PRÁCTICA
"CRITERIO DE NYQUIST"
FUNCIÓN DE TRANSFERENCIA TOTAL SIN POLOS EN EL ORIGEN

por

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Dada la siguiente función de Transferencia Total, trace el diagrama polar y aplique criterio de Nyquist

$$F_{(P)} = \frac{10}{(P^4 + 6 \cdot P^3 + 8 \cdot P^2 + 10 \cdot P + 20)}$$

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PASO 1 : Origen del Diagrama $F(P)|_{P \to 0}$

$$F_{(p)}\Big|_{p \to 0} = \frac{10}{20} = |0,5| \cdot \underline{|0°}$$

$$F_{(P)} = \frac{10}{(P^4 + 6 \cdot P^3 + 8 \cdot P^2 + 10 \cdot P + 20)}$$

PASO 2 : Final del Diagrama $F(P)|_{P \to \infty}$

$$F_{(p)}\Big|_{p \to \infty} = \frac{10}{p^4}\Big|_{P \to \infty} = \frac{10}{(\rho \cdot e^{j\theta})^4}\Big|_{P \to \infty} =$$

$$\frac{10}{(\rho^4 \cdot e^{j4\theta})}\Big|_{P \to \infty} = |0| \cdot e^{-j4 \cdot \theta} = |0| \cdot \underline{|-4 \cdot \theta} =$$

$$= |0| \cdot \underline{|-360°}$$

$$F_{(P)} = \frac{10}{(P^4 + 6 \cdot P^3 + 8 \cdot P^2 + 10 \cdot P + 20)}$$

PASO 3 : P →jω es decir F(P) →F(j ω)

$$F_{(j\omega)} = \frac{10}{(\omega^4 - 8 \cdot \omega^2 + 20) + j\,(10 \cdot \omega - 6 \cdot \omega^3)}$$

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PASO 4 : F(j ω) = Re + j Im

$$F_{(j\omega)} = \frac{10 \cdot (\omega^4 - 8 \cdot \omega^2 + 20)}{(\omega^4 - 8 \cdot \omega^2 + 20)^2 + (10 \cdot \omega - 6 \cdot \omega^3)^2} + j \frac{10 \cdot (6 \cdot \omega^3 - 10 \cdot \omega)}{(\omega^4 - 8 \cdot \omega^2 + 20)^2 + j\,(10 \cdot \omega - 6 \cdot \omega^3)^2}$$

F(jw)= Re + j Im

$$F_{(j\omega)} = \frac{10 \cdot (\omega^4 - 8 \cdot \omega^2 + 20)}{(\omega^4 - 8 \cdot \omega^2 + 20)^2 + (10 \cdot \omega - 6 \cdot \omega^3)^2} + j \frac{10 \cdot (6 \cdot \omega^3 - 10 \cdot \omega)}{(\omega^4 - 8 \cdot \omega^2 + 20)^2 + j\,(10 \cdot \omega - 6 \cdot \omega^3)^2}$$

PASO 5 : $\mathrm{Re}\,|_{F(j\omega)} = 0$

$$\mathrm{Re} = 0 = \frac{10 \cdot (\omega^4 - 8 \cdot \omega^2 + 20)}{(\omega^4 - 8 \cdot \omega^2 + 20)^2 + (10 \cdot \omega - 6 \cdot \omega^3)^2} = 0$$

$$\omega = \begin{cases} 2.058171027271491e+000 + 4.858682717566459e-001i \\ 2.058171027271491e+000 - 4.858682717566459e-001i \\ -2.058171027271493e+000 + 4.858682717566457e-001i \\ -2.058171027271493e+000 - 4.858682717566457e-001i \end{cases}$$

NINGÚN VALOR REAL DE w

$$F_{(j\omega)} = \frac{10 \cdot (\omega^4 - 8 \cdot \omega^2 + 20)}{(\omega^4 - 8 \cdot \omega^2 + 20)^2 + (10 \cdot \omega - 6 \cdot \omega^3)^2} + j \frac{10 \cdot (6 \cdot \omega^3 - 10 \cdot \omega)}{(\omega^4 - 8 \cdot \omega^2 + 20)^2 + j\,(10 \cdot \omega - 6 \cdot \omega^3)^2}$$

