

Parameters for Problem 5a

$$j := \sqrt{-1} \quad \text{dB} := 1 \quad G_A := 11 \cdot \text{dB}$$

$$M := \begin{bmatrix} 0.53 & 0.09 \\ 2.93 & 0.4 \end{bmatrix} \quad \phi := \begin{bmatrix} 178 \cdot \text{deg} & 48 \cdot \text{deg} \\ 76 \cdot \text{deg} & -56 \cdot \text{deg} \end{bmatrix} \quad m := 1..2 \quad n := 1..2 \quad S_{m,n} := M_{m,n} \cdot e^{j \cdot (\phi_{m,n} \cdot \text{rad})}$$

$$\Delta := S_{1,1} \cdot S_{2,2} - S_{2,1} \cdot S_{1,2} \quad |\Delta| = 5.235 \cdot 10^{-2} \quad \arg(\Delta) = -4.788 \cdot 10^1 \cdot \text{deg}$$

$$K := \left[\frac{1 - (|S_{1,1}|)^2 - (|S_{2,2}|)^2 + (|\Delta|)^2}{2 \cdot |S_{1,2} \cdot S_{2,1}|} \right] \quad K = 1.065$$

$$g_a := \frac{10^{(1 \cdot G_A)}}{(|S_{2,1}|)^2} \quad r_a := \frac{\sqrt{1 - 2 \cdot K \cdot |S_{1,2} \cdot S_{2,1}| \cdot g_a + (|S_{1,2} \cdot S_{2,1}|)^2 \cdot g_a^2}}{|1 + g_a \cdot [(|S_{1,1}|)^2 - (|\Delta|)^2]|} \quad C_a := \frac{g_a \cdot S_{1,1} - \Delta \cdot (\overline{S_{2,2}})}{1 + g_a \cdot [(|S_{1,1}|)^2 - (|\Delta|)^2]}$$

$$r_a = 4.053 \cdot 10^{-1} \quad C_a = -5.733 \cdot 10^{-1} - 1.618j \cdot 10^{-2} \quad |C_a| = 5.735 \cdot 10^{-1} \quad \arg(C_a) = -1.784 \cdot 10^2 \cdot \text{deg}$$

$$\theta := 0 \cdot \text{deg}, 20 \cdot \text{deg}.. 360 \cdot \text{deg} \quad \Gamma_s(\theta) := C_a + r_a \cdot e^{j \cdot \theta} \quad \Gamma_{\text{out}}(\theta) := S_{2,2} + \frac{S_{2,1} \cdot S_{1,2} \cdot \Gamma_s(\theta)}{1 - S_{1,1} \cdot \Gamma_s(\theta)} \quad \Gamma_L(\theta) := \overline{\Gamma_{\text{out}}(\theta)}$$

$$\Gamma_{in}(\theta) := S_{1,1} + \frac{S_{2,1} \cdot S_{1,2} \cdot \Gamma_L(\theta)}{1 - S_{2,2} \cdot \Gamma_L(\theta)} \quad \text{MAG}_{\Gamma_a}(\theta) := \left| \frac{\Gamma_{in}(\theta) - \overline{\Gamma_s(\theta)}}{1 - \Gamma_{in}(\theta) \cdot \Gamma_s(\theta)} \right| \quad \text{VSWR}_{in}(\theta) := \frac{1 + \text{MAG}_{\Gamma_a}(\theta)}{1 - \text{MAG}_{\Gamma_a}(\theta)}$$

$$\theta := ((-178.4 + 180) \cdot \text{deg}) \quad \Gamma_s := C_a + r_a \cdot e^{j\theta} \quad \Gamma_{out} := S_{2,2} + \frac{S_{2,1} \cdot S_{1,2} \cdot \Gamma_s}{1 - S_{1,1} \cdot \Gamma_s}$$

$$\Gamma_L := \overline{\Gamma_{out}} \quad \Gamma_{in} := S_{1,1} + \frac{S_{2,1} \cdot S_{1,2} \cdot \Gamma_L}{1 - S_{2,2} \cdot \Gamma_L}$$

