

**B.Tech. Degree VI Semester (Supplementary)  
Examination, November 2006**

**CS/EC/EB/EI 605 CONTROL SYSTEMS ENGINEERING**

( 1999 Admissions onwards)

Time: 3 Hours

Maximum Marks: 100

I a) Obtain the inverse L-transform of the following functions:

$$(i) \quad F_1(s) = \frac{s^2 + 5s^2 + 9s + 7}{(s+1)(s+2)}$$

$$(ii) \quad F_2(s) = \frac{2s+12}{s^2 + 2s + 5} \quad (10)$$

b) Develop a block diagram representation for a series RLC circuit with output taken across the capacitor. Also obtain the transfer function. (10)

OR

II a) Estimate the initial value of the derivative of the function with L-transform

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

by applying initial value theorem. (10)

b) Establish force-voltage and force-current analogies. (10)

III a) Derive the unit step response a unity feedback control system with open loop transfer function  $G(s)H(s) = \frac{10(s+1)}{s^2}$ . (10)

b) Derive expressions for maximum overshoot, peak time and rise time of a standard second order system. (10)

OR

IV a) Determine the condition for the steady state error in the unit ramp response of a system with transfer function  $\frac{C(s)}{R(s)} = \frac{Ks+b}{s^2 + as + b}$  to be zero. (10)

b) Assess the stability of a system with characteristic equation  $s^4 + Ks^3 + s^2 + s + 1 = 0$ . Also determine the number of closed loop poles with positive real part if  $K = 2$ . (10)

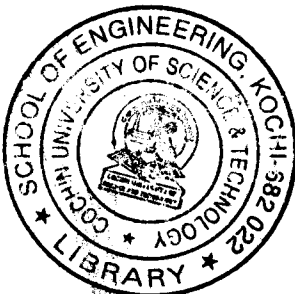
V (a) Analyze the stability of a system with open loop transfer function 0

$$G(s)H(s) = \frac{K}{s(sT_1+1)(sT_2+1)} \text{ by Nyquist stability criterion.} \quad (10)$$

(b) Sketch the bode-plot for a unity feedback control system with open loop transfer function  $G(s)H(s) = \frac{K}{s(s+1)(s+5)}$  for  $K = 10$ . Also obtain the gain and phase margins. (10)

OR

(Turn Over)



- VI. (a) Prove that the polar plot of the sinusoidal transfer function

$$G(j\omega) = \frac{j\omega T}{1 + j\omega T} \quad (0 \leq \omega \leq \infty) \text{ is a semicircle.} \quad (6)$$

- (b) Briefly explain the following:

- |                              |                         |
|------------------------------|-------------------------|
| (i) Gain Margin              | (ii) Phase Margin       |
| (iii) Resonant Peak          | (iv) Resonant Frequency |
| (v) Cut off frequency and BW |                         |
- (14)

- VII. (a) Sketch the root loci of a unity feed back system with open loop transfer function

$$G(s)H(s) = \frac{K}{s(s^2 + 9s + 18)}. \text{ Also determine the following:}$$

- (i) Range of K for stability  
 (ii) Value of K for marginal stability and corresponding value of frequency of oscillations  
 (iii) Value of K for which the damping ratio of dominant closed loop poles is 0.5. (16)
- (b) What is meant by dominant closed loop pole? What is the significance of dominant pole in system design? (4)

OR

- VIII. (a) For a unity feed back control system with open loop transfer function

$$G(s)H(s) = \frac{4}{s(s+2)}, \text{ design a lead compensator so that the static velocity error constant is 20, the phase margin is atleast } 50^\circ, \text{ and the gain margin is atleast 10dB.} \quad (16)$$

- (b) Briefly explain the effect of adding

- (i) an open loop pole  
 (ii) an open loop zero to the open loop transfer function

$$G(s)H(s) = \frac{K}{(s+a)}. \quad (4)$$

- IX. (a) Obtain a state space representation for a unity feedback system with open loop transfer

$$\text{function } G(s)H(s) = \frac{K(s+z)}{s(s+a)(s+p)}. \quad (10)$$

- (b) Obtain the time response of the following system.

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

where  $u$  is unit step occurring at  $t = 0$  and  $x_1$  and  $x_2$  are state variables. (10)

- X. Write short notes on:

- (i) Magnetic Amplifier  
 (ii) Amplidyne  
 (iii) Tacho generator (20)

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