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Question Paper Code : 11236

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Third Semester

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Electronics and Communication Engineering

EC 3351 – CONTROL SYSTEMS

(Common to : Electronics and Telecommunication Engineering)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Compare feedback and feedforward control.
2. List some advantages of signal flow graph over block diagram method.
3. A second order system has a damping ratio of 0.6 and frequency of oscillation is 10 rad/sec. Determine the damped frequency of oscillation.
4. Compare PI and PD control action.
5. Define phase cross over frequency of a system.
6. Determine the resonant frequency for a system with natural frequency of oscillation 5 rad/sec and damping ratio 0.5.
7. Define BIBO stability of a linear system.
8. What are asymptotes? Give the equation for finding angle of asymptotes.
9. List the advantages of state space modeling using physical variable.
10. What are the conditions for defining a system as completely controllable?

PART B — (5 × 13 = 65 marks)

11. (a) Find the transfer function of the system $\theta(S)/T(S)$ shown in Figure 11(a)

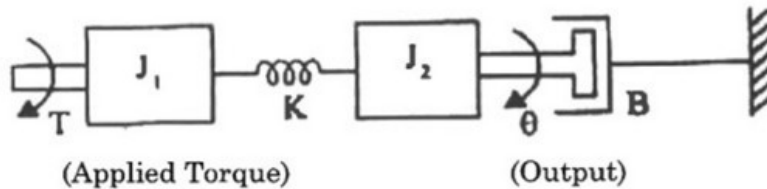


Figure 11(a)

Or

- (b) Determine the closed loop transfer function $C(S)/R(S)$ of the system represented by block diagram shown in Figure 11(b).

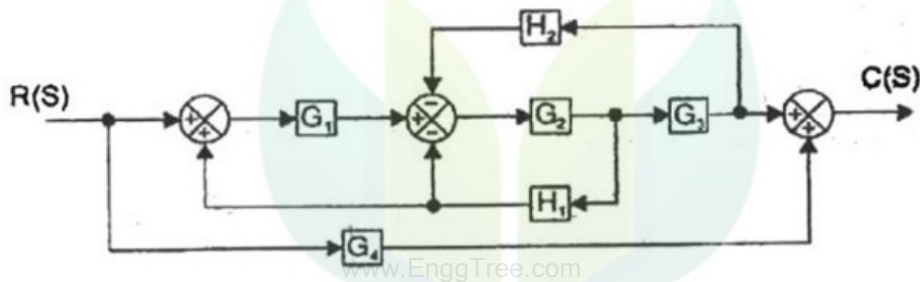


Figure 11(b)

12. (a) (i) A system is with open loop transfer function $G(S) = K / S(S + 10)$. Determine the value of K for damping ratio of 0.5 also calculate its settling time, peak overshoot peak time of the system when subjected with unit step input. (7)
- (ii) For the unity feedback control system calculate the position error and velocity error constant defined by transfer function $G(S) = \frac{10(S + 2)}{S^2(S + 1)}$. (6)

Or

- (b) In the three mode controller for the operating modes mentioned below discuss its characteristics with block diagram also derive its transfer function
- (i) P + I control action (6)
- (ii) P + D control action (7)

13. (a) For the open loop transfer function given below draw the bode plot and determine its gain margin, phase margin and gain cross over frequency

$$G(S) = \frac{20}{S(1 + 3S)(1 + 4S)}.$$

Or

- (b) Sketch the polar plot, also determine the gain margin and phase margin of the system if the open loop transfer function of unity feedback system is given by $G(S) = \frac{1}{S(1 + S)(1 + 2S)}$.

14. (a) Determine the location of roots of the characteristic equation given below using Routh criterion also comment the stability of the system.

$$(i) \quad 2S^5 + 2S^4 + 5S^3 + 5S^2 + 3S + 5 = 0 \quad (6)$$

$$(ii) \quad 2S^6 + 4S^5 + S^4 - 32S^3 + 51S^2 + 3S + 15 = 0 \quad (7)$$

Or

- (b) Sketch the root locus of the unity feedback control system with its open loop transfer function given as $G(S) = \frac{K}{S(S^2 + 4S + 13)}$.

15. (a) (i) Determine the state model of armature controlled dc motor. (8)
(ii) Estimate the state controllability using Kalman's test if the system is described as follows (5)

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}; B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \text{ and } C = [3 \quad 4 \quad 1].$$

Or

- (b) Derive the state-space representation of the system with the given transfer function $\frac{Y(S)}{U(S)} = \frac{10(S + 4)}{S(S + 1)(S + 3)}$ using both canonical model method and signal flow graph method. Also sketch its state diagram.

PART C — (1 × 15 = 15 marks)

16. (a) Discuss the role of compensators in control system also construct a suitable lag compensator for the system given below such that the velocity error constant = 20 sec and phase margin = 40°.

Or

- (b) (i) Derive the solutions of Homogeneous state equations. (7)
(ii) Compute state transition matrix for the following system.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u. \quad (8)$$

