

1.- Programar la forma estándar, directa, serie y paralelo de la siguiente función de transferencia

$$G(z) = \frac{uz^{-3} + (2-u)z^{-2} + (u-3)z^{-1} + (1-\frac{u}{4})}{5uz^{-3} + (6-u)z^{-2} + (7-u)z^{-1} + (1-\frac{u}{8})}$$

u: último número del numero de cuenta del alumno

EQUIPO 2

u=2

Solución:

$$G(z) = \frac{(2)z^{-3} + (2-2)z^{-2} + (2-3)z^{-1} + (1-\frac{2}{4})}{5(2)z^{-3} + (6-2)z^{-2} + (7-2)z^{-1} + (1-\frac{2}{8})}$$

$$G(z) = \frac{2z^{-3} - 1z^{-1} + (\frac{4}{4} - \frac{2}{4})}{10z^{-3} + (4)z^{-2} + 5z^{-1} + (\frac{8}{8} - \frac{2}{8})}$$

$$G(z) = \frac{2z^{-3} - z^{-1} + (\frac{2}{4})}{10z^{-3} + 4z^{-2} + 5z^{-1} + (\frac{6}{8})}$$

$$G(z) = \frac{2z^{-3} - z^{-1} + \frac{1}{2}}{10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}} \text{ (simplificada)}$$

PROGRAMACIÓN FORMA DIRECTA

$$G(z) = \frac{Y(z)}{X(z)} = \frac{2z^{-3} - z^{-1} + \frac{1}{2}}{10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}}$$

$$G(z) = \frac{Y(z)}{X(z)} = \frac{2z^{-3} - z^{-1} + \frac{1}{2}}{10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}}$$

$$\frac{Y(z)\left(10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}\right)}{1} = \frac{X(z)\left(2z^{-3} - z^{-1} + \frac{1}{2}\right)}{1}$$

$$Y(z)\left(10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}\right) = X(z)\left(2z^{-3} - z^{-1} + \frac{1}{2}\right)$$

$$10Y(z)z^{-3} + 4Y(z)z^{-2} + 5Y(z)z^{-1} + \frac{3}{4}Y(z) =$$

$$2X(z)z^{-3} - X(z)z^{-1} + \frac{1}{2}X(z)$$

$$+ \frac{3}{4}Y(z) =$$

$$2X(z)z^{-3} - X(z)z^{-1} + \frac{1}{2}X(z) - \left(10Y(z)z^{-3} + 4Y(z)z^{-2} + \frac{3}{4}Y(z)\right)$$

$$+ Y(z) =$$

$$\frac{4}{3}\left[2X(z)z^{-3} - X(z)z^{-1} + \frac{1}{2}X(z) - \left(10Y(z)z^{-3} + 4Y(z)z^{-2} + \frac{3}{4}Y(z)\right)\right]$$

$$+ Y(z) =$$

$$\frac{4}{3}\left[2X(z)z^{-3} - X(z)z^{-1} + \frac{1}{2}X(z) - 10Y(z)z^{-3} - 4Y(z)z^{-2} - \frac{3}{4}Y(z)\right]$$

$$Y(z) =$$

$$\frac{8}{3}X(z)z^{-3} - \frac{4}{3}X(z)z^{-1} + \frac{4}{6}X(z) - \frac{40}{3}Y(z)z^{-3} - \frac{16}{3}Y(z)z^{-2} - \frac{1}{3}Y(z)$$

$$Y(z) =$$

$$\frac{8}{3}X(z)z^{-3} - \frac{4}{3}X(z)z^{-1} + \frac{2}{3}X(z) - \frac{40}{3}Y(z)z^{-3} - \frac{16}{3}Y(z)z^{-2} - \frac{1}{3}Y(z)$$

DIAGRAMA DE BLOQUES PROGRAMACION DIRECTA

PROGRAMAR FORMA ESTANDAR

$$G(z) = \frac{2z^{-3} - z^{-1} + \frac{1}{2}}{10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}} \quad (\text{simplificada})$$

$$G(z) = \frac{Y(z)}{X(z)} = \frac{2z^{-3} - z^{-1} + \frac{1}{2}}{10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}}$$

$$\frac{Y(z)}{X(z)} = \frac{Y(z)}{V(z)} \frac{V(z)}{X(z)} = \frac{2z^{-3} - z^{-1} + \frac{1}{2}}{10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}}$$

$$\frac{Y(z)}{V(z)} \frac{V(z)}{X(z)} = \left(\frac{2z^{-3} - z^{-1} + \frac{1}{2}}{1} \right) \left(\frac{1}{10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}} \right)$$

Donde:

$$\frac{Y(z)}{V(z)} = 2z^{-3} - z^{-1} + \frac{1}{2}$$

$$\frac{V(z)}{X(z)} = \frac{1}{10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}}$$