PASO 6 : Corte eje Imaginario. $\mathrm{Im}\,|_{F(j\omega)|\omega \to Re=0}$

AI NO EXISTIR NINGÚN VALOR REAL DE w, QUE HAGA CERO LA PARTE REAL, NO HABRÁ CORTE AL EJE IMAGINARIO

$$F_{(j\omega)} = \frac{10\cdot(\omega^4 - 8\cdot\omega^2 + 20)}{(\omega^4 - 8\cdot\omega^2 + 20)^2 + (10\cdot\omega - 6\cdot\omega^3)^2} + j\,\frac{10\cdot(6\cdot\omega^3 - 10\cdot\omega)}{(\omega^4 - 8\cdot\omega^2 + 20)^2 + j\,(10\cdot\omega - 6\cdot\omega^3)^2}$$

PASO 7 : = Im|F(jω) = 0

$$\text{Im}_{F_{(j\omega)}} = 0 = j\,\frac{10\cdot(6\cdot\omega^3 - 10\cdot\omega)}{(\omega^4 - 8\cdot\omega^2 + 20)^2 + j\,(10\cdot\omega - 6\cdot\omega^3)^2} =$$

$$\omega = \sqrt{\frac{10}{6}} = \pm\ 1{,}2909944$$

$$F_{(j\omega)} = \frac{10\cdot(\omega^4 - 8\cdot\omega^2 + 20)}{(\omega^4 - 8\cdot\omega^2 + 20)^2 + (10\cdot\omega - 6\cdot\omega^3)^2} + j\,\frac{10\cdot(6\cdot\omega^3 - 10\cdot\omega)}{(\omega^4 - 8\cdot\omega^2 + 20)^2 + j\,(10\cdot\omega - 6\cdot\omega^3)^2}$$

PASO 8 : Corte eje Real. Re|F(jω)|ω→Im=0

$$\text{Re}\Big|_{\omega=+\sqrt{\frac{10}{6}}=+1{,}29} = \frac{10\cdot(\omega^4 - 8\cdot\omega^2 + 20)}{(\omega^4 - 8\cdot\omega^3 + 20)^2 + (10\cdot\omega - 6\cdot\omega^3)^2}\Bigg|_{\omega=+\sqrt{\frac{10}{6}}=+1{,}29}$$

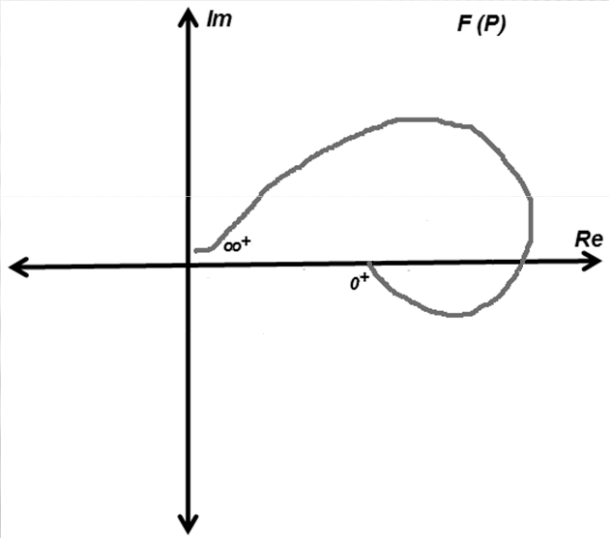
$$\text{Re}\Big|_{\omega=+\sqrt{\frac{10}{6}}=+1{,}29} = 1{,}0588235$$

PASO 9 : Trazar el diagrama Polar

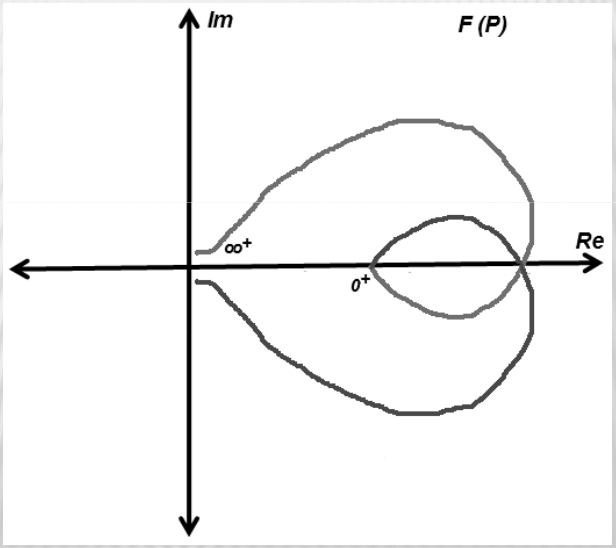
CON LOS DATOS OBTENIDOS EN LOS PASOS 1,2,6 Y 8, TRAZAR EL DIAGRAMA POLAR DE LAS FRECUENCIAS POSITIVAS.

