T.E. Electrical VI CBGS
C.S. -I

8.12.15

Q.P. Code : 6384

(3 Hours) **[Total Marks : 80**

NOTE:

1. Question **No. 1** is compulsory.
2. Attempt any **Three** questions from remaining.
3. Use graph paper and semi log paper where necessary.
4. Assume suitable data wherever necessary.

Q1 Solve any **Four**

a. Explain working of AC servo motor. (5)
b. Explain transient response specifications. (5)
c. Compare translation system with rotational system. (5)
d. Derive the expression to obtain transfer function from state space. (5)
e. Explain how Type of system affects the steady state error of the system. (5)
f. With the help of polar plot explain the effect of adding more poles. (5)

Q2 a. Determine the transfer function, C_1/R_1, C_2/R_2, C_1/R_2 and C_2/R_1 for the circuit given in Figure 1. (10)

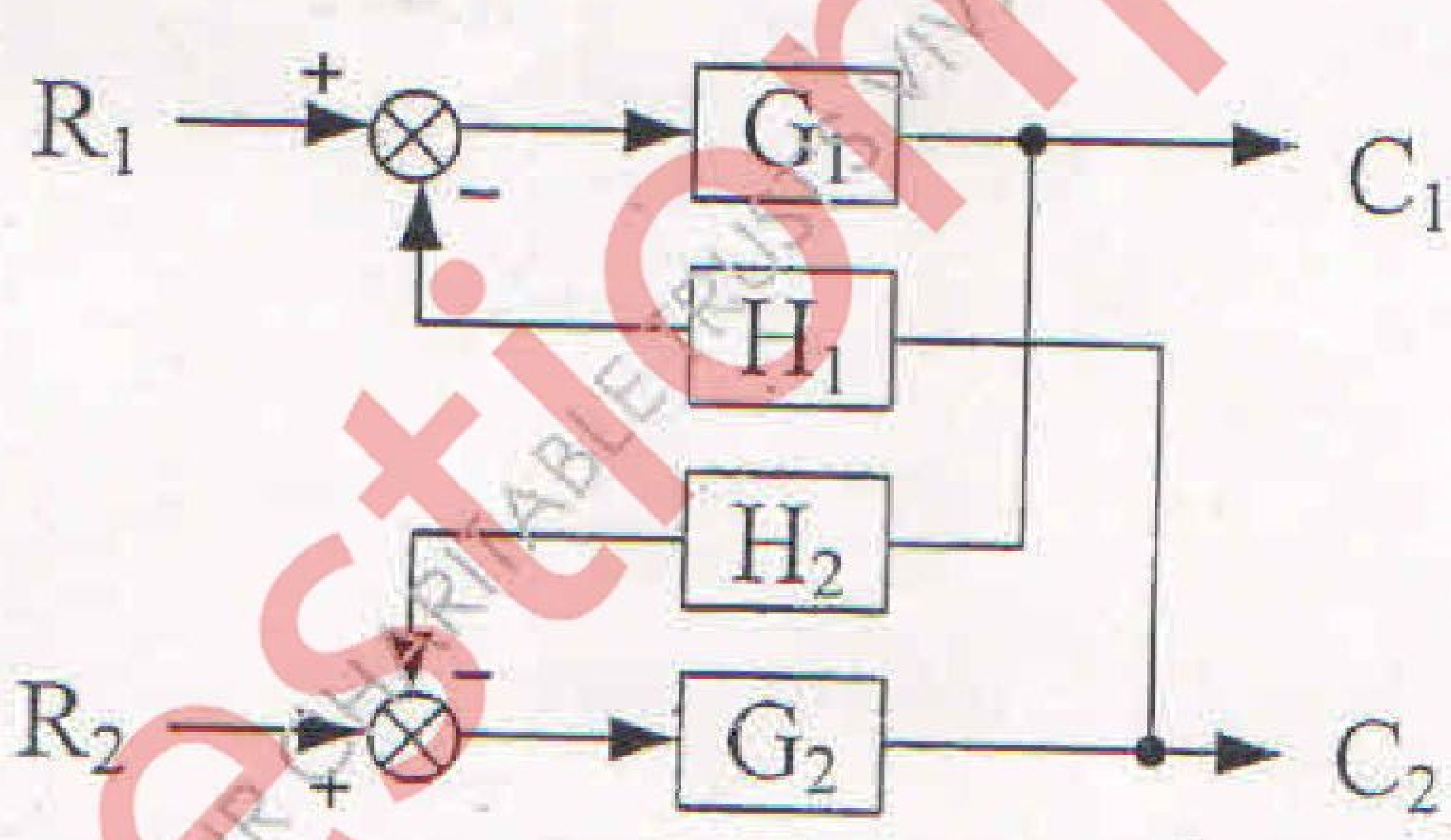

Figure 1 (Q.2 a)

[TURN OVER

MD-Con. 10376-15.

