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# 328556(28)

## B. E. (Fifth Semester) Examination, April-May 2021

**(New Scheme)**

**(Et & T Branch)**

## AUTOMATIC CONTROL SYSTEM

***Time Allowed : Three hours***

***Maximum Marks : 80***

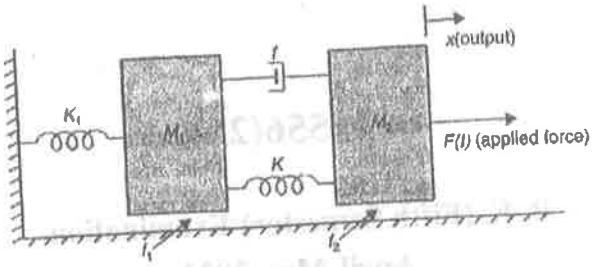
***Minimum Pass Marks : 28***

***Note :*** *Part (a) of each question is compulsory. Attempt any* ***two*** *parts from (b), (c) and (d) from each question.*

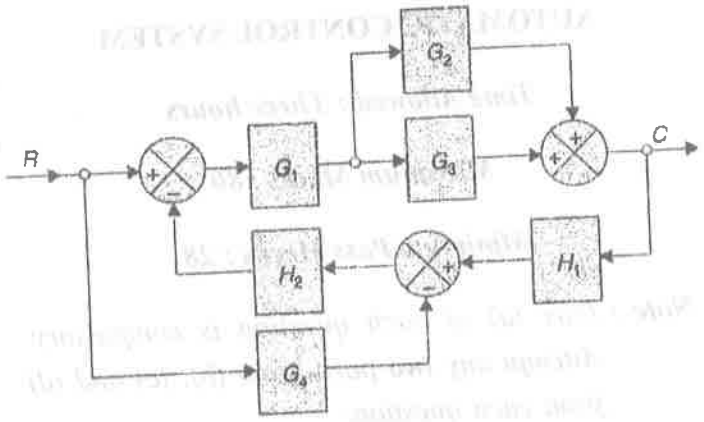
### Unit-I

1. (a) Explain Force Current Analogy and Force Voltage analogy. 2

(b) Obtain the transfer functions of the mechanical systems shown in fig. 7



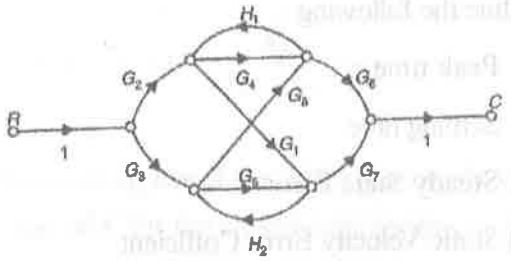

(c) Reduce the following block diagram using block diagram reduction techniques. And calculate the transfer function. 7




(d) Obtain the overall transfer function C/R from the signal flow graph shown in fig. using Mason Gain Formulae. 7








## Unit-II

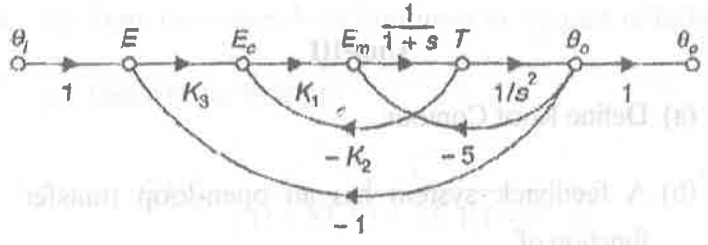
2. (a) What is Regenerative Feedback? 2

(b) A servo system is represented by the signal flow graph shown in fig. The variable $T$ is the torque and $E$ is the error. 7

Determine :

(i) The overall transmission if, $K_1 = 1, K_2 = 5$ and $K_3 = 5$;

(ii) The sensitivity of the system to changes in K1 for $\omega = 0$



(c) Define the following : 7

(i) Peak time

(ii) Settling time

(iii) Steady State Error

(iv) Static Velocity Error Cofficient

(v) Type of Transfer Function

(d) The open-loop transfer function of a servo system with unity feedback is

$$G(s) = 10/s(0{\cdot}1s+1)$$

Evaluate the static error constants $\left(K_p, K_v, K_a\right)$ for the system. Obtain the steady-state error of the system when subjected to an input given by the polynomial.

$$r(t) = a_0 + a_1 t + \frac{a_2}{2}t^2$$ 7

## Unit-III

**3.** (a) Define Root Contour. 2

(b) A feedback system has an open-loop transfer function of





$$G(s)H(s) = \frac{Ke^{-s}}{s\left(s^2+5s+9\right)}$$

Determine by use of the routh criterion, the maximum value of $K$ for the closed-loop system to be stable for low value of frequencies. 7

(c) The open loop transfer function of a control system is given by

$$G(s)H(s) = \frac{K}{\left[s(s+6)\left(s^2+4s+13\right)\right]}$$

Sketch the Root Locus and Determine (a) Breakaway Points (b) The angle of departure from complex poles. 7

(d) Write short notes on system with transportation lag. 7

## Unit-IV

**4.** (a) State the principle of Argument in Nyquist criteria. 2

(b) Draw Polar Plot of

$$G(s) = \frac{1}{\left[(1+ST_1)(1+ST_2)(1+ST_3)\right]}$$

And determine the frequency at which it crosses the Real and Imaginary axis. 7

(c) Determine the value of Gain $K$ for open loop transfer function given below, so that (i) Gain margin 15 db (ii) phase margin 60°. 7

(d) Correlate between Transient response and frequency response parameters. 7

**Unit-V**

5. (a) Define State Vector. 2

(b) Construct the state model for a system characterized by the differential equation

$$\frac{d^3y}{dt^3}+6\frac{d^2y}{dt^2}+11\frac{dy}{dt}+6y=u$$

Give the block diagram representation of the state model. 7

(c) Test the system for controllability and observability of a system having following coefficient matrices. 7





$$A=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix} \quad B=\begin{bmatrix}1\\0\\1\end{bmatrix} \quad \text{and} \quad C^T=\begin{bmatrix}10\\5\\1\end{bmatrix}$$

(d) Write short notes on advantages and limitations of State Variable Technique over Classical Method. 7