Use information from problem 2) to find the **exact**: a) input power, b) load power, c) power lost in TL, d) power from generator, and e) power consumed by Z_g.

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Use a 1 m length of the coaxial transmission line from 1) to create a TL circuit with $V_g = 16\angle 0°$ V, $Z_g = 45 - j10\ \Omega$, and $Z_L = 100 - j50\ \Omega$ operating at 3.6 GHz. Find: a) the load reflection coefficient, b) input reflection coefficient, c) V_0^+, d) general phasor voltage & current equations.

From earlier problem- $Z_{\text{in}} = 90.8596 - j\,5.8269\ \Omega$, $\Gamma_L = 0.4691\angle\text{-}24.6237°$,

$\Gamma_{\text{in}} = 0.3202\angle\text{-}5.2318°$, $V_0^+ = 6.6702\angle 13.9394°$ V. For $-1\text{ m} \le z \le 0$,

$$V(z) = (6.67\angle 13.94°)\left[e^{-(0.191+j119.2)z} + (0.469\angle -24.62°)e^{(0.191+j119.2)z}\right] \text{ (V)}$$

$$I(z) = (0.14175\angle 13.89°)\left[e^{-(0.191+j119.2)z} - (0.469\angle -24.624°)e^{(0.191+j119.2)z}\right] \text{ (A)}$$

****

A coaxial transmission line, operating at 3.6 GHz, has the distributed parameters $R = 3.8\ \Omega$/m, $L = 248$ nH/m, $G = 6.4$ mS/m, and $C = 112$ pF/m. <snip>

From earlier problem-

$\gamma = 0.19096 + j\,119.2113$ 1/m, $Z_0 = 47.0561 + j\,0.435\ \Omega = 47.0561\angle 0.05297°\ \Omega$,

****

a) Input power

$$V_{\text{in}} = V(-1\text{m}) = (6.67\angle 13.94°)\left[e^{(0.191+j119.2)} + (0.469\angle -24.62°)e^{-(0.191+j119.2)}\right]$$
$$= 10.6504\angle 2.9753° \text{ (V)}$$

$$I_{\text{in}} = I(-1\text{m}) = (0.14175\angle 13.89°)\left[e^{(0.191+j119.2)} - (0.469\angle -24.624°)e^{-(0.191+j119.2)}\right]$$
$$= 0.11698\angle 6.6447° \text{ (A)}$$

Per (2.92), $P_{\text{in}} = 0.5\,\text{Re}\{V_{\text{in}} I_{\text{in}}^*\} = 0.5\,\text{Re}\{(10.65\angle 2.975°)(0.117\angle\text{-}6.645°)\}$

$\Rightarrow$ **$P_{\text{in}} = 0.62165$ W.**

b) Load power

$$V_L = V(0) = (6.67\angle 13.94°)\left[1 + (0.469\angle -24.62°)\right] = 9.6033\angle 6.137° \text{ (V)}$$

$$I_L = I(0) = V_L / Z_L = (9.6033\angle 6.137°)/(100 - j50) = 0.08589\angle 32.703° \text{ (A)}$$

Per (2.93), $P_L = 0.5\,\text{Re}\{V(0)\,I(0)^*\} = 0.5\,\text{Re}\{(9.6033\angle 6.137°)(0.08589\angle\text{-}32.703°)\}$

$\Rightarrow$ **$P_L = 0.3689$ W.**

c) Power lost in TL

Per (2.94), $P_{\text{loss}} = P_{\text{in}} - P_L = 062165 - 0.3689$ $\Rightarrow$ **$P_{\text{loss}} = 0.25275$ W.**

d) Power from generator

Per circuit theory, $P_{\text{gen}} = 0.5\,\text{Re}\{V_g\, I_{\text{in}}{}^*\} = 0.5\,\text{Re}\{(16\angle 0°)\,(0.117\angle\text{-}6.645°)\}$

$\Rightarrow$ <u>**P_{gen} = 0.92953 W**</u>**.**

e) power consumed by Z_g

Per circuit theory, $P_{Zg} = 0.5\,|I_{\text{in}}|^2\,R_g = 0.5\,(0.117)^2\,45$ $\Rightarrow$ <u>**P_{Zg} = 0.30788 W**</u>**.**

As a check, ensure conservation of power holds true-

$$P_{\text{gen}} = P_{Zg} + P_{\text{in}}\ ?$$

$$0.92953\text{ W} = 0.30788 + 0.62165 = 0.92953\text{ W}\ \therefore$$