

# 電磁波與天線導論HW5

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(a)

$$k = \omega \sqrt{\mu_1 \epsilon_1} = 20\pi (\text{rad/m})$$

$$k_2 = \omega \sqrt{\mu_2 \epsilon_2} = \frac{40\pi}{3}$$

$$\eta_1 = \sqrt{\mu_1 / \epsilon_1} = 40\pi$$

$$\eta_2 = \sqrt{\mu_2 / \epsilon_2} = 60\pi$$

$$\Gamma = (\eta_2 - \eta_1) / (\eta_2 + \eta_1) = 0.2$$

$$\tau = 1 + \Gamma = 1.2$$

$$H^i = \hat{z} 2 \cos(2\pi * 10^9 t - 20\pi y)$$

$$E^i = -\hat{x} 2 \cos(2\pi * 10^9 t - 20\pi y) * \eta_1 = -\hat{x} 80\pi \cos(2\pi * 10^9 t - 20\pi y)$$

$$E^r = -\hat{x} \Gamma 80\pi \cos(2\pi * 10^9 t + 20\pi y) = -\hat{x} 16\pi \cos(2\pi * 10^9 t + 20\pi y)$$

$$H^r = -\hat{z} 2 \Gamma \cos(2\pi * 10^9 t + 20\pi y) = -\hat{z} 0.4 \cos(2\pi * 10^9 t + 20\pi y)$$

$$E^t = -\hat{x} 80\pi \tau \cos(2\pi * 10^9 t - k_2 y) = -\hat{x} 96\pi \cos(2\pi * 10^9 t - \frac{40\pi}{3} y)$$

$$H^t = \hat{z} 96\pi \cos(2\pi * 10^9 t - \frac{40\pi}{3} y) / \eta_2 = \hat{z} 1.6 \cos(2\pi * 10^9 t - \frac{40\pi}{3} y)$$

$$E_1 = E^i + E^r = -\hat{x} (80\pi \cos(2\pi * 10^9 t - 20\pi y) + 16\pi \cos(2\pi * 10^9 t + 20\pi y)) - < ans >$$

$$H_1 = H^i + H^r = \hat{z} (2 \cos(2\pi * 10^9 t - 20\pi y) - 0.4 \cos(2\pi * 10^9 t + 20\pi y)) - < ans >$$

$$E_2 = E^t = -\hat{x} 96\pi \cos(2\pi * 10^9 t - \frac{40\pi}{3} y) - < ans >$$

$$H_2 = H^t = \hat{z} 1.6 \cos(2\pi * 10^9 t - \frac{40\pi}{3} y) - < ans >$$

(b)

$$S_{av}^i = \hat{y} \frac{|E_0|^2}{2\eta_1} = \hat{y} \frac{(80\pi)^2}{2 * 40\pi} = \hat{y} 80\pi (W/m^2)$$

$$S_{av}^r = -\hat{y} \frac{|E_0^i|^2}{2\eta_1} = -\hat{y} 3.2\pi$$

$$S_{av}^t = S_{av}^i + S_{av}^r = \hat{y} 76.8\pi$$

## 2

(a)

$$\eta_1 = \eta_3 = \sqrt{\mu_0/\epsilon_0}$$

$$\eta_2 = \sqrt{\mu_0/4\epsilon_0}$$

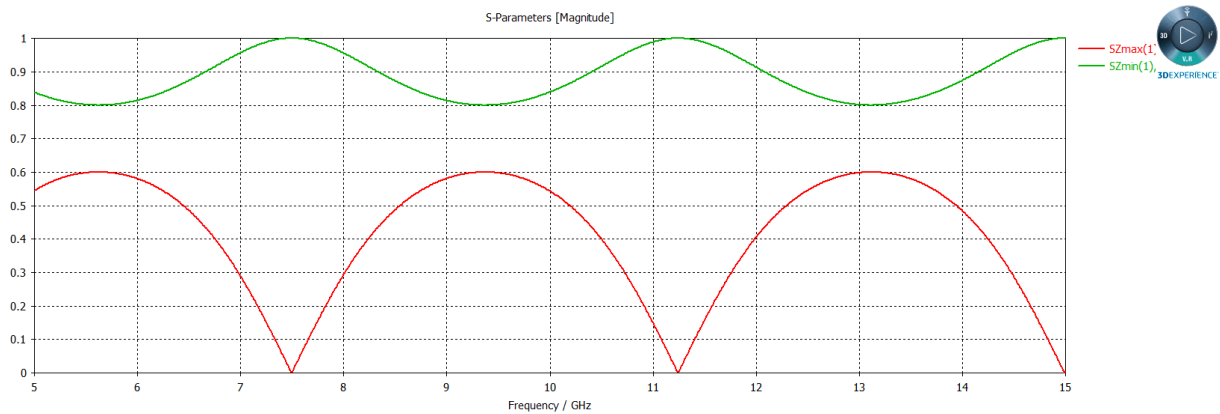
$$\Gamma_{12} = (\eta_2 - \eta_1)/(\eta_2 + \eta_1) = -\frac{1}{3} - \text{ans}$$

