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Tomando la grafica sabemos:

$C_{MAX} = 1.4 \quad C_{FINAL} = 1$

$\therefore T_S = 0.98\, C_{FINAL} = 0.98(1) = 0.98$

$\%OS = (1.4-1)/1 \Rightarrow \%OS = 40\%$

$$\zeta = \frac{-\ln(40/100)}{\sqrt{\pi^2 + \ln^2(40/100)}} = 0.2799$$

$$W_n = \frac{4}{(0.2799)(17.515)} = 0.8163$$

$K = (1)(0.8163)^2 = 0.6664$

$\Rightarrow$

$$G(s) = \frac{K}{s^2 + 2\zeta W_n s + W_n^2} = \frac{0.6664}{s^2 + 0.4570\, s + 0.6663}$$

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②

a) $G(S) = X(S)/F(S)$

$$F(S) = (ms^2 + f_v s + k)\,X(S)$$

$$\frac{X(S)}{F(S)} = \frac{1}{ms^2 + f_v s + k} = \frac{1/m}{s^2 + \frac{f_v s}{m} + \frac{k}{m}} \qquad G(S) = \frac{K}{s^2 + 2\xi W_n s + W_n^2}$$

b) $W_n^2 = k/m \Rightarrow W_n = \sqrt{k/m} = \sqrt{33/3} \Rightarrow W_n = 3{,}317$

$$2\xi W_n = \frac{f_v}{m} = \frac{15}{3} \Rightarrow \xi = \frac{5}{3{,}317(2)} = 0.754$$

$$\%OS = e^{-(\xi\pi/\sqrt{1-\xi^2})} \times 100 = e^{-(0.754\pi)/\sqrt{1-(0.754)^2}} \times 100 = 2.716\,\%$$

$$T_S = \frac{4}{\xi W_n} = \frac{4}{(0{,}754)(3{,}317)} \Rightarrow T_S = 1.6$$

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c)

$$f(t) = m\frac{d^2x(t)}{dt} + f_v\frac{dx(t)}{dt} + kx(t) \quad \ldots Ⓐ$$

Variables de estado:

$$a_1 = x_1 \,;\; a_2 = \dot{x}_1$$

Derivando las mismas:

$$\Rightarrow \dot{a}_1 = \dot{x}_1 = a_2 \,;\; \dot{a}_2 = \ddot{x}_1$$

De ec. Ⓐ despejo derivada mayor

$$\frac{d^2x(t)}{dt} = \frac{f(t)}{m} - \frac{f_v}{m}\frac{dx(t)}{t} - \frac{k}{m}x(t)$$

Sustituyendo

$$\dot{a}_2 = \frac{1}{3}f(t) - \frac{15}{3}a_2 - \frac{33}{3}a_1$$

$$\dot{a}_2 = \frac{1}{3}f(t) - 5a_2 - 11a_1$$

Construyendo matriz.

$$\begin{vmatrix}\dot{a}_1\\ \dot{a}_2\end{vmatrix} = \begin{vmatrix}0 & 1\\ -11 & -5\end{vmatrix}\begin{vmatrix}a_1\\ a_2\end{vmatrix} + \begin{vmatrix}0\\ 1/3\end{vmatrix} f(t)$$

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③ Tomando:

$$(SI-A)^{-1} = \frac{adj(SI-A)}{det(SI-A)} \qquad T(S) = \frac{Y(S)}{U(S)} = C(SI-A)^{-1}B + D$$

=>

$$(SI-A) = \begin{vmatrix} S & 0 & 0 \\ 0 & S & 0 \\ 0 & 0 & S \end{vmatrix} - \begin{vmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -3 & 2 & -5 \end{vmatrix} = \begin{vmatrix} S & -1 & 0 \\ 0 & S & -1 \\ 3 & -2 & S+5 \end{vmatrix}$$

