B. Tech Degree VI Semester Examination April 2011

CS/EC/EB/EI 605 CONTROL SYSTEMS ENGINEERING

(2002 Scheme)

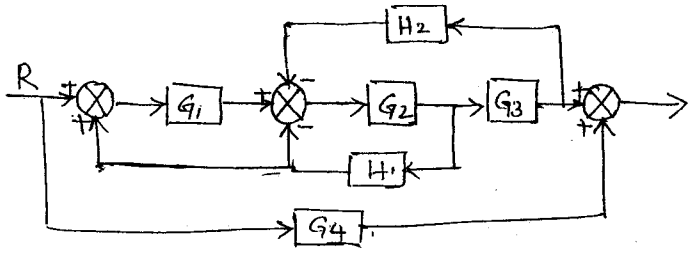
Time : 3 Hours Maximum Marks : 100

I. (a) Find the inverse Laplace transform of the function $F(s) = \dfrac{3}{s(s^2+4)}$ (5)

(b) Determine the final value of the function $f(t)$ whose Laplace transform is (5)

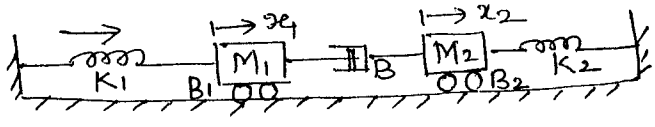
$$F(s) = \frac{2(s+1)}{s(s+3)(s+4)^2}$$

(c) Obtain the transfer function of the system using block diagram reduction technique. (10)

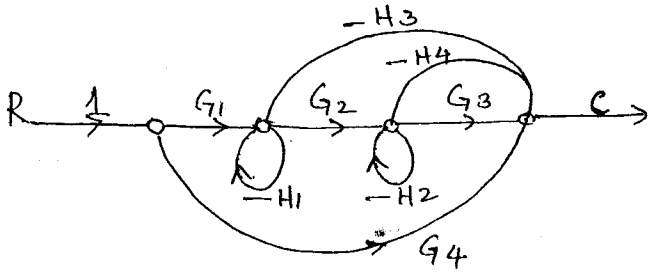


OR

II. (a) Obtain the nodal equations for the system and draw its electrical analog based on force current and force voltage analogy. (10)



(b) Determine the overall transfer function of the system using Mason's gain formula. (10)



III. (a) Obtain the unit impulse and unit step response of a unity feed back system with open loop transfer function $G(s) = \dfrac{2s+1}{s^2}$ (10)

(b) Derive the expression for unit step response of a second order underdamped system. (10)

OR

IV. (a) The open loop TF of a unity feedback control system is given by (10)

$$G(s)=\frac{K}{(s+2)(s+4)(s^2+6s+25)}$$

Using Routh's Harwitz criterion determine the stability of the system. Calculate the value of K which will cause sustained oscillations in the closed loop system and find the corresponding frequencies.

(b) Determine the error constants for a unity feed back control system whose open loop transfer function is given by $G(s)=\frac{K}{s(s+4)(s+10)}$ (10)

For $K=400$ determine the steady state error for unit ramp input.

V. (a) Explain the frequency domain specifications. (6)

(b) Draw the Bode plot for a system having $G(s)H(s)=\frac{100}{s(s+1)(s+2)}$ and find its gain margin and phase margin, (14)

OR

VI. (a) State and explain Nyquist stability criterion . (6)

(b) The open loop transfer function of a unity feed back system is (14)

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

Comment on the stability of the system using Nyquist criterion.

VII. (a) Explain the properties of root loci . (6)

(b) Sketch the root locus for a unity feed back system with open loop transfer function (14)

$$G(s)=\frac{K}{s(s^2+4s+8)}$$

OR

VIII. (a) Draw the circuit diagram of a phase lead electrical network and derive the transfer function. (6)

(b) The open loop transfer function of a unity feed back control system is $G(s)=\frac{K}{s(1+0.2s)}$. Design a suitable compensator such that the velocity error constant is at least 20 and phase margin is at least 45^0. (14)

IX. (a) Explain the terms: (8)

(i) State (ii) State variables (iii) State vector (iv) State space

(b) Obtain the solution of the system in time domain whose state equation is (12)

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ 1 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} \text{ and } x_0=\begin{bmatrix}1\\ 0\end{bmatrix}$$

OR

X. Write notes on

(i) Servo motors (7)

(ii) Magnetic amplifier (6)

(iii) Adaptive control system. (7)

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