CBCS SCHEME

USN | | | | | | | | | | 18ME71

Seventh Semester B.E. Degree Examination, July/August 2022
Control Engineering

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain the closed loop control system with an example and block diagram. **(05 Marks)**
b. Explain the requirements of an ideal control system (any five). **(05 Marks)**
c. Explain the following controllers : (i) PI controller (ii) PID controller. **(10 Marks)**

OR

2 a. Obtain the transfer function for an Armature Controlled DC motor. **(10 Marks)**
b. Obtain the transfer function for the mechanical system shown in Fig. Q2 (b). **(10 Marks)**

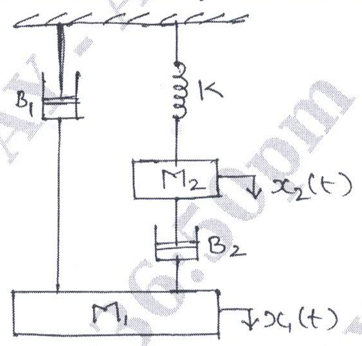

Fig. Q2 (b)

Module-2

3 a. Analyze the first order electrical system when it is subjected to an unit step input. **(08 Marks)**
b. A second order system is given by, $\frac{C(s)}{R(s)} = \frac{20}{s^2 + 6s + 25}$. Find the following transient response specifications, (i) Rise time (ii) Delay time (iii) Peak time (iv) Peak overshoot (v) Settling time.
Also find the expression for the output response C(t) when subjected to unit step response. **(12 Marks)**

OR

4 a. For an unity feed back system with $G(s) = \frac{K}{s^2(s+3)(s+4)}$, find the value of K for which the steady state error is to be limited to 10, when the input is $1 + 12t + \frac{50}{2}t^2$. **(08 Marks)**
b. Derive an expression for a second order sender damped system which is subjected to unit step response. **(12 Marks)**

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-3

5 a. Reduce the block diagram by reduction technique and find $\frac{C(s)}{R(s)}$ shown in Fig. Q5 (a). **(10 Marks)**

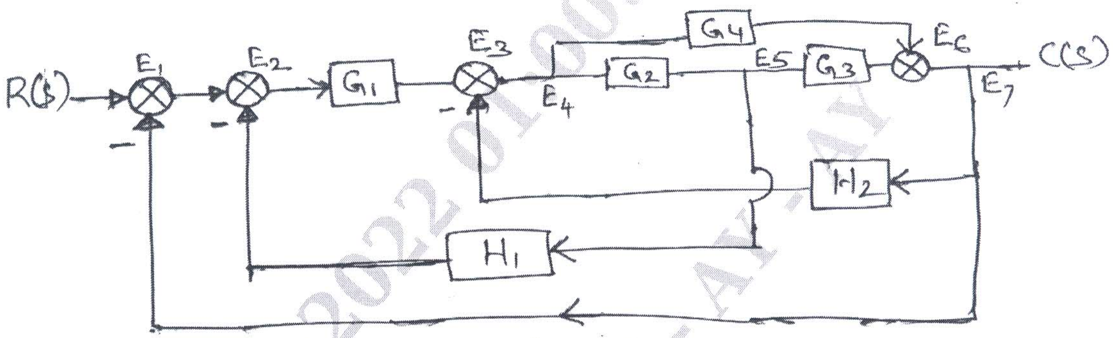

Fig. Q5 (a)

b. Determine the transfer function of the system shown in Fig. Q5 (b) using SFG technique.

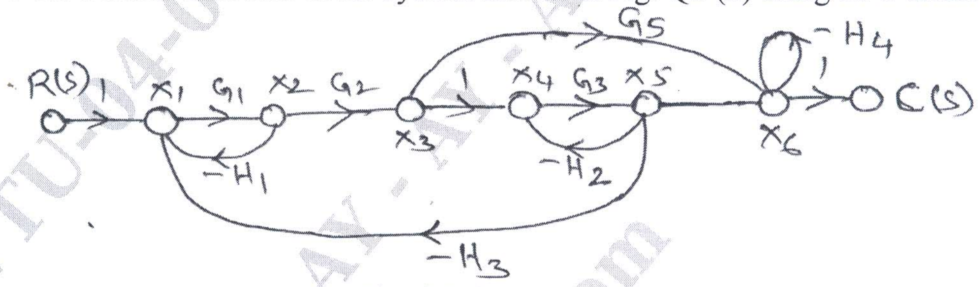

Fig. Q5 (b) **(10 Marks)**

OR

6 a. Define the following terms :
- (i) State
- (ii) State variables
- (iii) State vector.
- (iv) State space
- (v) State trajectory **(05 Marks)**

b. Determine the state controllability and observability of the system using Kalman's test.

$$\dot{X} = \begin{vmatrix} -3 & 1 & 1 \\ -1 & 0 & 1 \\ 0 & 0 & 1 \end{vmatrix} X + \begin{vmatrix} 0 & 1 \\ 0 & 0 \\ 2 & 1 \end{vmatrix} u, \quad Y = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} x$$ **(10 Marks)**

c. Evaluate the observability of the system by Gilbert's method.

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \text{ and } C = \begin{bmatrix} 3 & 4 & 1 \end{bmatrix}.$$ **(05 Marks)**

Module-4

7 Sketch the root locus for the given transfer function with $G(s)H(s) = \frac{K}{s(s+2)(s+4)(s+6)}$.

Comment on the stability of the system. **(20 Marks)**

OR

8 a. A system oscillates with a frequency ω, if it has poles of $s = \pm j\omega$ and no poles in the right half of S plane, determine the value of 'K' and 'a', so that the system shown in Fig. Q8 (a) oscillates at a frequency of 2 rad/s. **(06 Marks)**

Fig. Q8 (a)

b. Sketch the root locus with $G(s)H(s) = \dfrac{K}{s(s^2+4s+10)}$. Comment on the stability. **(14 Marks)**

Module-5

9 a. What are Polar Plots? Sketch the Polar Plot with $G(s)H(s) = \dfrac{1}{s(1+T_1 s)(1+T_2 s)}$. **(06 Marks)**

b. Draw the Nyquist plot for $G(s)H(s) = \dfrac{K}{s^4+8s^3+17s^2+10s}$ and find the value of K. **(14 Marks)**

OR

10 Sketch the Bode plot for the system with $G(s)H(s) = \dfrac{2(s+0.25)}{s^2(1+s)(s+0.5)}$. From the plot determine, (i) Phase cross over frequency (ii) gain cross over frequency (iii) Gain margin (iv) Phase margin.
Comment on the stability of the system. **(20 Marks)**

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