LUEGO TRAZAR LAS FRECUENCIAS NEGATIVAS, HACIENDO EL ESPEJO DE LA CURVA ANTERIOR SOBRE EL EJE REAL

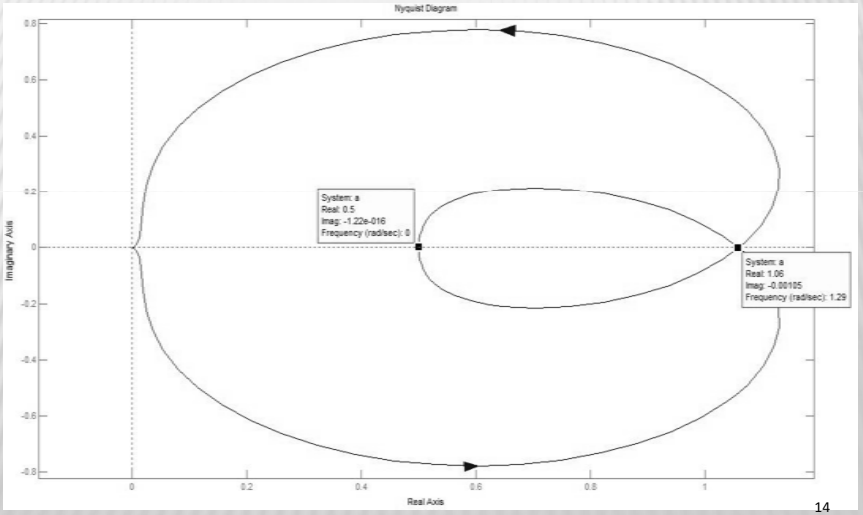
PASO 9 : Trazar el diagrama Polar



PASO 9 : Trazar el diagrama Polar



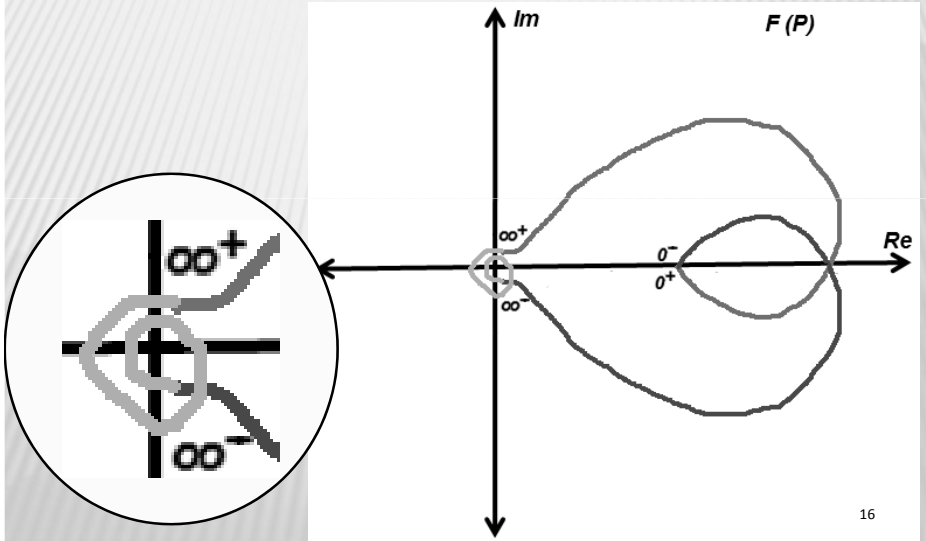
PASO 9 : Trazar el diagrama Polar



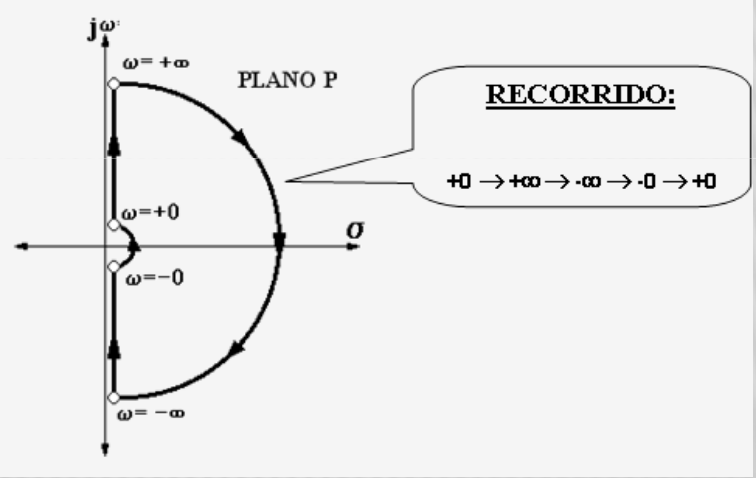
PASO 10 : Cerrar diagrama para P→0

