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

Question Paper Code: 34501

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2018

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. Define Transfer function of a system.
2. Differentiate open loop and closed loop control system.
3. Define steady state error.
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. What are asymptotes? How will you find the angle of asymptotes?
8. State Nyquist stability criterion.
9. Give any four advantages of state space analysis.
10. List the properties of state transition matrix.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) Find the transfer function V_0 (S) / V_i (S) of the given electrical network Fig.1.

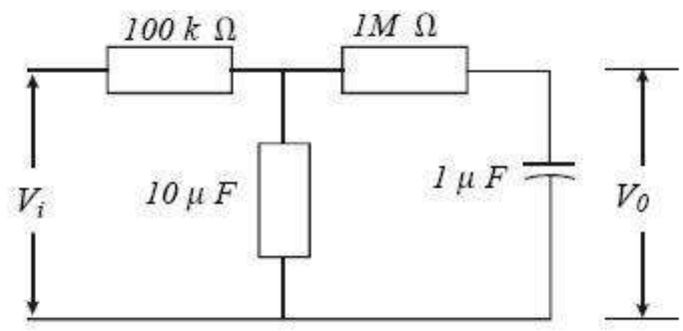


Fig. 1 (8)

(ii) Find the transfer function of the Mechanical system shown in Fig. 2.

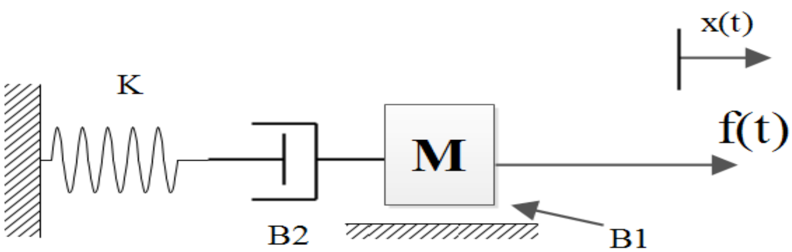
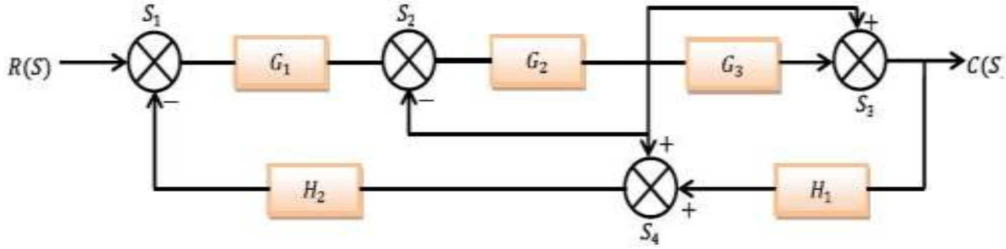


Fig. 2 (8)

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)



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12. (a) (i) Consider $G(s) = \frac{1}{s(1+0.5s)(1+0.2s)}$ in a control system having unity feedback. Calculate the values of ω_n, ξ, M_p, t_s and ω_d for unit step input. (8)

(ii) Derive the time response relation for a under damped second order system. (8)

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 $(a\text{-}k) / b$. (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) 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) 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) 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) (i) Derive the relationship between the state equation and transfer function. (8)

(ii) Obtain the transfer function of the system defined by the following state equations

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -2 & 1 \\ 1 & -2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$Y = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

(8)

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)
