CBCS SCHEME

USN | | | | | | | | | | **15MT34**

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Control Systems

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing one full question from each module.
2. Write neat sketches wherever required.

Module-1

1 a. Explain with an example and block diagram, a closed loop control system. **(06 Marks)**

b. Obtain the transfer function for the following mechanical system shown in Fig.Q.1(b). **(10 Marks)**

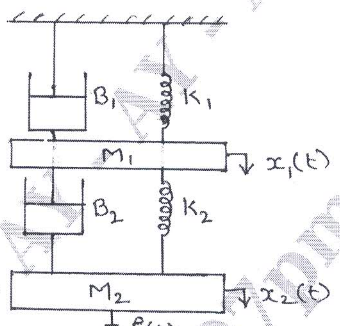

Fig.Q.1(b)

OR

2 a. For the given system shown in Fig.Q.2(a), write the differential equations in force voltage and force-current analogy. **(06 Marks)**

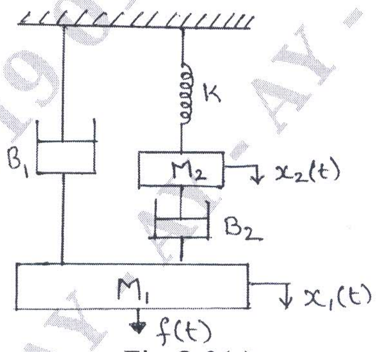

Fig.Q.2(a)

b. Reduce the block diagram shown in Fig.Q.2(b) by reduction technique and find C(s)/R(s). **(10 Marks)**

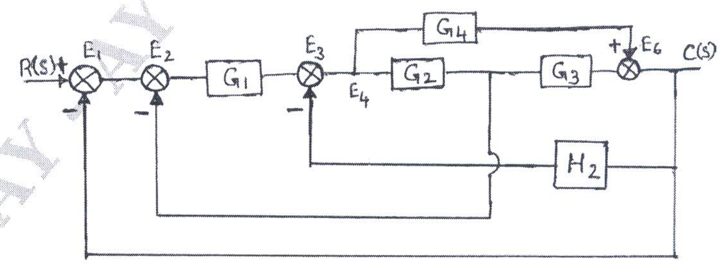

Fig.Q.2(b)

Module-2

3 a. Using SFG technique, find the transfer function for the system shown in Fig.Q.3(a). **(08 Marks)**

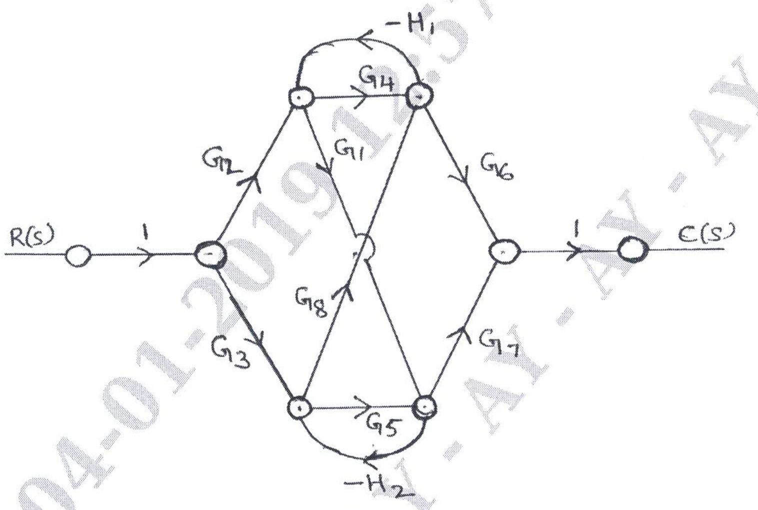

Fig.Q.3(a)

b. For the Fig.Q.2(b), find the transfer function using Mason's Gain formula. **(08 Marks)**

OR

4 a. Derive an expression for a second order system subjected to an unit step input for an underdamped system. **(09 Marks)**

b. For a system with $G(s)H(s) = \dfrac{K}{s^2(s+3)(s+4)}$, find the value of K for which the steady state error is to be limited to 12 when the input is $1 + 12t + \dfrac{50}{2}t^2$. **(07 Marks)**

Module-3

5 a. For an unity feed back system, the system is conditionally stable and oscillates with a frequency of 6 rad/sec. Find K_{mar} and R, $G(S) = \dfrac{9}{S^3 + RS^2 + 3KS}$. **(06 Marks)**

b. The characteristic equation of the system is $s^6 + 4s^5 + 3s^4 - 16s^2 - 64s - 48 = 0$. Check the stability of the equation using RH criteria and find the roots and W. **(10 Marks)**

OR

6 Sketch the Root locus for the given transfer function $G(S)H(S) = \dfrac{K}{s(s^2 + 4s + 10)}$. Comment on the stability of the system. **(16 Marks)**

Module-4

7 Sketch the Bode plot for the given transfer function with $G(s)H(s) = \dfrac{10(1+0.5s)}{S(1+0.1s)(1+0.2s)}$. Find w_{gc}, w_{pc}, GM and PM. Comment on its stability. **(16 Marks)**

OR

8 Sketch the Nyquist plot for $G(s)H(s) = \dfrac{K}{s^4 + 8s^3 + 17s^2 + 10s}$. Find the value of K for the system to be conditionally stable. **(16 Marks)**

Module-5

9 a. Obtain the state model of the electrical network shown in Fig.Q.9(a) in the standard form. Given $t = t_0$, $i(t) = i(t_0)$ and $v_0(t) = v_0(t_0)$. **(08 Marks)**

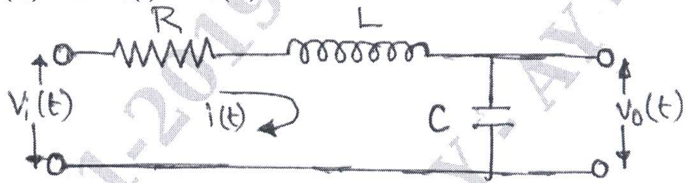

Fig.Q.9(a)

b. Consider a system having state model

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 3 \\ 5 \end{bmatrix} u \quad \text{and} \quad Y = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix},$$

with D = 0. Obtain its transfer function. **(08 Marks)**

OR

10 a. Obtain the complete time response of the system given by $\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ -2 & 0 \end{bmatrix} x(t)$ where $x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ and $Y(t) = \begin{bmatrix} 1 & -1 \end{bmatrix} x(t)$. **(10 Marks)**

b. Find the state transition matrix of the state equation $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} U$ using the inverse transform method. **(06 Marks)**

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