Reg. No. : | | | | | | | | | | |

Question Paper Code: 34501

B.E. / B.Tech. DEGREE EXAMINATION, DEC 2021

Fourth Semester

Electronics and Instrumentation Engineering

01UEI401 – CONTROL ENGINEERING

(Regulation 2013)

Duration: Threehours   Maximum: 100 Marks

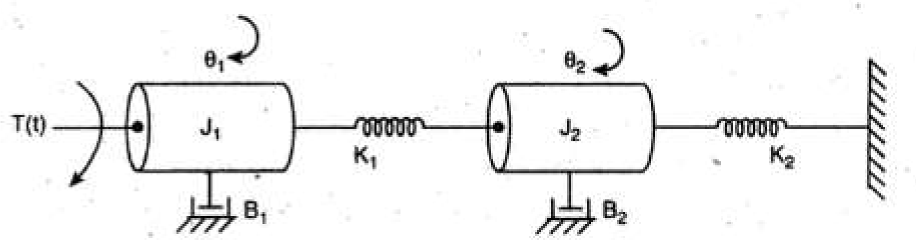
Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

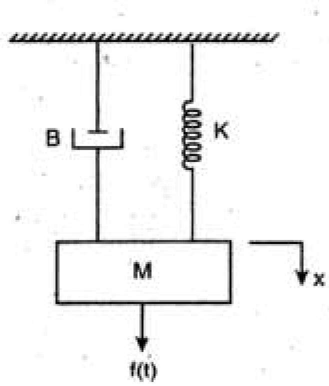
1. Compare open loop and closed loop control system.
2. State the rule for shifting the summing point ahead of a block.
3. Define steady state error.
4. What is positional error coefficient? Explain.
5. What are the frequency domain specifications?
6. What is compensator?
7. State Nyquist stability criterion.
8. Define centroid.
9. Define sampling theorem.
10. Write the solution of homogeneous state equations.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) For the mechanical system shown in figure write the differential equations and hence find $\frac{\theta_2(s)}{T(s)}$. (8)

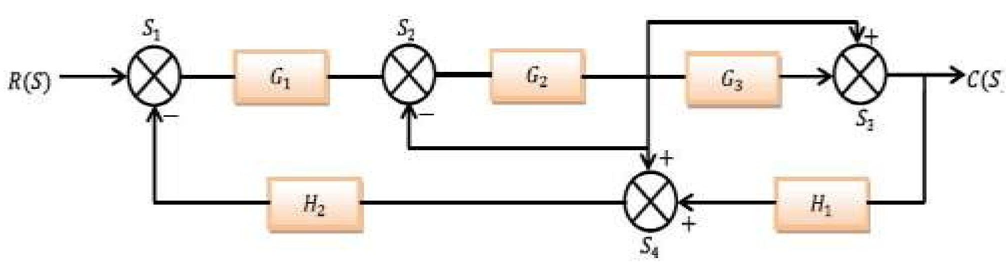


(ii) Draw the force-voltage and force-current analogous circuits for the given mechanical system. (8)



Or

(b) Draw the signal flow graph and find *C(S) / R(S)* using Mason's gain formula for the system shown in figure. (16)



12. (a) The open loop transfer of a feedback control system with unity feedback given by

$$G(s) = \frac{40}{s(1 + 0.5s)}$$

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Find the error constants for the system. Also obtain the steady state error when the input is $r(t) = 1 + 5t + 10t^2$. (16)

Or

(b) Closed loop transfer function of a system with unity feedback is given by $C(s)/R(s) = (Ks + b) / (s^2 + as + b)$. Find the open loop transfer function $G(s)$ and also show that Steady state error with unit ramp input is given by $(a-k) / b$. (16)

13. (a) The open loop transfer function of unity feedback system is given by $G(s) = \frac{10(s+2)}{s(s+1)(s+3)}$. Sketch the polar plot and determine the gain margin and phase margin. (16)

Or

(b) A unit step input is applied to a unity feedback control system having open loop transfer function $(s) = \frac{K}{s(1+sT)}$. Determine the values of K and T to have M_p=20% and resonant frequency $\omega_r = 6\ rad/sec$. Calculate the resonant peak M_r. (16)

14. (a) Sketch the root locus for the unity feedback system whose open loop transfer function is given by $G(s) = \frac{K}{s(s^2 + 6s + 10)}$. Determine the range of 'K' for which the system to be stable. (16)

Or

(b) Using Nyquist Criterion obtain the range of values of K for which the system with open loop transfer function $G(s)H(s) = \frac{K(s+1)}{[s^2(s+2)(s+4)]}$ (16)

15. (a) A LTI system is characterized by the state equation

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

Where 'u' is a unit step function. Compute the solution of these equation assuming initial condition $x_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ (16)

Or

(b) (i) Compute $x_1(t)$ and $x_2(t)$ of the system described by $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -3 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$,

where the initial conditions are $\begin{bmatrix} x_1(0) \\ x_2(0) \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$. (8)

(ii) Compute the transfer function of a linear time-invariant system is represented by the state equation $\dot{X} = \begin{bmatrix} 0 & 3 \\ 0 & -2 \end{bmatrix} X + \begin{bmatrix} 1 \\ 1 \end{bmatrix} U$ and $Y = [2 \quad 1] X$. (8)