DADO QUE LA FUNCIÓN NO TIENE POLOS EN EL ORIGEN, ESTE PASO NO SE APLICA

PASO 11 : Cerrar diagrama para P→∞



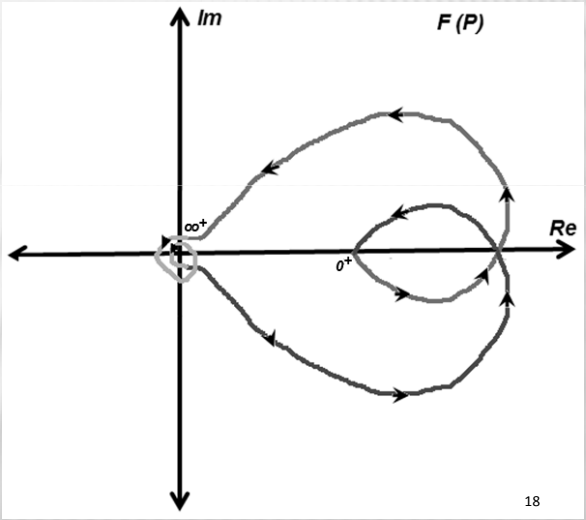
PASO 12 : Aplicar criterio de Nyquist



PASO 12 : Aplicar criterio de Nyquist

RECORRIDO:

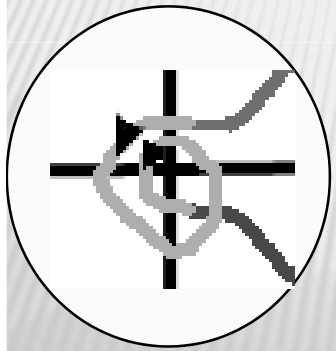
+0→ +∞→ -∞→ -0→ +0

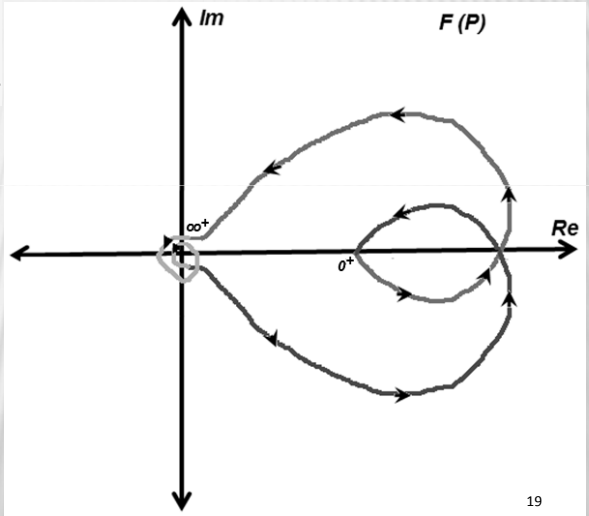


PASO 12 : Aplicar criterio de Nyquist

RECORRIDO:

