CBCS SCHEME

USN AY16MT038

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Control Systems

Time: 3 hrs.   Max. Marks: 80

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

Module-1

1 a. Obtain differential equations describing the mechanical system shown in Fig. Q1 (a) and draw electric circuits based on F-V and F-I analogy. **(12 Marks)**
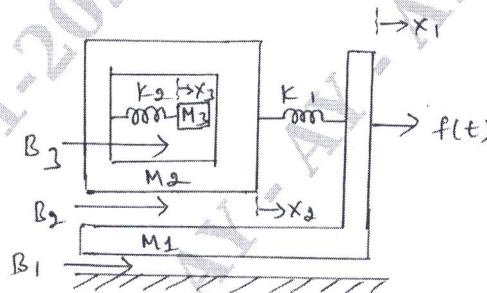

Fig. Q1 (a)

b. Differentiate between open loop and closed loop systems giving suitable examples. **(04 Marks)**

OR

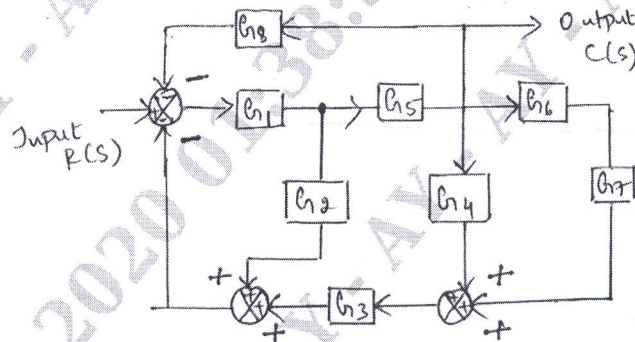2 a. Reduce the block diagram shown in Fig. Q2 (a) to a single block $T(S) = C(S)/R(S)$ **(08 Marks)**

Fig. Q2 (a)

b. The force voltage analogy of a mechanical translational system is given in Fig.Q2 (b). Obtain its analogous mechanical system. **(08 Marks)**
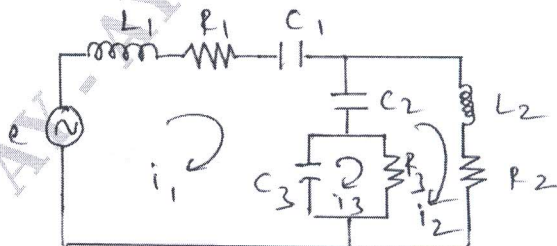

Fig. Q2 (b)

Module-2

3 a. Draw the corresponding signal flow graph of given block diagram Fig. Q3 (a) and find $\dfrac{C(s)}{R(s)}$. **(08 Marks)**
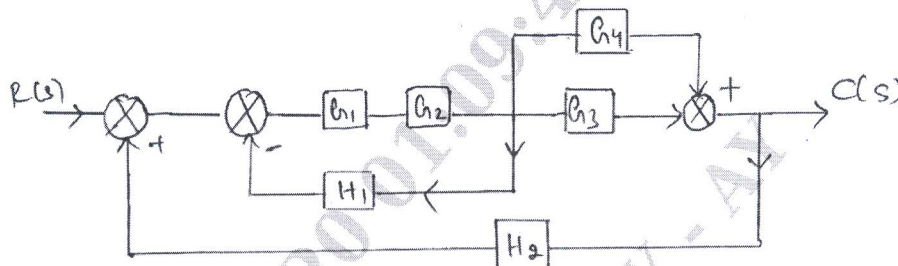

Fig. Q3 (a)

b. Find the transfer function $T(s) = C(s)/R(s)$ for the signal flow graph shown in Fig. Q3 (b) using Mason's gain formula. **(08 Marks)**
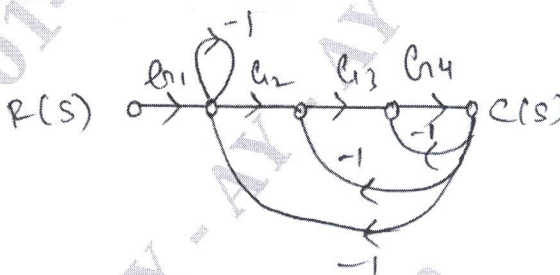

