USN

CBCS SCHEME

18EC43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Control System

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. For the mechanical system shown in Fig.Q1(a)
(i) Draw the mechanical network
(ii) Write the differential equations governing its dynamic behaviour
(iii) Write the Force-Voltage [F-V] analogous electric network

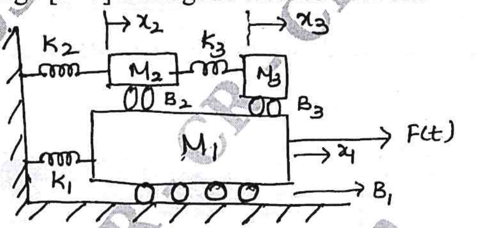

Fig.Q1(a) **(08 Marks)**

b. Define Open loop and closed loop system and list the difference between open loop system and closed loop system. **(05 Marks)**

c. Define analogous systems. Show that two systems shown in Fig.Q1(c) are analogous systems by comparing their transfer function.

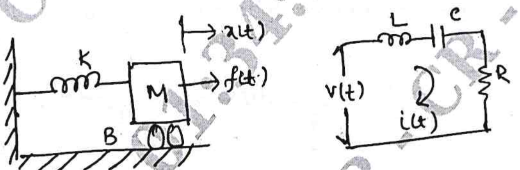

Fig.Q1(c) **(07 Marks)**

OR

2 a. Obtain the transfer function $\frac{\theta(s)}{T(s)}$ of the system shown in Fig.Q2(a).

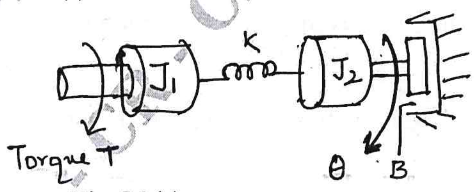

Fig.Q2(a) **(05 Marks)**

b. For the given electrical network in the Fig.Q2(b), obtain its analogous mechanical system.

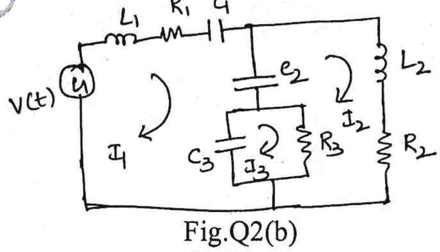

Fig.Q2(b) **(07 Marks)**

c. Draw F-I analogous circuit for the mechanical system shown in Fig.Q2(c) with necessary equations.

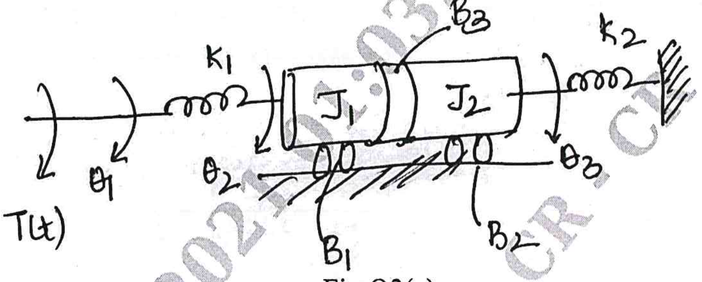

Fig.Q2(c) **(08 Marks)**

Module-2

3 a. For the block diagram shown in Fig.Q3(a), determine the transfer function $\frac{C(s)}{R(s)}$ using block diagram reduction technique.

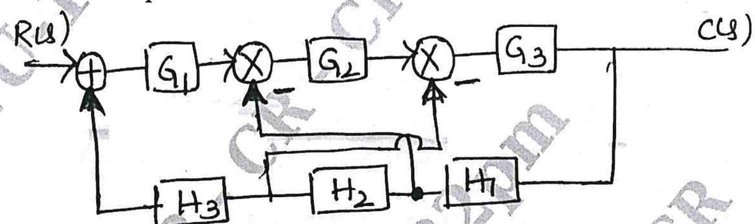

Fig.Q3(a) **(08 Marks)**

b. Find the transfer function for the network given in Fig.Q3(b).

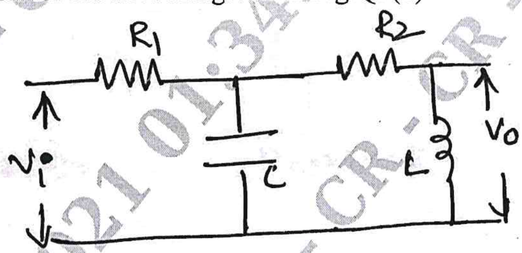

Fig.Q3(b) **(08 Marks)**

c. Define the following terms in connection with signal flow graph:
(i) Node (ii) Chain Node (iii) Self loop (iv) Non-touching loop **(04 Marks)**

OR

4 a. For the block diagram shown in Fig.Q4(a), obtain the transfer function using Mason's gain formula.

