Library B.E. (Elect) VII (Rev) 15/12/07
Control System - II
Master

Con. 5600-07. (REVISED COURSE) CD-7077

(3 Hours) [Total Marks : 100

N. B. : (1) Question No. **1** is **compulsory**.
(2) Answer any **four** out of remaining **six** questions.
(3) Assume **suitable** data wherever **required**.
(4) Figures to the **right** indicate **full** marks.

1. Attempt any **five** :—
   - (a) Describe the meaning of relative stability in reference with s-plane and Bode diagram. 4
   - (b) Explain in short with diagrams, the controller configurations used in controller design. 4
   - (c) Explain in short 4
     - (i) Random effects and
     - (ii) Disturbance Rejection.
   - (d) Explain the need of state estimator (observer) in designing controller via state-space approach. 4
   - (e) Explain the meaning of stability if the system is defined in discrete time. 4
   - (f) Explain in short – 4
     - (i) Tracking effectiveness
     - (ii) Systematic effects.

2. A unity feedback system with forward transfer function $G(s) = \dfrac{k}{s(s+7)}$, is operating with closed loop step response that has 15% overshoot. Do the following :– 20
   - (a) Estimate the setelling time
   - (b) Design a lead compensator to decrease the setelling time by three times. Choose the compensators zero to be at −10, Use Root locus technique.

3. Consider the unity feedback system with $G(s) = \dfrac{k}{(s+2)(s+4)(s+6)}$, 20

   Design a compensator that will yield Kp = 20 without appreciably changing the dominant pole location that yields a 10% overshoot for the uncompensated system. Use root locus technique.

4. For a unity feedback system with a forward transfer function – 20

$$G(s) = \frac{k}{s(s+50)(s+120)}$$

Use frequency response techniques to design a lag compensator that will improve the steady-state error tenfold, while still operating with 20% overshoot.

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5. Design a linear state-feedback controller to yield 20% overshoot and a settling time of 2 seconds for a plant, **20**

$$G(s) = \frac{(s+6)}{(s+9)(s+8)(s+7)},$$

that is represented in state space in cascade form by,

$$[\dot{z}] = [A][z] + [B]u = \begin{bmatrix} -7 & 1 & 0 \\ 0 & -8 & 1 \\ 0 & 0 & -9 \end{bmatrix}[z] + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}[u]$$

$$y = [c][z] = [-1 \;\; 1 \;\; 0][z]$$

6. Design an observer for the plant $G(s) = \frac{1}{(s+7)(s+8)(s+9)}$ **20**

whose estimated plant is represented in state space in cascade form as –

$$[\dot{\hat{z}}] = [A][\hat{z}][B]u = \begin{bmatrix} -7 & 1 & 0 \\ 0 & -8 & 1 \\ 0 & 0 & -9 \end{bmatrix}[\hat{z}] + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}u$$

$$[\hat{y}] = [c][\hat{z}] = [1 \;\; 0 \;\; 0][\hat{z}]$$

The closed-loop step response of the observer is to have 10% overshoot with 0·1 second settling time.

7. Write short notes on any **two** :— **20**
   (i) Controllability and Observability
   (ii) Antialias Prefilters
   (iii) A/D and D/A converters.