Fig. Q3 (b)

OR

4 a. A system is given by differential equation, $\dfrac{d^2y}{dt^2} + 4\dfrac{dy}{dt} + 8y = 8x$, where $y = $ output and $x = $ input. Determine all time domain specifications for unit step input. **(08 Marks)**

b. For a unity feedback control system with $G(s) = \dfrac{64}{s(s+9.6)}$, write the output response to a unit step input. Determine

    (i)   The response at $t = 0.1$ sec.

    (ii)   Maximum value of the response and the time at which it occurs.

    (iii)   Setting time. **(08 Marks)**

Module-3

5 a. Using Routh criteria determine stability of following systems:

    (i)   Its loop transfer function has poles at $S = 0$, $S = -1$, $S = -3$ and zero at $S = -5$, gain of K of forward path is 10.

    (ii)   It is a type one system with an error constant of 10 sec^{-1} and poles at $S = -3$ and $S = -6$ **(10 Marks)**

b. Determine the stability of the system having the characteristic equation using R-H criterion.

$s^6 + 2s^5 + 5s^4 + 8s^3 + 8s^2 + 8s + 4 = 0$ **(06 Marks)**

OR

6 Draw the root locus diagram for the loop transfer function, $G(s)H(s) = \dfrac{K}{s(s^2 + 8s + 17)}$.

Evaluate the value of K for a system having damping ratio of 0.5 from the diagram. **(16 Marks)**

Module-4

7   a.   Write a note on frequency domain specifications. **(08 Marks)**

    b.   Sketch the Bode plot for the transfer function, $G(s) = \dfrac{Ks^2}{(1+0.2s)(1+0.02s)}$. Determine the value of K for the gain cross-over frequency to be 5 rad/sec. **(08 Marks)**

OR

8   a.   The open loop transfer function of a unity negative feedback system is given by, $G(s) = \dfrac{K(s+3)}{s(s^2+2s+2)}$. Using Nyquist criteria, find the value of K for which the closed loop system is just stable. **(08 Marks)**

    b.   The transfer function of a control system is $G(s) = \dfrac{1}{s(1+2s)(1+5s)}$. Sketch the polar plot and hence determine the phase cross over frequency and gain margin. **(08 Marks)**

Module-5

9   a.   Define state variable and state transition matrix. List the properties of the state transition matrix. **(08 Marks)**

    b.   Obtain the state model for the electrical system shown in Fig. Q9 (b) choosing the state variables as $i_1(t)$, $i_2(t)$ and $V_c(t)$ **(08 Marks)**
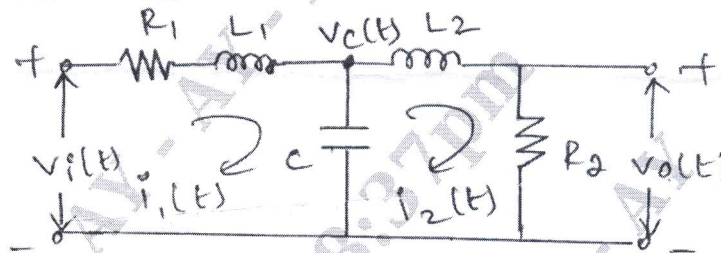

Fig. Q9 (b)

OR

10 a.   Obtain the state transition matrix for $A = \begin{bmatrix} 0 & -1 \\ 2 & -3 \end{bmatrix}$. **(08 Marks)**

    b.   Obtain the solution of the homogeneous state equation, $\dot{X} = AX$ where $A = \begin{bmatrix} 1 & -2 \\ 1 & -4 \end{bmatrix}$ and $X(0) = \begin{bmatrix} 0.5 \\ 1 \end{bmatrix}$. **(08 Marks)**

* * * * *