53 (IE 503) CNSY-I

2018

CONTROL SYSTEM-I

Paper : IE 503

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions out of **seven**.*

1. *(a)* Define the terms like closed loop system, linear system, non-linear system, time variant system and time invariant system with suitable examples. 10

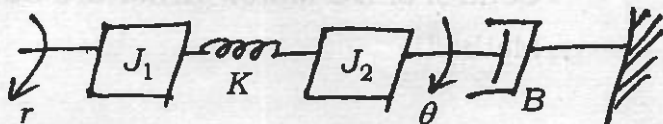   *(b)* Obtain the transfer function of the mechanical system shown in *Fig* : 01. 10

Fig : 01

2. (a) For the system represented by the block diagram shown in *Fig* : 02, determine $\dfrac{C_1}{R_1}$ and $\dfrac{C_2}{R_2}$. 16
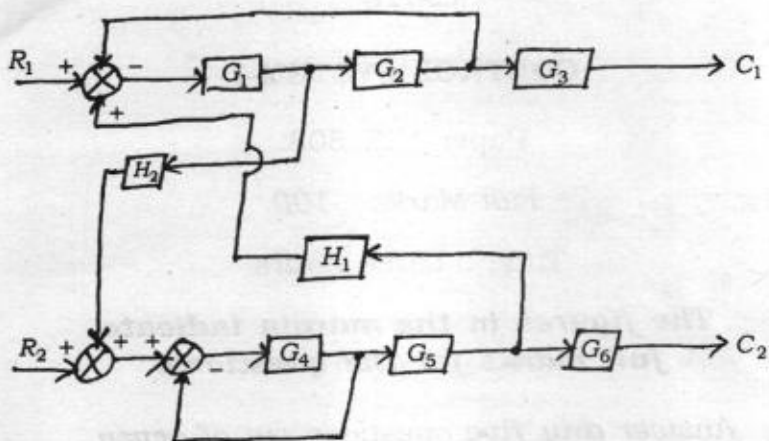

Fig : 02

(b) What is Mason's gain Formula ? Elaborate its formula. 4

3. (a) Derive the transfer function for Speed Control of DC Motor (Armature Control Method). 10

(b) A unity Feedback Control System has an open loop transfer function, $G(s) = \dfrac{20}{(s+2)(s+6)}$. Find the rise time, peak time, percentage overshoot and settling time. 10

4. (a) The open loop transfer function of a Control System is given below : 12

$$G(s)H(s) = \frac{2\left(s^2 + 3s + 20\right)}{s(s+2)\left(s^2 + 4s + 10\right)}$$

Determine the static error coefficients and steady state error for the input given as : (i) 5 (ii) $4t$ (iii) $\dfrac{4t^2}{2}$

(b) A Unity Feedback System has the Forward transfer function $G(s) = \dfrac{K_1(2s+1)}{s(5s+1)(1+s)^2}$, when the input $r(t) = 1 + 6t$. Determine the minimum value of K_1 so that the steady error is less than 0·1. 8

5. Determine the stability of a system having following characteristic equations :

   (a) $s^5 + 1 \cdot 5 s^4 + 2s^3 + 4s^2 + 5s + 10$

   (b) $s^6 + s^5 + 5s^4 + 3s^3 + 2s^2 - 4s - 8 = 0$

   20

6. (a) Sketch Bode plot for the following transfer function and determine the system gain K for the gain crossover frequency to be 5 rad/sec.

   $$G(s) = \frac{Ks^2}{(1 + 0 \cdot 2s)(1 + 0 \cdot 02s)}.$$ 10

   (b) The open-loop transfer function of a unity Feedback System is given by

   $$G(s) = \frac{1}{s(s+1)(1+2s)}.$$ Sketch the polar

   plot and determine the gain margin and phase margin.   10

7. Draw the root locus for a system having open-loop transfer function as :

   $$G(s)H(s) = \frac{K}{s(s+1)(s+3)}.$$

   Determine :

   (a) Gain Margin

   (b) Phase Margin, for $K = 6$.   20