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Question Paper Code : 91721

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019
Fifth Semester
Instrumentation and Control Engineering
IC 6501 – CONTROL SYSTEMS
(Common to Electrical and Electronics Engineering/Electronics and Instrumentation Engineering)
(Regulations 2013)
(Also Common to PTIC 6501 – Control Systems for B.E. Part time for Third Semester – Electrical and Electronics Engineering – Regulations 2014)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. List the characteristics of negative feedback in control system.
2. Write the expression for Mason's gain formula.
3. Distinguish between type and order of a system.
4. What is the effect on system performance when a proportional controller is introduced in a system ?
5. Why frequency domain analysis is needed ?
6. Show the shape of the polar plot for the transfer function $K/s\ (1 + sT_1)\ (1 + sT_2)$.
7. How are the roots of the characteristic equation of a system related to stability ?
8. Draw the electric lag network and its pole-zero plot.
9. What is meant by state space ?
10. When a system is said to be completely observable ?

PART – B (5×13=65 Marks)

11. a) i) Explain open loop and closed loop systems with suitable examples. (6)

ii) Derive the transfer function for an armature controlled DC motor. (7)

(OR)

b) Obtain the transfer function of the mechanical systems shown in the following Figure 11 (b). (13)

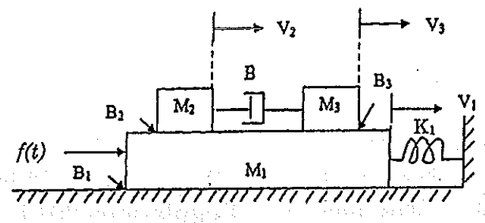

Figure 11 (b)

12. a) Derive the time domain specifications of a second order system.

(OR)

b) i) For a Unity feedback control system, the open loop transfer function is given by $G(S) = \frac{10(S+2)}{S^2(S+1)}$

1) Find the position, velocity and acceleration error co-efficients.

2) Also find the steady state error when the input is

$R(S) = \frac{3}{S} - \frac{2}{s^2} + \frac{1}{3s^3}$. (8)

ii) With a neat diagram explain the effect of PD controller in detail. (5)

13. a) Sketch the Bode plot and hence find Gain cross over frequency. Phase cross over frequency, gain margin and phase margin for the function

$G(s) = \frac{10(s+3)}{s(s+2)(s^2+4s+100)}$.

(OR)

b) Sketch the polar plot for the following transfer function and find Gain cross over frequency, phase cross over frequency, gain margin and phase margin for $G(s) = 400/s(s+2)(s+10)$.

14. a) i) Use the routh stability criterion, determine the range of K for stability of unity feedback system whose open loop transfer function is

$G(s) = \frac{K}{s(s+1)(s+2)}$. (10)

ii) State Routh stability criterion. (3)

(OR)

b) Design a lead compensator for a unity feedback system with open loop transfer function, $G(s) = \frac{K}{s(s+1)(s+5)}$ to satisfy the following specifications

i) Velocity error constant, $K_v \geq 50$

ii) Phase margin ≥ 20 degrees. (13)

15. a) i) Obtain the state model of the mechanical system shown in Fig. 11 (b) (i) in which f(t) is the input and $y_2(t)$ is the output. (8)

ii) State and prove the properties of State Transition Matrix. (5)

(OR)

b) Check for controllability and observability of a system having following coefficient matrices.

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}; B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}; C^T = \begin{bmatrix} 10 \\ 5 \\ 1 \end{bmatrix}$$

PART – C (1×15=15 Marks)

16. a) Draw the signal flow graph and find the closed loop transfer function of a system whose block diagram is shown in Figure 16 a). (15)

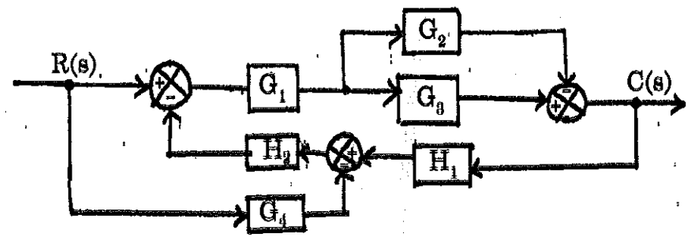

Figure 16 a)

(OR)

b) The open loop transfer function of a unity feedback system is given by $G(s) = K/[s(1+0.2s)(1+0.05s)]$. Construct Nyquist plot and find the range of K for stability. (15)