CBCS SCHEME

USN

17MT34

Third Semester B.E. Degree Examination, June/July 2019
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 the difference between open loop and closed control systems and also list merits and demerits of them. **(08 Marks)**

b. Write the differential equations governing the mechanical systems shown in Fig.Q1(b) and determine the transfer function. **(06 Marks)**

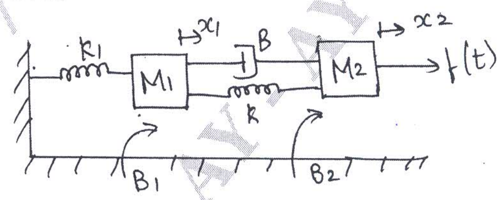

Fig.Q1(b)

c. For the electrical system shown in Fig.Q1(c) below obtain transfer function $V_2(s)/V_1(s)$.

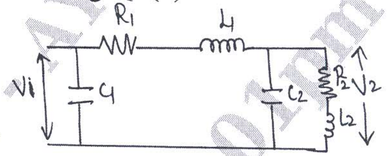

Fig.Q1(c) **(06 Marks)**

OR

2 a. For the block diagram given below Fig.Q2(a), obtain overall TF using block diagram reduction technique. **(08 Marks)**

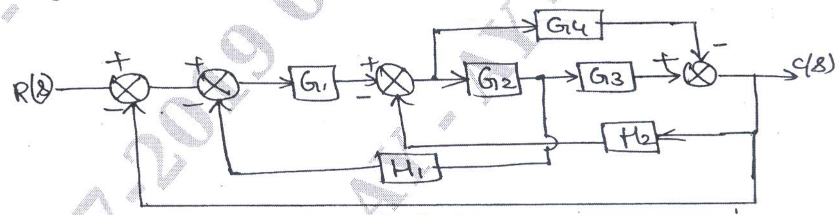

Fig.Q2(a)

b. For the mechanical system shown in Fig.Q2(b), write mechanical network, differential equations and draw F – V analogous circuit with necessary equations. **(12 Marks)**

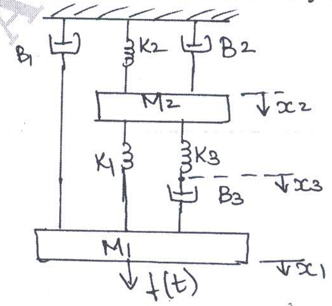

Fig.Q2(b)

Module-2

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

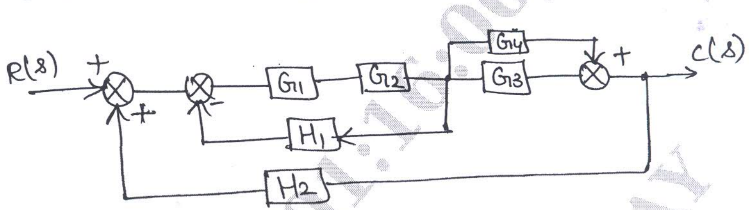

Fig.Q3(a) **(10 Marks)**

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

OR

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)**

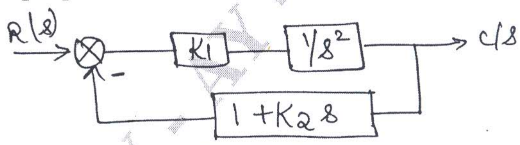

Fig.Q4(b)

Module-3

5 a. A unity feedback control system has $G(s) = \frac{K(s+13)}{s(s+3)(s+7)}$, 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. Write the necessary and sufficient conditions for a system to be stable using Routh's criterion. **(04 Marks)**

c. The characteristics equation for certain feedback control systems are given below. Determine the system is stable or not. Find the value of K for a stable system

$$s^3 + 3Ks^2 + (K+2)s + 4 = 0$$ **(06 Marks)**

OR

6 a. Sketch the root locus plot for

$$G(s)H(s) = \frac{k}{s(s+2)(s+4)}.$$ Find the value of K for stable. **(12 Marks)**

b. Define root loci. Explain the following terms :
(i) Centroid (ii) Asymptotes (iii) Breakaway point. **(08 Marks)**

Module-4

7 a. Define the following frequency response specification terms:
(i) Bandwidth (ii) Cut off frequency (iii) Resonant frequency
(iv) Phase crossover frequency **(08 Marks)**

b. Construct the Bode plot for a unity feedback control system with $G(s) = \frac{10(s+10)}{s(s+2)(s+5)}$

Find its gain marging and phase margin. **(12 Marks)**

OR

8 a. Using Nyquist stability criterion investigate the stability of a negative feedback control system whose open loop TF is given by $G(s)H(s) = \dfrac{100}{(s+1)(s+2)(s+3)}$ **(12 Marks)**

b. Explain terms in magnitude plot and phase plot in polar plots. **(04 Marks)**

c. Explain Nyquist stability criterion. **(04 Marks)**

Module-5

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,

$$\dot{X}(t) = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} X(t) + \begin{bmatrix} 2 \\ 5 \end{bmatrix} u(t) \;\; ; \;\; y(t) = [1 \quad 2] \times (t)$$ **(08 Marks)**

OR

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)**

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