$$\Gamma_{23} = (\eta_3 - \eta_2)/(\eta_2 + \eta_3) = \frac{1}{3}$$

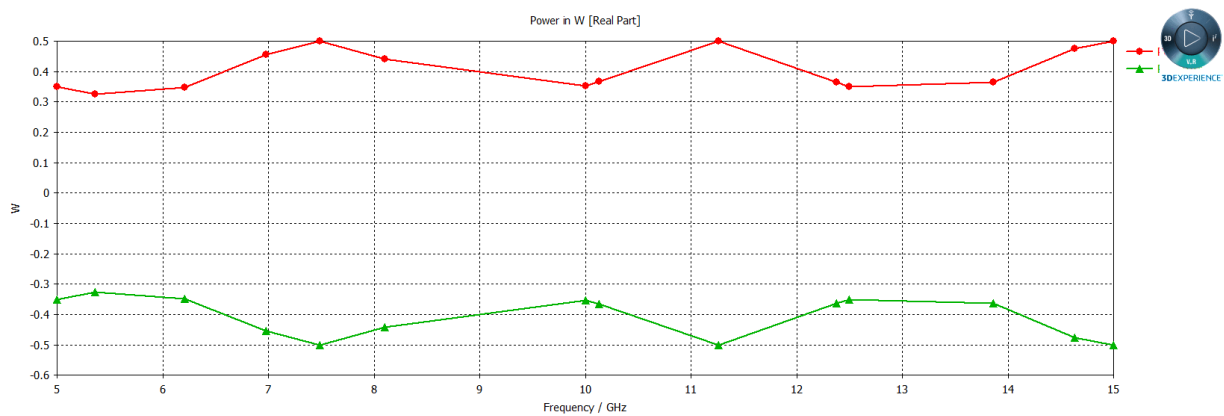
$$\tau_{23} = 1 + \Gamma_{23} = \frac{4}{3} - \text{ans}$$

(b)

reflection and transmission coefficients



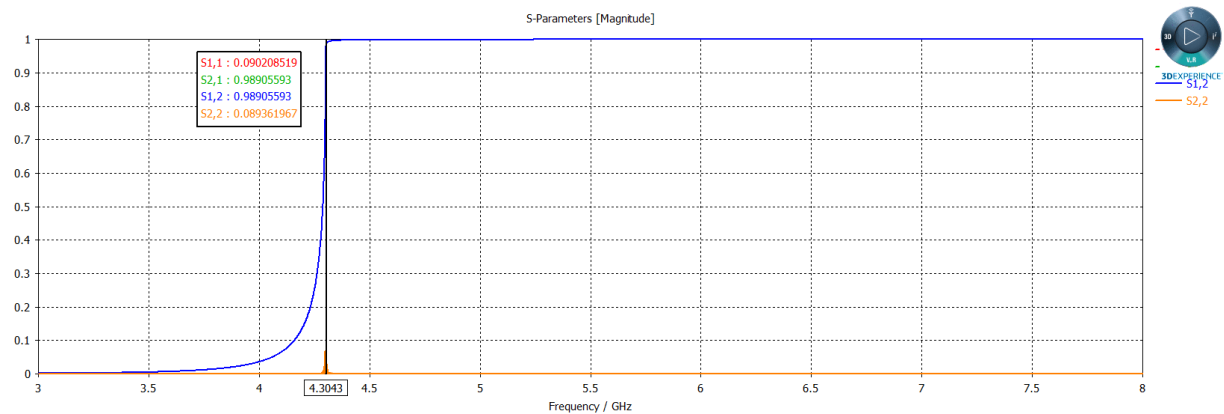
power reflection and transmission



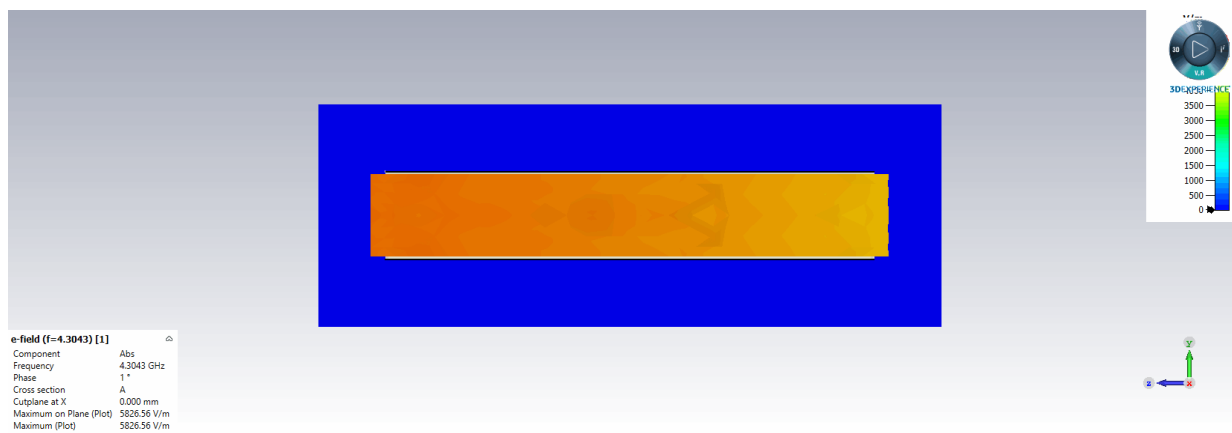
## 3

$$f = \frac{c}{2} \sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2} = \frac{c}{2} \sqrt{\left(\frac{1}{34.8488 \times 10^{-3}}\right)^2 + \left(\frac{0}{15.7988 \times 10^{-3}}\right)^2} = 4.3043(GHz)$$

reflection and transmission coefficients



## electric field



## magnetic field