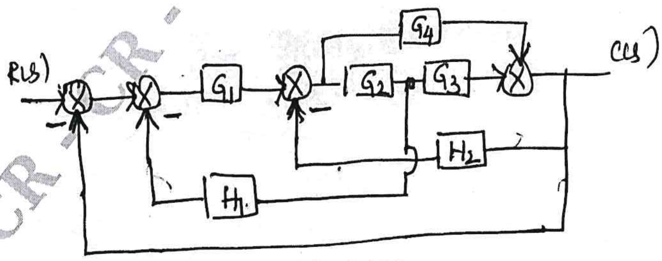

Fig.Q4(a) **(10 Marks)**

b. Using Maxon's gain formula find the transfer function for the given signal flow graph shown in the Fig.Q4(b).

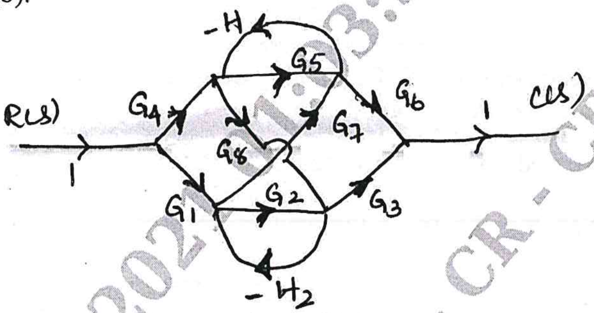

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Derive expression for peak response time Tp and maximum overshoot Mp of an under-damped second order system subjected to step input. **(06 Marks)**

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

c. For a unity feedback control system with $G(s) = \frac{10(s+2)}{s^2(s+1)}$. Find all the static error coefficients and steady state error when the input transform is $R(s) = \frac{3}{s} + \frac{2}{s^2} + \frac{1}{3s^3}$. **(06 Marks)**

OR

6 a. Draw the typical time domain in response of an underdamped second order system to a unit step input and define various time domain performance parameter indicating the same on the diagram. **(10 Marks)**

b. Find the open loop transfer function of an equivalent prototype single loop unity feedback system having second order whose step repose is an shown in Fig.Q6(b).

$$\frac{C(s)}{R(s)} = \frac{w_n^2}{s^2 + 2yw_n s + w_n^2}$$

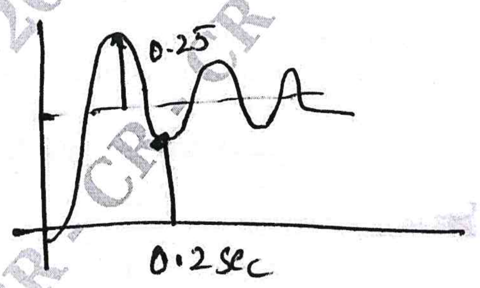

Fig.Q6(b) **(10 Marks)**

Module-4

7 a. Using RH criterion find the range of values of K for stability, marginal value of 'K' and frequency of sustained oscillation for the unity feedback system.

$$G(s) = \frac{K}{s(1+0.4s)(1+0.25s)}$$ **(06 Marks)**

b. Sketch the root locus plot of system having

$$G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$$

(i) Find range of 'K' for stability of system.
(ii) Find 'K' for marginal stability. **(08 Marks)**

c. A unity feedback control system has $G(s) = \frac{80}{s(s+2)(s+20)}$. Draw the Bode plot. Determine GM, PM, W_{gc} and W_{pc}. Comment on stability. **(06 Marks)**

OR

8 a. Draw root locus for the given open loop transfer function,

$$G(s)H(s) = \frac{K}{s(s+4)(s^2+4s+20)}$$

(10 Marks)

b. The open loop transfer function of a system is $G(s) = \frac{K}{s(1+0.2s)(1+0.05s)}$. Determine the value of 'K' such that (i) gain margin = 10 db (ii) phase margin = 40° using Bode plot. **(10 Marks)**

Module-5

9 a. Using Nyquist stability criterion, determine the stability of a negative feedback control system given by $G(s)H(s) = \frac{100}{(s+1)(s+2)(s+3)}$. **(10 Marks)**

b. Obtain the state model of the given electrical system shown in Fig.Q9(b).

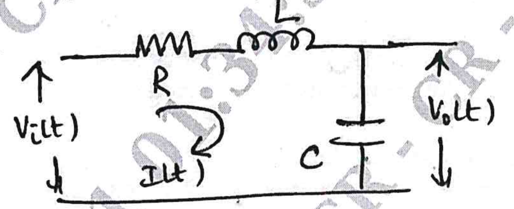

Fig.Q9(b)

(10 Marks)

OR

10 a. State the properties of state transition matrix. **(04 Marks)**

b. Obtain state model for the given electrical circuit as shown in Fig.Q10(b).

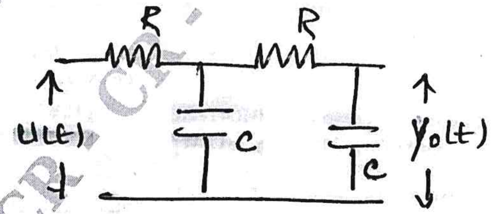

Fig.Q10(b) **(10 Marks)**

c. For the open loop transfer function given below $G(s)H(s) = \frac{1}{s(s+1)(s+2)}$. Sketch polar plot and find: (i) Phase cross over frequency (ii) Gain cross over frequency (iii) Gain margin **(06 Marks)**

* * * * *