CBCS SCHEME

USN | | | | | | | | | | | **15EE61**

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Control Systems

Time: 3 hrs. Max. Marks: 80

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

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.

Module-1

1 a. Define open loop control system and closed loop control system with examples. **(06 Marks)**

b. Obtain transfer function of armature controlled DC servo motor. **(10 Marks)**

OR

2 a. For the mechanical system shown in Fig.Q2(a). Write the differential equation relating displacement x(t) and force f(t). Derive electrical analogous equations for the mechanical quantities using force-voltage analogy and draw electrical analogous circuit.

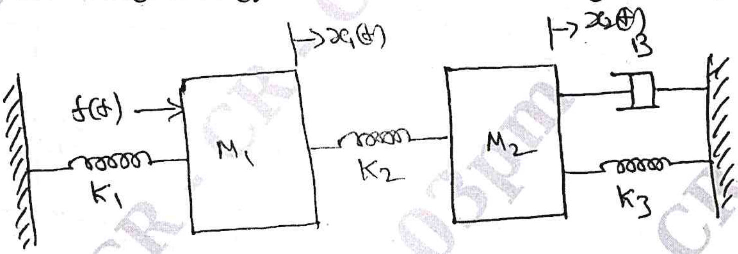

Fig.Q2(a) **(08 Marks)**

b. For the rotational system shown in Fig.Q2(b), write the differential equations relating angular displacement θ(t) and torque T(t). Derive electrical analogous equation using torque-current analogy and draw electrical analogous network.

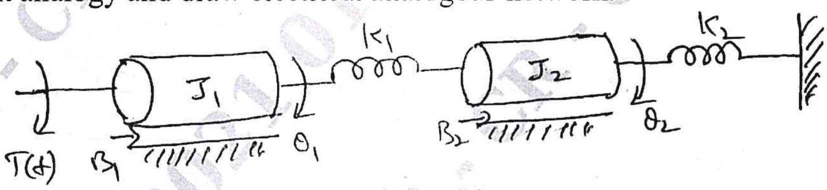

Fig.Q2(b) **(08 Marks)**

Module-2

3 a. Find the transfer function of the system shown in Fig.Q3(a) using block diagram reduction technique.

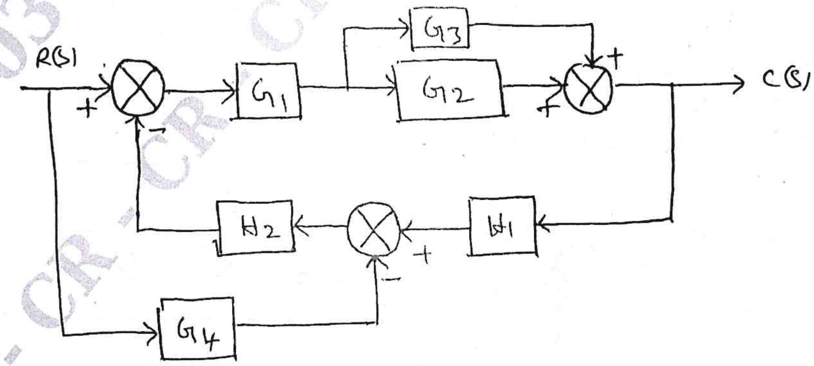

Fig.Q3(a) **(08 Marks)**

b. Find the transfer function $\frac{Y_5}{Y_1}$ for the signal flow graph shown in Fig.Q3(b).

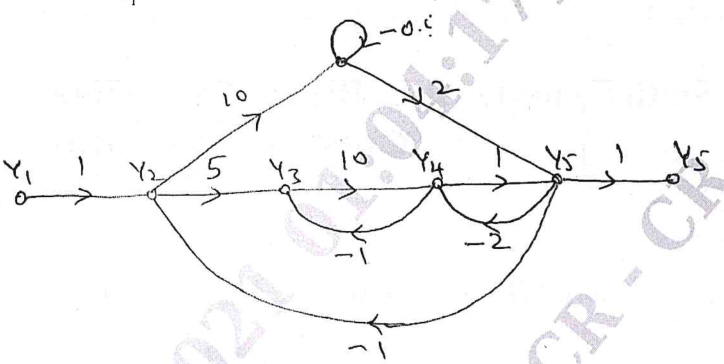

Fig.Q3(b) **(08 Marks)**

OR

4 a. For the network shown in Fig.Q4(a) construct the signal flow graph and find the transfer function $\frac{V_0(s)}{V_i(s)}$ using Mason's gain formula.

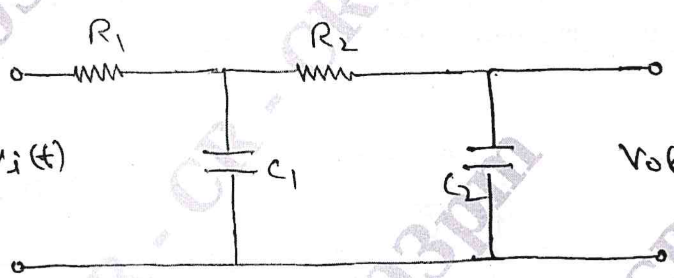

Fig.Q4(a) **(08 Marks)**

b. Obtain the transfer function $\frac{C(s)}{R(s)}$ of the block diagram shown in Fig.Q4(b) using block diagram reduction technique.

