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Question Paper Code : 72004

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Fifth Semester

Electrical and Electronics Engineering

IC 6501 — CONTROL SYSTEMS

(Common to Electronics and Instrumentation Engineering/Instrumentation and Control Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Why negative feedback is preferred in closed loop control system?

2. What is block diagram? State its components.

3. Define maximum peak overshoot.

4. Determine type and order of the following system $G(s)H(s) = 10/[S^3(S^2 + 2s + 1)]$

5. What is meant by frequency response?

6. State about Lead-Lag compensation.

7. What is characteristic equation?

8. State Nyquist stability criterion.

9. Draw the block diagram representation of a state model.

10. What is controllability?

PART B — (5 × 16 = 80 marks)

11. (a) Write the differential equations governing the mechanical translational system shown in figure1. Draw the electrical equivalent analogy circuits. (16)

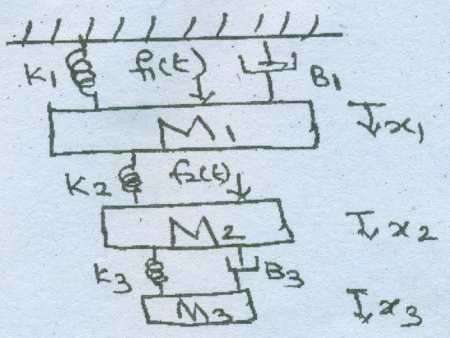

Figure.1.

Or

(b) (i) With its operating principle derive the transfer function of AC servo motor in control system. (12)

(ii) Compare open loop and closed loop control systems. (4)

12. (a) Derive the time response of Undamped and Critically damped second order system for unit step input. (16)

Or

(b) (i) A unity feedback control system has an open loop transfer Function $G(s) = 10/[s(s+2)]$. Find the rise time, peak time, percentage overshoot and settling time for step input of 12 units. (8)

(ii) For servomechanisms, with open loop transfer function given below explain what type of input signal give rise to a steady state error and calculate their values.

(1) $G(s) = [20(s+2)]/s(s+1)(s+3)]$

(2) $G(s) = 10/[(s+2)(s+3)]$. (8)

13. (a) Plot the Bode plot for the following transfer function and determine the phase and gain cross over frequencies. $G(s) = 10/[s(1+0.4s)(1+0.1s)]$. (16)

Or

(b) The open loop function of a unity feedback system is given by $G(s) = 1/[s(1+s)(1+2s)]$. Sketch the polar plot and determine the gain and phase margin. (16)

14. (a) (i) Using Routh criterion, determine the stability of a system representing the characteristic equation $S^4+8S^3+18S^2+16S+5=0$ Comment on location of the roots of the characteristics equation. (6)

(ii) Write down the procedure for designing Lag compensator using Bode plot. (10)

Or

(b) Explain in detail the realization of Lag, Lead and Lag-Lead electrical networks. (16)

15. (a) Check the controllability and observability of the system whose state space representation is given as (16)

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}-1 & 0 & 0\\ 1 & -2 & 0\\ 2 & 1 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}10\\ 1\\ 0\end{bmatrix}u \quad y=\begin{bmatrix}1 & 0 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$

Or

(b) (i) What are state variables? Explain the state space formulation with its equation. (8)

(ii) Given that

$A_1=\begin{bmatrix}\sigma & 0\\ 0 & \sigma\end{bmatrix}$; $A_2\begin{bmatrix}0 & w\\ -w & 0\end{bmatrix}$; $A=\begin{bmatrix}\sigma & w\\ -w & \sigma\end{bmatrix}$ Compute state transistion matrix. (8)
