CBCS SCHEME

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15EE61

Sixth Semester B.E. Degree Examination, June/July 2023
Control Systems

Time: 3 hrs. Max. Marks: 80

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

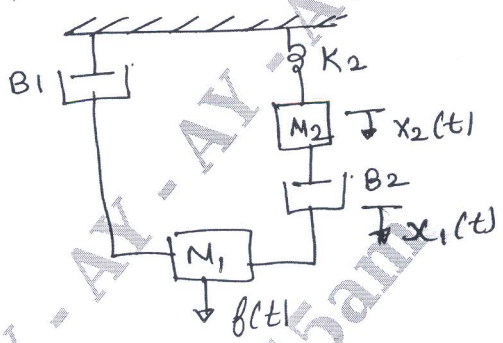
Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Define control system. Distinguish between open loop and closed loop system with an example. **(06 Marks)**

b. For the mechanical system shown in Fig.Q.1(b). Write the differential equation relating to the mechanical system. Also obtain electrical analogous circuits using i) F-V analogy ii) F-I analogy. **(10 Marks)**

Fig.Q.1(b)



OR

2 a. Derive the transfer function of armature controlled DC motor. **(06 Marks)**

b. Explain in detail the AC servometer. **(05 Marks)**

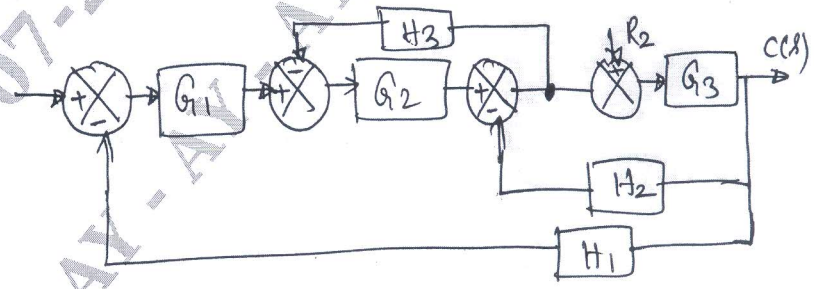
c. Explain the synchro as an error detector. **(05 Marks)**

Module-2

3 a. Determine using block reduction

i) When $R_2 = 0 \frac{C(s)}{R_1(S)}$ ii) When $R_1 = 0 \frac{C(s)}{R_2(s)}$. **(10 Marks)**

Fig.Q.3(a)



b. Define : i) Source and sink node ii) Loop and forward path iii) Error signal and primary feed back signal. **(06 Marks)**

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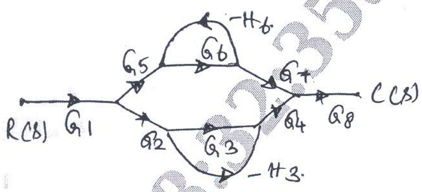
OR

4 a. Explain Mason's gain formula indicating each term. **(04 Marks)**

b. Find: $\frac{C(s)}{R(s)}$ by Mason's gain formula.

Fig.Q.4(b)



(08 Marks)

c. What is transfer function? List the limitations of transfer function. **(04 Marks)**

Module-3

5 a. Derive the time Domain specification
i) Peak time (Tp) ii) Rise time (Tr). **(06 Marks)**

b. What are the necessary and sufficient condition for the system to be stable as for RF criteria? **(04 Marks)**

c. An unity feedback system has $G(S) = \frac{20(1+s)}{s^2(2+s)(4+s)}$. Calculate its steady state error co-efficient and error when the applied input is $r(t) = 40 + 2t + 5t^2$. **(06 Marks)**

OR

6 a. The open loop transfer function of a unity feedback system is given by $G(s) = \frac{10K(s+0.5)}{s^2(s+2)(s+1)}$. Find the values of K. **(05 Marks)**

b. Comment on stability using routh criteria of characteristic equation.
$s^5 + 2s^4 + 24s^3 + 48s^2 - 25s - 50 = 0$. **(05 Marks)**

c. Derive an expression for response of second order underdamped system for unit step input. **(06 Marks)**

Module-4

7 a. Write a note on frequency domain specifications. **(06 Marks)**

b. Sketcsh the complete root locus of system having $G(S)H(S) = \frac{K}{s(s+1)(s+2)(s+3)}$. **(10 Marks)**

OR

8 a. Derive an expression for resonant peak and resonant frequency for a second order system. **(06 Marks)**

b. For the following transfer function draw bode plot and obtain gain cross over frequency $G(s) = \frac{20}{s(1+3s)(1+4s)}$. **(10 Marks)**

Module-5

9 a. Explain the Nyquist stability criteria. **(06 Marks)**

b. Explain step by step procedure to design lag compensation network. **(10 Marks)**

OR

10 a. Sketch the Nyquist plot and comment on the stability of the closed loop system whose open loop transfer function is $G(s)H(s) = \frac{5}{s(1-s)}$. **(10 Marks)**

b. Write notes on PID controller. **(06 Marks)**

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