

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)

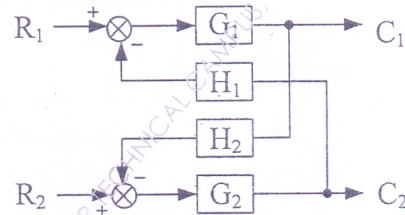


Figure 1 (Q.2 a)

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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)

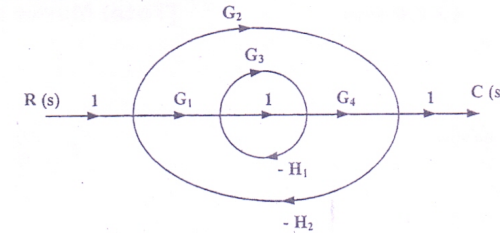


Figure 2 (Q.2 b)

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

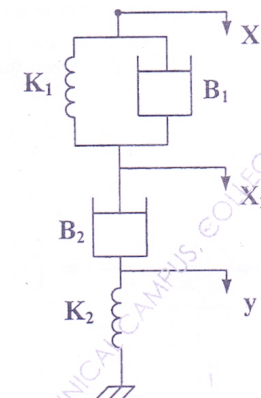


Figure 3 (Q. 3 a)

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.

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- 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 $j\omega$ - 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 $X^T(0) = [1 \ 0]$.

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

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