De aquí, hacemos un cambio de variable para Y(z)
y X(z), (despeje)

$$\frac{Y(z)}{V(z)} = 2z^{-3} - z^{-1} + \frac{1}{2}$$

$$Y(z) = V(z) \left(2z^{-3} - z^{-1} + \frac{1}{2} \right)$$

$$Y(z) = 2V(z)z^{-3} - V(z)z^{-1} + \frac{1}{2}V(z)$$

$$\frac{V(z)}{X(z)} = \frac{1}{10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}}$$

$$V(z) \left(10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4} \right) = X(z)$$

$$\left(10V(z)z^{-3} + 4V(z)z^{-2} + 5V(z)z^{-1} + \frac{3}{4}V(z) \right) = X(z)$$

$$\left(\frac{3}{4}V(z) \right) = X(z) - \left(10V(z)z^{-3} + 4V(z)z^{-2} + 5V(z)z^{-1} \right)$$

$$V(z) = \frac{4}{3} \left\{ X(z) - \left[10V(z)z^{-3} + 4V(z)z^{-2} + 5V(z)z^{-1} \right] \right\}$$

$$V(z) = \left\{ \frac{4}{3}X(z) - \frac{40}{3}V(z)z^{-3} - \frac{16}{3}V(z)z^{-2} - \frac{20}{3}V(z)z^{-1} \right\}$$

$$V(z) = \frac{4}{3}X(z) - \frac{40}{3}V(z)z^{-3} - \frac{16}{3}V(z)z^{-2} - \frac{20}{3}V(z)z^{-1}$$

DIAGRAMA DE BLOQUES PROGRAMACION STANDAR

PROGRAMACIÓN FORMA SERIE O CASCADA

$$H(z) = \prod_{k=1}^K H_k(z)$$

$$K = \frac{N+1}{2}$$

$$H_k(Z) = \frac{b_{k0} + b_{k1}z^{-1} + b_{k2}z^{-2} + b_{k3}z^{-3}}{1 + a_{k0} + a_{k1}z^{-1} + a_{k2}z^{-2} + a_{k3}z^{-3}}$$

Tenemos G(Z):

$$G(z) = \frac{2z^{-3} - z^{-1} + \frac{1}{2}}{10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}} \quad (\text{simplificada})$$

MEJOR:

$$G(z) = \frac{2 - z^2 + \frac{1}{2}z^3}{10 + 4z^1 + 5z^2 + \frac{3}{4}z^3}$$

Obteniendo los polos y ceros:

$$G(z) = \frac{(z - [1.5652 + j1.0434])(z - [1.5652 - j1.0434])(z - [-0.2573 + j1.4495])(z - [-0.2573 - j1.4495])}{(z - [-0.2573 + j1.4495])(z - [-0.2573 - j1.4495])}$$

Dividiendo entre Z, numerador y denominador

$$G(z) = \frac{(1 - [1.5652 + j1.0434]z^{-1})(1 - [1.5652 - j1.0434]z^{-1})(1 - [-0.2573 + j1.4495]z^{-1})(1 - [-0.2573 - j1.4495]z^{-1})}{(1 - [-0.2573 + j1.4495]z^{-1})(1 - [-0.2573 - j1.4495]z^{-1})}$$

Y un posible empaquetamiento de los polos y ceros sería:

$$G(z) = \frac{(1 - [1.5652 + j1.0434]z^{-1})(1 - [1.5652 - j1.0434]z^{-1})(1 - [-0.2573 + j1.4495]z^{-1})(1 - [-0.2573 - j1.4495]z^{-1})}{(1 - [-0.2573 + j1.4495]z^{-1})(1 - [-0.2573 - j1.4495]z^{-1})}$$

$$\begin{aligned} &1 - 1.5652z^{-1} - j1.0434z^{-1} - 1.5652z^{-1} \\ &+ (1.5652)^2 z^{-2} + (1.5652z^{-1})(j1.0434z^{-1}) \\ &+ j1.0434z^{-1} - (1.0434z^{-1})(j1.5652z^{-1}) \\ &- (j1.0434z^{-1})^2 \end{aligned}$$

$$\begin{aligned} &1 - 2(1.5652)z^{-1} + (1.5652)^2 z^{-2} \\ &- (j1.4644z^{-1})^2 \end{aligned}$$

numerador:

$$1 - 3.1304z^{-1} + 4.5943z^{-2}$$

$$G(z) =$$

$$\frac{(1 - [0.5689 + j1.4644]z^{-1})(1 - [0.5689 - j1.4644]z^{-1})(1 - [1.3425 + j4.0184]z^{-1})(1 - [1.3425 - j4.0184]z^{-1})}{(1 - [1.3425 + j4.0184]z^{-1})(1 - [1.3425 - j4.0184]z^{-1})}$$

