Reg. No. :

Question Paper Code: 34501

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

Fourth Semester

Electronics and Instrumentation Engineering

01UEI401 – CONTROL ENGINEERING

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

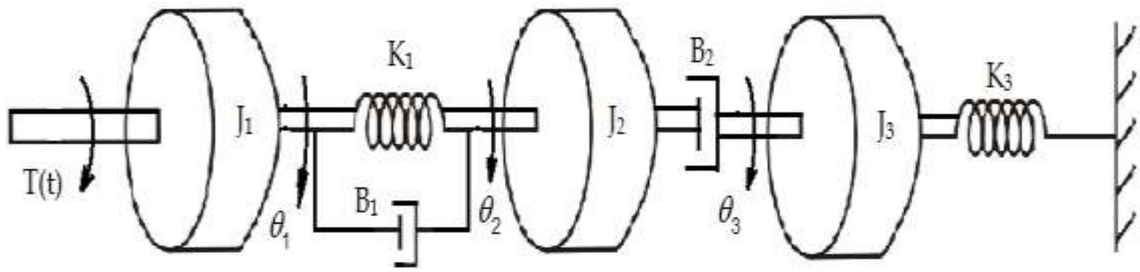
Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. Distinguish open loop and closed loop control system with an example.
2. List the steps involved to obtain the mathematical model for a physical system.
3. Calculate the value of damping ratio for a unity feedback system with open loop transfer function $G(s) = \frac{9}{s(s+2)}$
4. Identify the position error coefficient of a unity feedback system with $(s) = \frac{25}{s+6}$.
5. Calculate the frequency domain specification of a second order system whose closed loop transfer function is given by $\frac{C(s)}{R(s)} = \frac{64}{(s^2+10s+64)}$.
6. What is compensator?
7. Relate the roots of the characteristic equation with stability.
8. State Nyquist stability criterion.
9. What is the advantage and disadvantage in canonical form of state model?
10. Write the solution of homogeneous state equations.

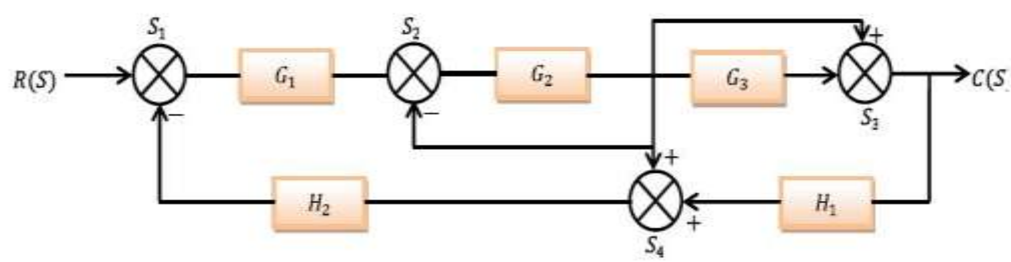
PART - B (5 x 16 = 80 Marks)

11. (a) Give the differential equation governing the mechanical rotational system for the figure shown below. Draw the torque-voltage and torque-current electrical analogous circuits and verify the same by writing mesh equations. (16)



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) Derive an expression for time response of a second order under damped unity feedback system when excited with an unit step input. (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)

34501

13. (a) Given $G(s) = \frac{Ke^{-0.2s}}{s(s+2)(s+8)}$ calculate the 'K' so that the system is stable with gain margin equal to 6 *db* and phase margin equal to 45^o . (16)

Or

(b) Design a suitable compensator for a system with open-loop transfer function is $G(S) = \frac{1}{S(S+1)(0.5S+1)}$, so that the static velocity error constant K_v is 5 sec^{-1}, the phase margin is at least 40°, and the gain margin is at least 10 *dB*. (16)

14. (a) Explain the importance of routh array for carrying out the stability analysis and find the range of 'K' for stability of unity feedback system whose open loop transfer is $G(s) = \frac{K}{s(s+1)(s+2)}$. (16)

Or

(b) Sketch the root locus of the system whose open loop transfer function is $G(s) = \frac{K}{s(s+4)(s+2)}$ Identify the value of 'K' so that the damping ratio of the closed loop system is 0.5. (16)

15. (a) Formulate the state model and draw the state diagram for the system represented by the transfer function using cascade decomposition $\frac{Y(s)}{U(s)} = \frac{s^2+5s+6}{s^3+3s^2+4s+2}$. (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)