ADJ:

$$Adj(SI-A) = \begin{vmatrix} S(S+5)-2 & S+5 & 1 \\ -3 & S(S+5) & S \\ -3S & 2S-3 & S^2 \end{vmatrix}$$

$$Det(SI-A) = S[S(S+5)-2]+3$$

SUSTITUYENDO:

$$T(S) = C(SI-A)^{-1}B+D$$

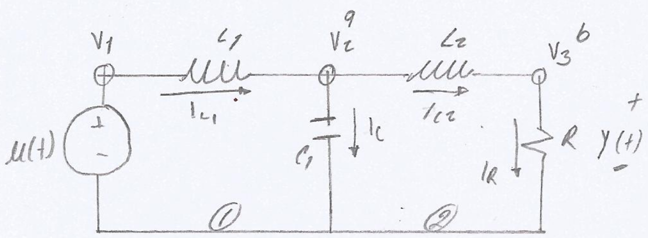
$$T(S) = [1\ 0\ 0](SI-A)^{-1}\begin{vmatrix} 0 \\ 0 \\ 10 \end{vmatrix} + 0$$

$$T(S) = \frac{10}{S[S(S+5)-2]+3} = \frac{10}{S(S^2+5S)-2S+3} = \frac{10}{S^3+5S^2-2S+3}$$

∴

$$T(S) = \frac{10}{S^3+5S^2-2S+3}$$

(4) CELAYA ORVIN




Almacenadores de flujo: $q = CV$

Almacenadores de esfuerzo $= \lambda_1 = L_1 i_1$

$\lambda_2 = L_2 i_2$

$\lambda_R = R i_R$

$V_2 = V_C \quad V_3 = V_R \quad V_1 = u(t)$

Disipador de energía: $V_R = R i_R$

Prop de estados:

$V_1 = q \qquad \dot{x}_1 = i_L$

$x_2 = \lambda_1 \qquad \dot{x}_2 = V_{L1}$

$x_3 = \lambda_2 \qquad \dot{x}_3 = V_{L2}$

Ec. de continuidad de Nodo (a)

$i_{L1} = i_C + i_{L2} \quad \ldots (1)$

$i_{L2} = i_R \quad \ldots (2)$

Ec de compatibilidad malla (1)

$-V(t) + V_{L1} + V_C = 0 \quad \ldots (3)$

Malla 2

$-V_C + V_{L2} + V_R = 0 \quad \ldots (4)$

De (1)

$i_C = i_{L1} - i_{L2}$

$i_C = \frac{1}{L_1}\lambda_1 - \frac{1}{L_2}\lambda_2$

$\dot{x}_1 = \frac{1}{L_1} x_2 - \frac{1}{L_2} x_3$

De (3)

$V_{L1} = V(t) - V_C$

$V_{L1} = V(t) - \frac{1}{C} q$

$\dot{x}_2 = u(t) - \frac{1}{C} x_1$

De (4)

$V_{L2} = \frac{1}{C} q - R i_R \leftarrow i_R = i_{L2} = \frac{1}{L_2}\lambda_2$

$V_{L2} = \frac{1}{C} q - \frac{R}{L_2}\lambda_2$

$\dot{x}_3 = \frac{1}{C} x_1 - \frac{R}{L_2} x_3$

Matriz:

$$\begin{vmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{vmatrix} = \begin{vmatrix} 0 & 1/L_1 & -1/L_2 \\ -1/C & 0 & 0 \\ 1/C & 0 & -R/L_2 \end{vmatrix} \begin{vmatrix} x_1 \\ x_2 \\ x_3 \end{vmatrix} + \begin{vmatrix} 0 \\ 1 \\ 0 \end{vmatrix} u(t)$$

SALIDA $V_R = y$

$V_R = R i_R$

$V_R = \frac{R}{L_2}\lambda_2$

$y = \frac{R}{L_2} x_3$

$\Rightarrow$

$$y = \begin{bmatrix} 0 & 0 & -\frac{R}{L_2} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + [0]\, u(t)$$