T.E. Electrical VI CBGS
C.S-I

(13)

8.12.15

Q2 b. Find the equivalent transfer function, $T(s) = C(s)/R(s)$, for the system shown in Figure 2 using masson's gain formula. (10)

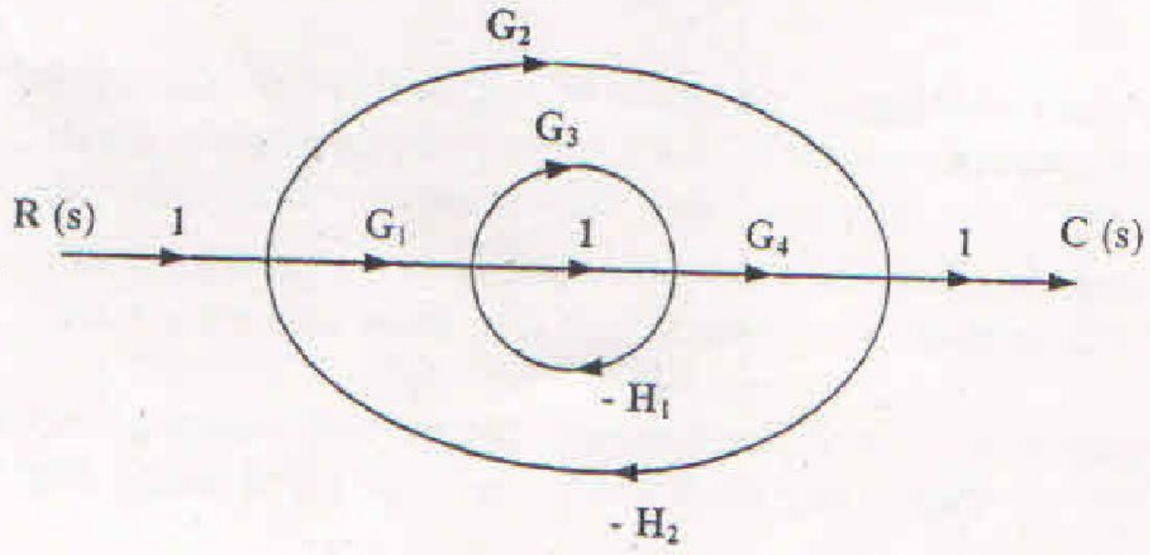

Figure 2 (Q.2 b)

Q3 a. Given the mechanical system in Figure 3, find the transfer function $X_2(s) / X_1(s)$. (10)

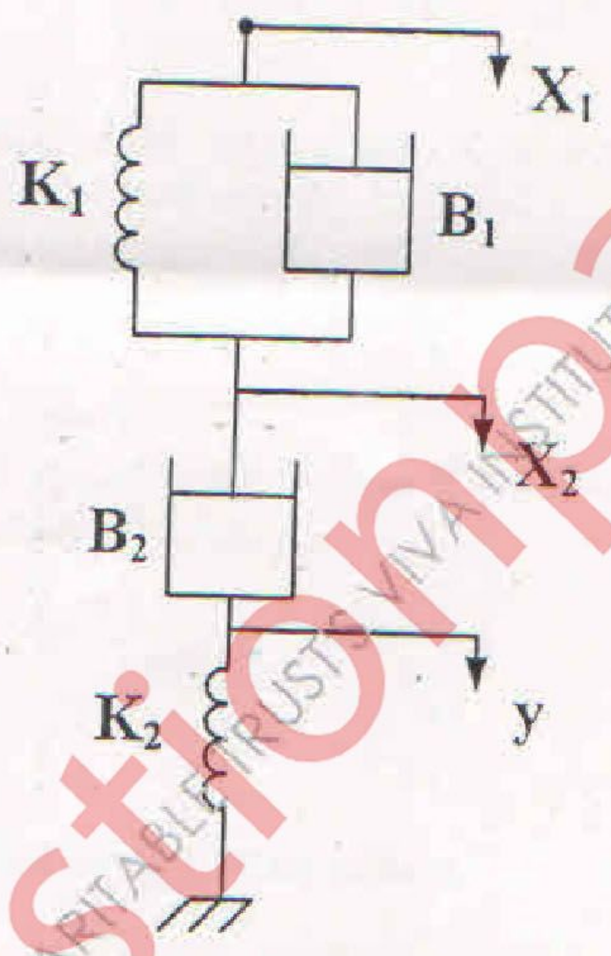

Figure 3 (Q. 3 a)

b. Measurement conducted on a servomechanism show the system response to be (10)

$$c(t) = 1 + 0.2\,e^{-60t} - 1.2\,e^{-10t}$$

When subjected to a unit step input.

(i) Obtain the expression for the closed loop transfer function.

(ii) Determine the undamped natural frequency, damping ration of the system, percentage peak overshoot and settling time.

Q4 a. A unity feedback (negative) system has open loop transfer function (10)

$$G(s) = \frac{K}{s(s+2)}$$

(i) Calculate the value of gain K so that the closed loop system has steady – state unit ramp error of 0.1. What are corresponding damping factor and percentage peak overshoot.

(ii) The system is now modified to include a forward path zero at s = - 6. What is the new value of K for the steady – state error as in part (i).

b. For the following system represented in state space, find out how many poles are in the left half- plane, in the right half- plane and on jw – axes. (10)

$$\dot{x} = \begin{bmatrix} 2 & 1 & 1 \\ 1 & 7 & 1 \\ -3 & 4 & -5 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = [0 \ 1 \ 0]\, x$$

Q5 a. Sketch the root locus and find the range of gain K for system stability for a unity feedback system with the forward transfer function . (10)

$$G(s) = \frac{K}{(S+4)^3}$$

b. For given unity feedback system draw Bode plot and determine G.M., P.M., Wgc and Wpc . Comment on stability. (10)

$$G(s) = \frac{e^{-0.2s}}{s(s+1)}$$

Q6 a. Obtain the time response of the following system. (10)

$$\dot{x} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} x + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

where $u(t)$ is a unit step occurring at $t = 0$ and $X^T(0) = [\,1 \quad 0\,]$.

b. Discuss the stability of system using Nyquist plot for (10)

$$G(s)H(s) = \frac{20}{s(s+4)(s-2)}$$