SC -121

Total No. of Pages : 3

Seat No.	

T.E. (Electrical) (Semester-V) (New) Examination, November-2019

CONTROL SYSTEM - II

Sub. Code :66253

Day and Date : Friday, 29 - 11 - 2019

Time : 2.30 p.m. to 5.30 p.m.

Total Marks : 100

Instructions :
1) All questions are compulsory.
2) Attempt any two from (1) and (2) and any one question from (3).
3) Figures to the right indicate full marks.
4) Solve any two sub questions from main questions.
5) Assume suitable data wherever necessary.

SECTION-I

Q1) a) Explain objectives and characteristics of Feedback control system [8]

b) What is the importance of tunning of controller? Explain Ziegler - Nichols methods for controller tunning. [8]

c) Explain lead compensator, lag compensator and lead-lag compensator with their transfer function considering simple electrical network. [8]

Q2) a) Draw Bode plot for lag compensator. Also explain design procedure for design of lag compensator. [9]

b) Describe two degree of freedom of control. [9]

c) Explain effect of addition of poles and zeros on performance of control system. [9]

Q3) a) The open loop transfer function of uncompensated system is $G(s)=\frac{k}{s(s+1)}$ Design a suitable lead compensator of the system to meet following specifications-

Damping ratio = 0.7, settling time = 1.4 sec. [16]

b) The open loop transfer function of uncompensated system is - [16]

$G(s)=\frac{5}{s(s+2)}$. Design suitable lag compensator for the system so that $K_v = 20\ \text{sec}^{-1}$, P.M. is at least 55^0 and gain margin is at least 12 db

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SECTION-II

Q4) a) Design a state variable feedback controller for a following system by Ackermann's method so that closed loop poles are at s = $-1 \pm j2$ and at s = -4.

where,
$$\dot{x} = Ax + Bu$$
$$y = Cx + Du$$

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -4 & -7 & -9 \end{bmatrix}, \; B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \; C = [1\ 0\ 0]$$ **[8]**

b) Determine whether the system is controllable by Gilberts test. **[8]**

$$A = \begin{bmatrix} -1 & 1 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -2 \end{bmatrix}, \; B = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$$

c) Determine whether the system is observable by Kalmans test. **[8]**

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -4 & -3 & -2 \end{bmatrix} \; B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \; C = [0\ \ 5\ \ 1]$$

Q5) a) Design an observer for a given plant by direct substitution method so that designed eigen values are at s = $-2 \pm j3$ and at s = -4 **[9]**

where.
$$\dot{x} = Ax + Bu$$
$$y = Cx + Du$$

$$A = \begin{bmatrix} 3 & 2 & 0 \\ 5 & -2 & 1 \\ 0 & 4 & 0 \end{bmatrix}, \; B = \begin{bmatrix} 4 \\ 1 \\ 1 \end{bmatrix}, \; C = [0\ \ 0\ \ 1]$$

b) Derive the transfer function of observer based controller. **[9]**

c) Design an observer for the plant by direct substitution method, to yield 17.1% overshoot and settling time of 1.6 seconds. Take third closed loop pole at S = -6 $G(S) = \dfrac{(S+6)}{(S+7)(S+8)(S+9)}$ **[9]**

Q6) a) Find the Z transform for following functions **[8]**

$$F(S)=\frac{2}{\left(S^2+2S+2\right)}$$

b) Find the Z transform for following functions **[8]**

$$F(S)=\frac{2}{S\left(S^2+1\right)}$$

c) Derive the Ackermann's formula to evaluate state feedback gain matrix. **[8]**

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