BTS(C) – VI – 06 – 066 (B)

# *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) $F_1(s) = \dfrac{s^2+5s^2+9s+7}{(s+1)(s+2)}$

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

b) Develop a block diagram representation for a series RLC circuit with output taken cross 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 $G(s)H(s) = \dfrac{10(s+1)}{s^2}$. (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 $\dfrac{C(s)}{R(s)} = \dfrac{Ks+b}{s^2+as+b}$ 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 $G(s)H(s) = \dfrac{K}{s(sT_1+1)(sT_2+1)}$ by Nyquist stability criterion. (10)

(b) Sketch the bode-plot for a unity feedback control system with open loop transfer function $G(s)H(s) = \dfrac{K}{s(s+1)(s+5)}$ 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

$$G(jw) = \frac{jwT}{1+iwT}(0 \le w \le \infty) \text{ is a semicircle.}$$ (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

$$G(s)H(s) = \frac{K}{s(s^2+9s+18)}$$. 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

$$G(s)H(s) = \frac{4}{s(s+2)}$$, design a lead compensator so that the static velocity error

constant is 20, the phase margin is atleast $50^0$, and the gain margin is ateast 10dB. (16)

(b) Briefly explain the effect of adding

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

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

IX. (a) Obtain a state space representation for a unity feedback system with open loop transfer function $G(s)H(s) = \frac{K(s+z)}{s(s+a)(s+p)}$. (10)

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

$$\begin{bmatrix} x_1' \\ x_2' \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

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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