

Fig.Q3(a) **(10 Marks)**

b. Explain Mason's gain formula in detail. **(10 Marks)**

4 a. Define the following time domain specifications of second order system, with equations:
i) Delay time ii) Rise time iii) Max overshoot (M_p) iv) Settling time (t_s)
v) Peak time (t_p) **(10 Marks)**

b. For a control systems shown in Fig.Q4(b), find the value of k_1 and k_2 so that $M_p = 25\%$ and $T_p = 4$ sec. Assume unit step i/p. **(10 Marks)**

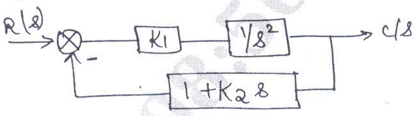

Fig.Q4(b)

5 a. A unity feedback control system has $G(s) = \dfrac{K(s+13)}{s(s+3)(s+7)}$, using Routh's criteria. Calculate the range of 'K' for which the system is (i) Stable (ii) has its closed loop (iii) poles more negative than –1. **(10 Marks)**

b. A given system in Fig. Q5 (b) oscillates with frequency 2rad/sec find values of "K_{mar}" and 'P'. Number of poles are in RHS.

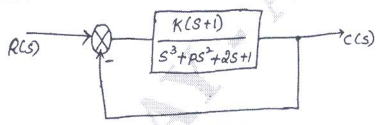

Fig.Q5(b) **(10 Marks)**

6 a. Explain the terms : i) Asymptotes ii) Centroid iii) Break-way point. **(09 Marks)**

b. A feedback control system has an open loop transfer function :

$G(s)H(s) = \dfrac{K}{s(s+3)(s^2+2s+2)}$. Draw the root locus as K various from 0 to ∞ **(11 Marks)**

7 a. A system of third order shows resonance peak of 2 and resonance frequency 3^{rd}/sec. Determine the transfer function of the equivalent second order system and hence find the T_r, T_p, T_s,% overshoot, time of oscillations and number of oscillations before settling. **(10 Marks)**

b. Draw the Bdoe plot for a system have $G(s) = \dfrac{K(1+0.2s)(1+0.025s)}{s^3(1+0.001s)(1+0.005s)}$ show that the system is condictionally stable, find the range of K for which the system is stable. **(10 Marks)**

8 a. Sketch the Nyquist plot for system with $G(s)H(s) = \dfrac{(1+0.5s)}{s^2(1+0.1s)(1+0.02s)}$ comment on the stability. **(10 Marks)**

b. Let us add a simple pole and see its effect on polar plot. $G(s)H(s) = \dfrac{1}{(1+T_1 s)(1+T_2 s)}$. **(10 Marks)**

9 a. Define terms (i) State (ii) State variables (iii) State space (iv) State diagram. **(04 Marks)**

b. Consider a system given by $y''' + 9y'' + 26y' + 24y = 6u$. Obtain its state model. Write state diagram. **(08 Marks)**

c. Obtain TF of system having state model, $\dot{X}(t) = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} X(t) + \begin{bmatrix} 2 \\ 5 \end{bmatrix} u(t); y(t) = [1 \; 2] \times (t)$. **(08 Marks)**

10 a. Define state transition matrix. List its properties. **(08 Marks)**

b. Find state transition matrix for, $A = \begin{bmatrix} 0 & -1 \\ 2 & -3 \end{bmatrix}$ **(10 Marks)**

c. Write the solution of non-homogeneous equation. **(02 Marks)**