CONTROL SYSTEMS

Full Marks – 70

Pass Marks – 28

Time – Three hours

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

Answer any *five* questions.

1. Derive the transfer function of following systems :

    (a) Field control DC motor

    (b) AC servomotor.   7+7=14

2. (a) Explain the construction and operating principle of synchro with suitable example.

           8

    (b) Define the terms :   6

         (i) Linear system

         (ii) Automatic controlled closed loop system

         (iii) Time invariant system.

[Turn over

3. (a) How the system is classified depending on the value of damping ? 4

(b) Define ramp signal and parabolic signal. 4

(c) Write the differential equation governing the mechanical rotational system shown in Fig. 1. Obtain the transfer function of the system. 6
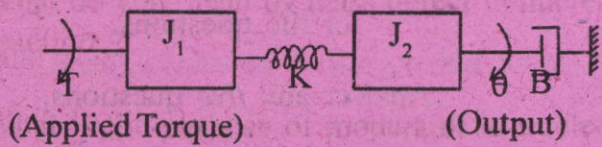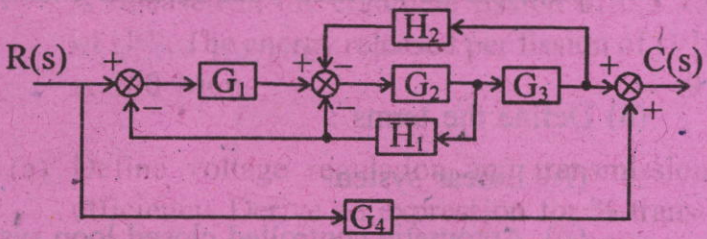

(Applied Torque)   (Output)

Fig. 1

4. Obtain the transfer function for the given below system both block diagram reduction method and Mason's gain formula (signal / flow graph method) 14

5. (a) A unity feedback control system has a open loop transfer function, $G(s) = 10/s(s + 4)$. Find the rise time, percentage overshoot, peak time and setting time for unit step input. 5

(b) For a unity feedback control system the open loop transfer function $G(s) = \dfrac{10\,(s + 4)}{s^2\,(s + 2)}$.

Find

(i) the position, velocity and acceleration error constants

(ii) the steady state error when the input is $R(s)$, where $R(s) = \dfrac{3}{s} - \dfrac{2}{2s^2} + \dfrac{1}{3s^3}$. 6

(c) Determine the position, velocity and acceleration error coefficient for a system given by

$$G(s)\,H(s) = \dfrac{100\,(s + 2)\,(s + 50)}{s^3\,(s^2 + 5s + 250)} \cdot$$

3

6. (a) Construct Routh array and determine the stability of the system represented by the characteristic equation

$s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$. Comment on the location of the roots of characteristic equation. 7

(b) Consider a unity feedback system with a closed loop transfer function

$$\frac{C(s)}{R(s)} = \frac{Ks + b}{s^2 + as + b}.$$

Determine open loop transfer function G(s). Show that steady state error with unit ramp input is given by $\frac{(a - k)}{b}$.   7

7. (a) What are the rules to construct root locus ?   6

(b) Define the terms given below :   8

(i) Time response

(ii) Frequency response

(iii) Gain margin

(iv) Phase margin.