$$\text{MAG}_{\Gamma_a} := \left| \frac{\Gamma_{in} - \overline{\Gamma_s}}{1 - \Gamma_{in} \cdot \Gamma_s} \right| \quad \text{MAG}_{\Gamma_b} := \left| \frac{\Gamma_{out} - \overline{\Gamma_L}}{1 - \Gamma_{out} \cdot \Gamma_L} \right| \quad \text{VSWR}_{in} := \frac{1 + \text{MAG}_{\Gamma_a}}{1 - \text{MAG}_{\Gamma_a}}$$

$$G_T := \left[\frac{1 - (\Gamma_s)^2}{(1 - \Gamma_{in} \cdot \Gamma_s)^2} \right] \cdot (S_{2,1})^2 \cdot \left[\frac{1 - (\Gamma_L)^2}{(1 - S_{2,2} \cdot \Gamma_L)^2} \right] \quad \text{VSWR}_{out} := \frac{1 + \text{MAG}_{\Gamma_b}}{1 - \text{MAG}_{\Gamma_b}}$$

$$G_P := \left[\frac{1}{1 - (\Gamma_{in})^2} \right] \cdot (S_{2,1})^2 \cdot \left[\frac{1 - (\Gamma_L)^2}{(1 - S_{2,2} \cdot \Gamma_L)^2} \right] \quad G_A := \left[\frac{1 - (\Gamma_s)^2}{(1 - S_{1,1} \cdot \Gamma_s)^2} \right] \cdot (S_{2,1})^2 \cdot \left[\frac{1}{1 - (\Gamma_{out})^2} \right]$$

$\frac{\theta}{\text{deg}} =$	$\text{VSWR}_{in}(\theta) =$
0	3.658
2·10 ¹	3.658
4·10 ¹	3.658
6·10 ¹	3.658
8·10 ¹	3.658
1·10 ²	3.658
1.2·10 ²	3.658
1.4·10 ²	3.658
1.6·10 ²	3.658
1.8·10 ²	3.658
2·10 ²	3.658
2.2·10 ²	3.658
2.4·10 ²	3.658
2.6·10 ²	3.658
2.8·10 ²	3.658
3.10 ²	3.658

Answers for Problem 5a

$$|\Gamma_s| = 1.682 \cdot 10^{-1} \quad \arg(\Gamma_s) = -1.783 \cdot 10^2 \cdot \text{deg} \quad \Gamma_s = -1.681 \cdot 10^{-1} - 4.866j \cdot 10^{-3}$$

$$|\Gamma_{in}| = 6.741 \cdot 10^{-1} \quad \arg(\Gamma_{in}) = 1.784 \cdot 10^2 \cdot \text{deg} \quad \Gamma_{in} = -6.739 \cdot 10^{-1} + 1.904j \cdot 10^{-2}$$

$$|\Gamma_{out}| = 4.487 \cdot 10^{-1} \quad \arg(\Gamma_{out}) = -5.582 \cdot 10^1 \cdot \text{deg} \quad \Gamma_{out} = 2.52 \cdot 10^{-1} - 3.712j \cdot 10^{-1}$$

$$|\Gamma_L| = 4.487 \cdot 10^{-1} \quad \arg(\Gamma_L) = 5.582 \cdot 10^1 \cdot \text{deg} \quad \Gamma_L = 2.52 \cdot 10^{-1} + 3.712j \cdot 10^{-1}$$

$$\text{MAG}_{\Gamma_a} = 5.706 \cdot 10^{-1} \quad \text{VSWR}_{in} = 3.658$$

$$\text{MAG}_{\Gamma_b} = 0 \quad \text{VSWR}_{out} = 1$$

$$G_A = 1.259 \cdot 10^1 \quad 10 \cdot \log(G_A) = 1.1 \cdot 10^1 \cdot \text{dB}$$

$$G_P = 1.867 \cdot 10^1 \quad 10 \cdot \log(G_P) = 1.271 \cdot 10^1 \cdot \text{dB}$$

$$G_T = 1.259 \cdot 10^1 \quad 10 \cdot \log(G_T) = 1.1 \cdot 10^1 \cdot \text{dB}$$