Tugas Kelompok Elektronika RF

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Dik: $Z_0 = Z_{01} = Z_{02} = 50\ \Omega$

$Z_S = 20\ \Omega$

$Z_L = 30\ \Omega$

$S_{11} = 0,45 \angle 150^\circ$

$S_{12} = 0,01 \angle -10^\circ$

$S_{21} = 2,05 \angle 10^\circ$

$S_{22} = 0,40 \angle -150$

Dit: G_P = ... ?

G_A = ... ?

G_T = ... ?

Solusi:

Cari Γ_S dan Γ_L

$$\Gamma_S = \frac{Z_S - Z_{01}}{Z_S + Z_{01}} = \frac{Z_S - Z_0}{Z_S + Z_0} = \frac{20 - 50}{20 + 50} = \frac{-30}{70} = -0,4285 \ldots$$

$$\Gamma_S \simeq -0,429$$

$$\Gamma_L = \frac{Z_L - Z_{02}}{Z_L + Z_{02}} = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{30 - 50}{30 + 50} = \frac{-20}{80} = -0,250$$

Ubah parameter S ke bentuk bil. kompleks

$S_{11} = 0,45 \angle 150^\circ \rightarrow S_{11} = 0,45(\cos 150^\circ + j \sin 150^\circ)$

$S_{11} = -0,390 + j0,225$

$S_{12} = 0,01 \angle -10^\circ \rightarrow S_{12} = 0,01(\cos(-10^\circ) + j \sin(-10^\circ))$

$= 0,01 - j0,001$

$S_{21} = 2{,}05 \angle 10^\circ \rightarrow S_{21} = 2{,}05(\cos 10^\circ + j \sin 10^\circ)$

$S_{21} = 2{,}019 + j\,0{,}356$

$S_{22} = 0{,}40 \angle -150^\circ \rightarrow S_{22} = 0{,}40(\cos(-150^\circ) + j \sin(-150^\circ))$

$S_{22} = -0{,}35 - j\,0{,}2$

Cari nilai Γ_{in} dan Γ_{out}

$$\Gamma_{in} = S_{11} + \frac{S_{12} \cdot S_{21} \cdot \Gamma_L}{1 - S_{22} \cdot \Gamma_L}$$

$$= (-0{,}39 + j\,0{,}225) + \frac{(0{,}01 - j\,0{,}001)\cdot(2{,}019 + j\,0{,}356)\cdot(-0{,}25)}{1 - (-0{,}35 - j\,0{,}2)\cdot(-0{,}25)}$$

$$= -0{,}39 + j\,0{,}225 + \frac{(0{,}02 + j\,0{,}01)(-0{,}25)}{1 - (0{,}0875 + j\,0{,}05)}$$

$$= -0{,}39 + j\,0{,}225 + \frac{-0{,}005 + j\,0{,}0025}{0{,}9125 - j\,0{,}05}$$

$$= -0{,}39 + j\,0{,}225 + \frac{-2 + j}{365 - j\,20} \times \frac{365 + j20}{365 + j20}$$

$$= -0{,}39 + j0{,}225 + \frac{-750 + j325}{365^2 + 20^2}$$

$$= -0{,}39 + j0{,}225 + (-0{,}0056 + j0{,}0024)$$

$$= -0{,}3956 + j\,0{,}2274$$

$$= \sqrt{(-0{,}3956)^2 + (0{,}2274)^2} \angle \tan^{-1}\left(\frac{0{,}2274}{-0{,}3596}\right)$$

$$= 0{,}4156 \angle -30^\circ = 0{,}456 \angle 150^\circ$$

$$\Gamma_{out} = S_{22} + \frac{S_{12} \cdot S_{21} \cdot \Gamma_S}{1 - S_{11} \cdot \Gamma_S}$$

$$= (-0{,}35 - j\,0{,}2) + \frac{(0{,}01 + j\,0{,}001)(2{,}019 + j\,0{,}356)(-0{,}429)}{1 - (-0{,}39 + j\,0{,}225)(-0{,}429)}$$

$$= -0,35 - j0,2 + \frac{(0,02 + j0,01)(-0,429)}{1 - (0,167 - j0,096)}$$

$$= -0,35 - j0,2 + \frac{-0,009 - j0,004}{0,833 + j0,096} \times \frac{0,833 - j0,096}{0,833 - j0,096}$$

$$= -0,35 - j0,2 + \frac{-0,008 - j0,0025}{0,833^2 + 0,096^2}$$

$$= -0,35 - j0,2 + (-0,0114 - j0,0036)$$

$$= -0,361 - j0,2036$$

$$= \sqrt{(-0,361)^2 + (-0,2036)^2} \angle \tan^{-1}\left(\frac{-0,2036}{-0,361}\right)$$

$$= 0,414 \angle 29^\circ = 0,414 \angle -151^\circ$$

Cari G_P, G_A, G_T

$$G_P = \frac{1}{1 - |\Gamma_{in}|^2} |S_{21}|^2 \frac{1 - |\Gamma_L|^2}{|1 - S_{22}.\Gamma_L|^2}$$

$$= \frac{1}{1 - 0,456^2} (2,05)^2 \frac{1 - (-0,25)^2}{|1 - (-0,35 - j0,2).(-0,25)|^2}$$

$$= 1,26 . 4,2025 . \frac{1 - 0,0625}{|0,0125 - j0,05|^2}$$

$$= 5,295 . \frac{0,9375}{0,8351}$$

$$G_P = 5,944$$

$$G_A = \frac{1 - |\Gamma_S|^2}{|1 - S_{11}.\Gamma_S|^2} . |S_{21}|^2 \frac{1}{1 - |\Gamma_{out}|^2}$$

$$= \frac{1-(-0,429)^2}{|1-(-0,39+j0,225)(-0,429)|^2} \cdot (2,05)^2 \cdot \frac{1}{1-(0,414)^2}$$

$$= \frac{0,816}{|0,833+j0,096|^2} \cdot 4,2025 \cdot \frac{1}{0,829}$$

$$G_A = 5,883$$

$$G_T = \frac{1-|\Gamma_S|^2}{|1-S_{11}\cdot\Gamma_S|^2} \cdot |S_{21}|^2 \cdot \frac{1-|\Gamma_L|^2}{|1-\Gamma_{out}\cdot\Gamma_L|^2}$$

$$= \frac{1-(-0,429)^2}{|1-(-0,39+j0,225)(-0,429)|^2} \cdot (2,05)^2 \cdot \frac{1-(-0,25)^2}{|1-(-0,361-j0,2036)(-0,25)|^2}$$

$$= \frac{0,816}{|0,833+j0,096|^2} \cdot 4,2025 \cdot \frac{0,9375}{|0,90975-j0,0509|^2}$$

$$G_T = 5,507$$