CBCS SCHEME

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17ME73

# 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.** ***Write neat sketches, wherever required.***



### Module-1

1 a. Explain loop control system, with an example and block diagram. **(07 Marks)**
b. Explain briefly the requirements of an ideal control system. **(06 Marks)**
c. With an example and block diagram, explain the closed loop control system. **(07 Marks)**

**OR**

2 a. Define controllers. Enumerate the classification of the controllers. **(04 Marks)**
b. Explain the PI controller. Enumerate its characteristics. **(08 Marks)**
c. Explain the PID controller. Enumerate the characteristics of PID controllers. **(08 Marks)**

### Module-2

3 a. Obtain the transfer function of the mechanical system shown in Fig. Q3 (a). **(10 Marks)**

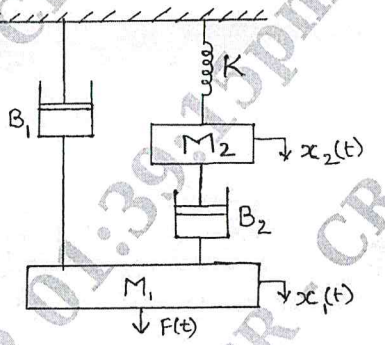


Fig. Q3 (a)

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

**OR**

4 a. Obtain the closed loop transfer function of the system shown in Fig. Q4 (a) by block diagram reduction technique. **(10 Marks)**

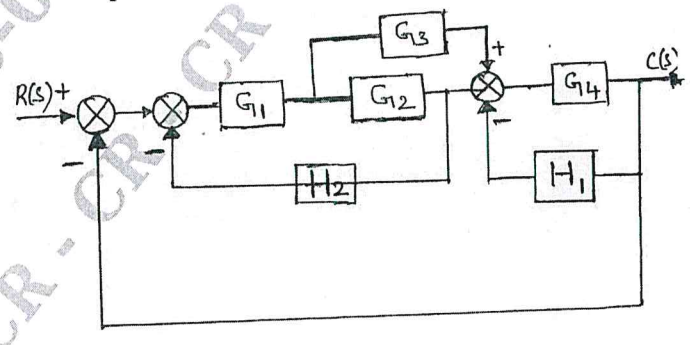


Fig. Q4 (a)

b. Using Mason's gain formula, find $\frac{X_2(s)}{X_1(s)}$ for the system shown in Fig. Q4 (b). **(10 Marks)**

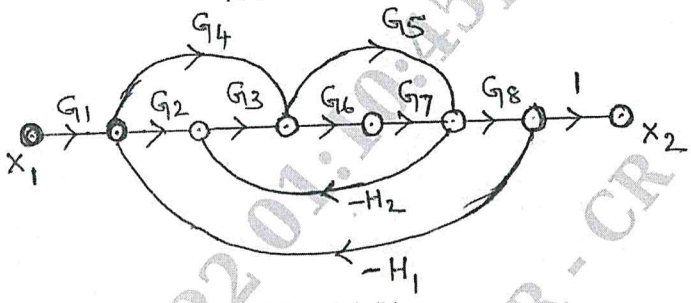


Fig. Q4 (b)

## Module-3

5 a. Obtain an expression for a second order system subjected to unit step response for an under damped system. **(08 Marks)**

b. An unity feed back system with $G(S)=\frac{9}{S^3+RS^2+3KS}$ is conditionally stable. Find $K_{mar}$ and R, if the system oscillates with a frequency of 6 radians/sec. **(06 Marks)**

c. A system is represented by $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+8y=8x$, where y is the output and x is the input. Find (i) Delay time (ii) % $M_p$ (iii) Settling time. **(06 Marks)**

**OR**

6 Plot the root locus for the given transfer function $G(s)H(s)=\frac{K}{s(s+2)(s+4)(s+6)}$. Find the range of K and comment on the stability of the system. **(20 Marks)**

## Module-4

7 a. Sketch the polar plot for the system with $G(s)H(s)=\frac{1}{(1+T_1s)(1+T_2s)(1+T_3s)}$. **(06 Marks)**

b. Sketch the Nyquist plot for the system with $G(s)H(s)=\frac{40}{(s+4)(s^2+2s+2)}$. Comment on the stability of the system. **(14 Marks)**

**OR**

8 Sketch the Bode plot for the system with $G(s)H(s)=\frac{2(s+0.25)}{s^2(s+1)(s+0.5)}$. 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)**



## Module-5

9 a. What is system compensation? Explain the two types of system compensation. **(06 Marks)**

b. Explain Lead compensation. Enumerate the effects and limitations of lead compensator. **(07 Marks)**

c. Explain Lag compensation. Enumerate the effects and limitations of Lag compensator. **(07 Marks)**

**OR**

**10** a. Explain the following terms:

(i) State variables.
(ii) State vector.
(iii) State
(iv) State space.
(v) State tajectory. **(05 Marks)**

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

$$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u;$$

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} X$$

**(15 Marks)**

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