$$\begin{aligned} &(1 - [-0.2573 + j1.4495]z^{-1}) \\ &(1 - [-0.2573 - j1.4495]z^{-1}) \end{aligned}$$

$$\begin{aligned} &(1 + 0.2573z^{-1} - j1.4495z^{-1}) \\ &(1 + 0.2573z^{-1} + j1.4495z^{-1}) \end{aligned}$$

$$\begin{aligned} &1 + 0.2573z^{-1} - j1.4495z^{-1} + 0.2573z^{-1} \\ &(0.2573)^2 z^{-2} - (0.2573z^{-1})(j1.4495z^{-1}) \\ &+ j1.4495z^{-1} + (0.2573z^{-1})(j1.4495z^{-1}) \\ &- (j1.4495z^{-1})^2 \end{aligned}$$

$$\begin{aligned} &1 - 2(0.2573)z^{-1} + (0.2573)^2 z^{-2} \\ &- (j1.4495z^{-1})^2 \end{aligned}$$

denominador

$$1 - 0.5146z^{-1} + 0.0662z^{-2} + 2.1010z^{-2}$$

$$G(z) =$$

$$\frac{(1 - 1.1378z^{-1} + 2.4681z^{-2})(1 - 4.8622z^{-1})}{(1 - 0.5146z^{-1} + 0.0662z^{-2})(1 + 6.6851z^{-1})}$$

$$G_1(z) = \frac{(1 - 1.1378z^{-1} + 2.4681z^{-2})}{(1 - 2.685z^{-1} + 17.9498z^{-2})}$$

$$G_2(z) = \frac{(1 - 4.8622z^{-1})}{(1 + 6.6851z^{-1})}$$

$$G(z) = G_1(z)G_2(z)$$

**DIAGRAMA DE BLOQUES
PROGRAMACION STANDAR**

PROGRAMACIÓN FORMA PARALELO

$$G(z) = G_1(z) + G_2(z) + G_3(z) + \dots$$

$$A = -4.1398$$

$$B = -1.8602$$

$$C = 9.3204$$

$$G(z) = \frac{2z^{-3} - z^{-1} + \frac{1}{2}}{10z^{-3} + 4z^{-2} + 5z^{-1} + \frac{3}{4}} \quad (\text{simplificada})$$

$$G(z) = \frac{-4.1398}{(z + 6.6851)} + \frac{-1.8602z + 9.3204}{(z^2 - 2.685z + 17.9498)}$$

$$G(z) = \frac{(1 - 1.1378z^{-1} + 2.4681z^{-2})(1 - 4.8622z^{-1})}{(1 - 0.5146z^{-1} + 0.0662z^{-2})(1 + 6.6851z^{-1})}$$

$$\frac{(z^2 - 1.1378z + 2.4681)(z - 4.8622)}{(z + 6.6851)(z^2 - 2.685z + 17.9498)} = \frac{A}{(z + 6.6851)} + \frac{Bz + C}{(z^2 - 2.685z + 17.9498)}$$

Multiplicando por el minimo común múltiplo:

$$(z^2 - 1.1378z + 2.4681)(z - 4.8622) = A(z^2 - 2.685z + 17.9498) + (Bz + C)(z + 6.6851)$$

$$(z^3 - 6z^2 + 8z - 12) = A(z^2 - 2.685z + 17.9498) + (Bz + C)(z + 6.6851)$$

$$(z^3 - 6z^2 + 8z - 12) = Az^2 - 2.685Az + 17.9498A + (Bz + C)(z + 6.6851)$$

$$(z^3 - 6z^2 + 8z - 12) = Az^2 - 2.685Az + 17.9498A + Bz^2 + 6.6851Bz + Cz + 6$$

$$(z^3 - 6z^2 + 8z - 12) = Az^2 + Bz^2 + 6.6851Bz + Cz - 2.685Az + 17.9498A + 6$$

$$(z^3 - 6z^2 + 8z - 12) = (A + B)z^2 + (6.6851B + C - 2.685A)z + (17.9498A + 6)$$

igualando terminos:

$$1 = 0 \quad \text{ERROR}$$

$$(A + B) = -6$$

$$(6.6851B + C - 2.685A) = 8$$

$$(17.9498A + 6.6851C) = -12$$

2.- Determinar la estabilidad de $G(z)$ por la prueba de Jury

$$G(z) = \frac{6z^{-3} - 4z^{-2} + 3z^{-1} - \frac{1}{2}}{30z^{-3} + z^{-1} + \frac{1}{4}}$$

$$D(z) = 30z^{-3} + z^{-1} + \frac{1}{4}$$

$$D(z) = 30 + z^2 + \frac{1}{4}z^3$$

Renglón	Z^0	z	Z^2	z^3
1	30	0	1	0.25
2	0.25	1	0	30
3	899.9375	-0.25	30	