SE - 129

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Seat No.	

T.E. (Electrical) (Semester - V) Examination, November - 2018

CONTROL SYSTEM - II (New)

Sub. Code : 66253

Day and Date : Wednesday, 28 - 11 - 2018 **Total Marks : 100**

Time : 10.00 a.m. to 01.00 p.m.

Instructions :
1) **Que.No.4 and 8 are compulsory. Solve any two questions from each section.**
2) **Figures to the right indicate full marks**
3) **Assume suitable data wherever necessary.**

SECTION - I

Q1) a) Explain the characteristics of PI and PD controller for step and ramp input respectively. **[8]**

b) The closed loop feedback control system is controlled by PID Controller having open loop transfer function. **[8]**

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

Determine the value of K_p, T_I and TD by Ziegler Nichols method. Also find transfer function of PID controller.

Q2) a) Derive the expression of maximum phase lead frequency (W_m) for lead compensator. **[6]**

b) The open loop transfer function of a system is **[10]**

$$G(s) = \frac{10}{s(s+4)}$$

Design a suitable compensator such that the static velocity error constant Kv=50 Sec^{-1} without appreciably changing location of original closed loop poles which is at $s = -2 \pm j\,2.4495$.

P.T.O.

Q3) The open loop transfer function of a unity feedback system is **[16]**

$$G(s) = \frac{4}{s(s+2)}$$

It is desired to modify the closed loop poles so that undamped natural frequency Wn= 4 rad/sec and damping ratio ζ=0.5. Design a lead compensator.

Q4) Consider a unity feedback system has an open loop transfer function **[18]**

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

Design a lead-lag compensator so that

a) Phase margin is 50°.

b) Gain Margin is at least 10db.

c) Static velocity error constant is 10Sec^{-1}.

SECTION - II

Q5) a) Design a state variable feedback controller for a following system by Ackermann's method so that closed loop poles are at s = −1 ± j2 and at s = −4. **[8]**

$$\dot{x} = Ax + Bu$$

$$y = Cx + Du$$

Where,

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -4 & -7 & -9 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \quad C = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$$

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

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

Q6) a) Design an observer for a given plant by direct substation method so that designed eigen values are at s = −2 ± j3 and at s = −4 **[8]**

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

Where,

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

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

Q7) a) Design an observer for a given plant by direct substitution method, to yield 5% overshoot and settling time of 4 seconds. Take third closed loop pole at S = −4. **[8]**

$$G(S) = \frac{(S+4)}{(S+1)(S+2)(S+5)}$$

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

i) $F(S) = \dfrac{2}{(s^2 + 2s + 2)}$

ii) $F(S) = \dfrac{2}{s(s^2 + 1)}$

Q8) Design a state variable feedback controller for a following system by. **[18]**

a) Transformation matrix method.

b) Direct substation method.

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

Where,

$$A = \begin{bmatrix} -7 & 1 & 0 \\ 0 & -8 & 1 \\ 0 & 0 & -9 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, C = \begin{bmatrix} -1 & 1 & 0 \end{bmatrix}$$

Assume that the desired closed loop poles are at s = −2 ± j3.9 and at s = −6.

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