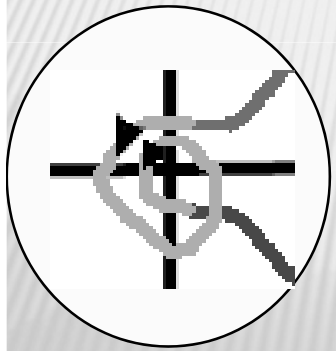
+0→ +∞→ -∞→ -0→ +0

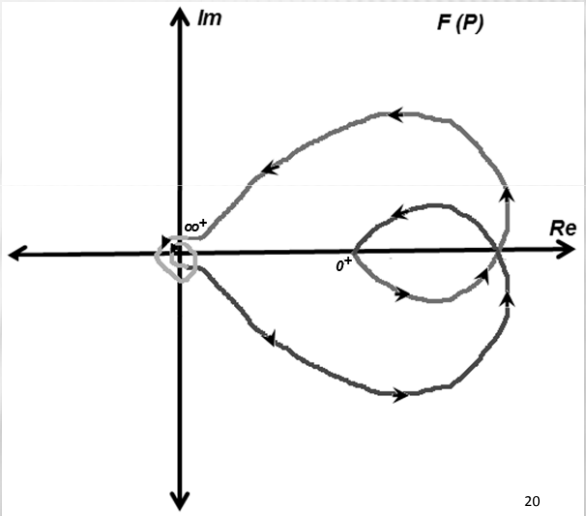




PASO 12 : Aplicar criterio de Nyquist

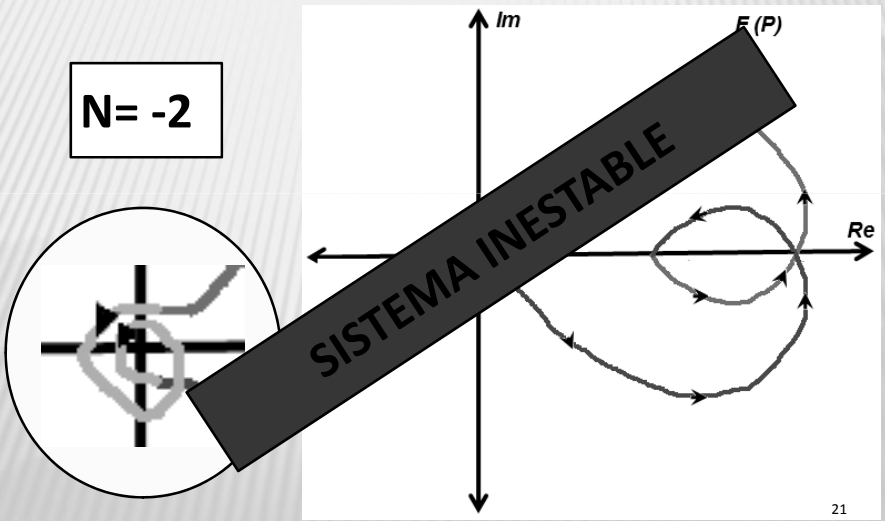
N= -2





PASO 12 : Aplicar criterio de Nyquist

N= -2



$$F_{(P)} = \frac{10}{(P^4 + 6 \cdot P^3 + 8 \cdot P^2 + 10 \cdot P + 20)}$$

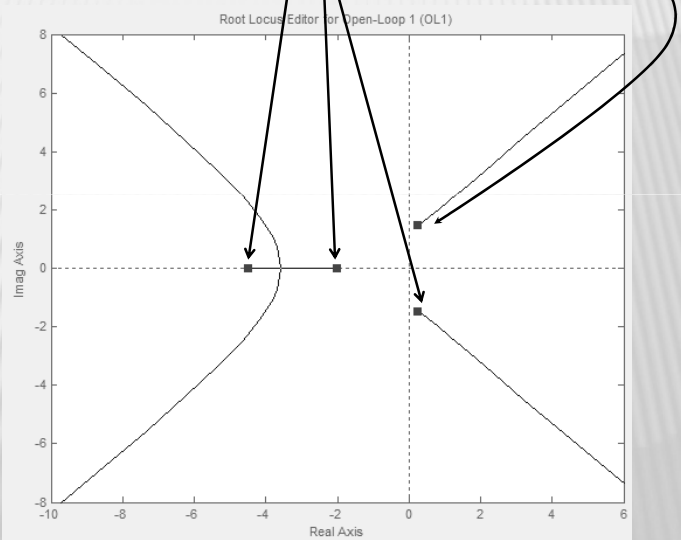
```
>> roots(den)

ans =

    -4.494939671263590e+000
    -1.999999999999998e+000
     2.474698356317927e-001 +1.470878187919456e+000i
     2.474698356317927e-001 -1.470878187919456e+000i
```



```
>> roots(den)      ans = -4.49e+000
                        -1.99e+000
                         2.47e-001 +1.47e+000i
                         2.47e-001 -1.47e+000i
```



FIN DE LA PRESENTACIÓN

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