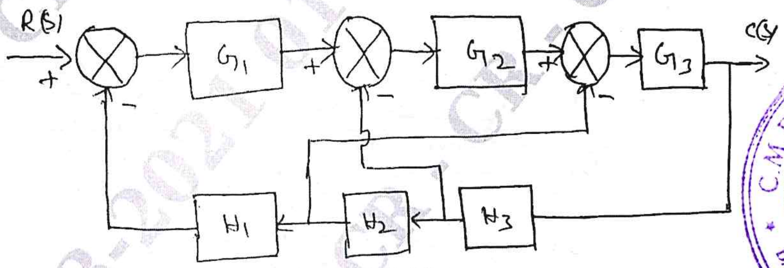

Fig.Q4(b) **(08 Marks)**

Module-3

5 a. Draw the time response curve and define time domain specifications for second order control system for unit step input. **(08 Marks)**

b. Determine the values of 'K' and 'a' so that the system shown in Fig.Q5(b) oscillates at a frequency of 2 radius/sec.

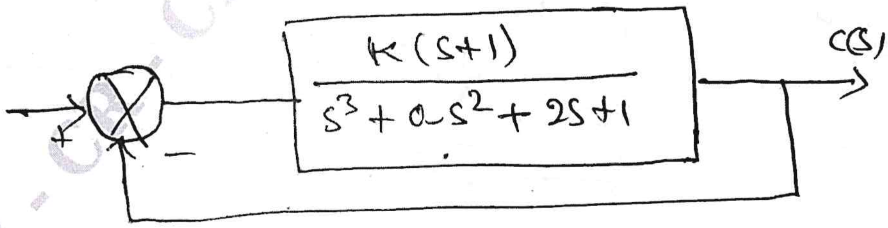

Fig.Q5(b) **(08 Marks)**

OR

6 a. Explain Routh-Hurwitz criterion on stability of a control system. **(04 Marks)**

b. Test the stability of the system characterized by its characteristic equation:

$s^4 + 2s^3 + 3s^2 + 4s + 5 = 0$ **(04 Marks)**

c. For a unity feedback control system shown in Fig.Q6(c), obtain closed loop transfer function, damping ratio, natural frequency and expression for output response subjected to unit step input.

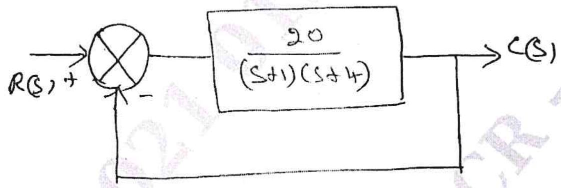

Fig.Q6(c) **(08 Marks)**

Module-4

7 a. Discuss the various rules for construction of root locus. **(06 Marks)**

b. A negative feedback control system is characterized by $G(s)H(s) = \dfrac{K}{s(s+1)(s+2)(s+3)}$.

Sketch the root locus plot for values of 'K' ranging from 0 to ∞ mark all the salient points on the root locus. **(10 Marks)**

OR

8 a. Construct the Bode plot for a unity feedback control system having $G(s) = \dfrac{2000}{s(s+1)(s+100)}$,

from the Bode plot, determine:

(i) Gain cross over frequency (ii) Phase cross over frequency

(iii) Gain margin (iv) Phase margin

Comment on stability. **(10 Marks)**

b. Determine the open loop transfer function of a system whose approximate plot is shown in Fig.Q8(b).

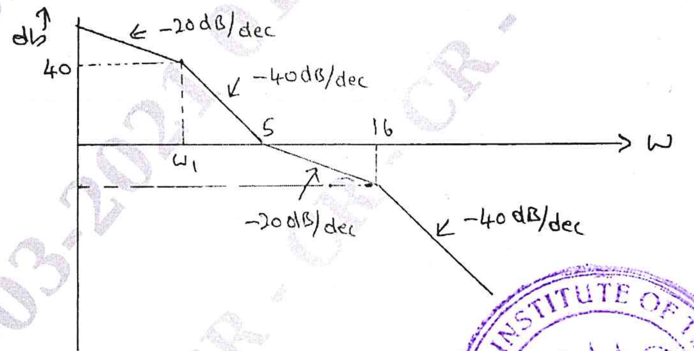

Fig.Q8(b) **(06 Marks)**

Module-5

9 a. State and explain Nyquist stability criterion. **(06 Marks)**

b. Write a note on PID controller. **(10 Marks)**

OR

10 a. Sketch the Nyquist plot for a system with $G(s)H(s) = \dfrac{10(s+3)}{s(s-1)}$. Comment on closed loop stability. **(10 Marks)**

b. Write a note on lag-lead compensator. **(06 Marks)**

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