23-19. Given $n_I = 5.3$ at $\lambda = 589.3\,\text{nm}$. (a) $\alpha = 4\pi n_I/\lambda = 4\pi(5.3)/(589.3\,\text{nm}) = 0.113\,\text{nm}^{-1}$

(b) $I = I_0 e^{-\alpha s}$. For $I = 0.01\,I_0$, $e^{-\alpha s} = 0.01 \Rightarrow s = (-1/\alpha)\ln(0.01) = 40.75\,\text{nm} = 0.069\,\lambda$

23-21. (a) The penetration depth is

$$|z|_{1/e} = \frac{1}{\alpha} = \frac{\lambda}{2\pi}\frac{1}{\sqrt{\sin^2\theta/n^2 - 1}} = \frac{0.546\,\mu\text{m}}{2\pi}\frac{1}{\sqrt{\sin^2(45°)/(1/1.6)^2 - 1}} = 0.164\,\mu\text{m}$$

(b) Since irradiance is proportional to the square of the field amplitude and with $\alpha = \dfrac{1}{|z|_{1/e}} = 6.089\,\mu\text{m}^{-1}$,

$$\frac{I}{I_0} = e^{-2\alpha|z|} = e^{-2(6.089\,\mu\text{m}^{-1})(1\,\mu\text{m})} = 5.1 \times 10^{-6}$$

25-1. (a) Consider,

$$K \equiv n^2 = (n_R + i\,n_I)^2 = n_R^2 - n_I^2 + 2\,i\,n_I n_R = K_R + i\,K_I$$
$$K_R = n_R^2 - n_I^2,\; K_I = 2\,n_I n_R$$

Solving these two relations for n_R and n_I proceeds as,

$$K_I = 2\,n_I n_R = 2\,n_I\sqrt{K_R^2 + n_I^2}$$
$$K_I^2 = 4\,n_I^2(K_R^2 + n_I^2)$$
$$4\,n_I^4 + 4K_R^2 n_I^2 - K_I^2 = 0$$
$$n_I^2 = \frac{-4\,K_R \pm \sqrt{16\,K_R^2 + 16\,K_I^2}}{8} = \frac{-K_R \pm \sqrt{K_R^2 + K_I^2}}{2}$$

To make $n_I^2 > 0$, choose the $+$ sign. Thus,

$$n_I = \left[\frac{-K_R + \sqrt{K_R^2 + K_I^2}}{2}\right]^{1/2}$$

$$n_R^2 = K_R + n_I^2 = \frac{2\,K_R}{2} + \frac{-K_R + \sqrt{K_R^2 + K_I^2}}{2} = \frac{K_R + \sqrt{K_R^2 + K_I^2}}{2}$$

$$n_R = \left[\frac{K_R + \sqrt{K_R^2 + K_I^2}}{2}\right]^{1/2}$$

(b) If $K_I \approx K_R$,

$$n_R = \left[\frac{K_I + \sqrt{2\,K_I^2}}{2}\right]^{1/2} = \sqrt{K_I}\left(\frac{1 + \sqrt{2}}{2}\right)^{1/2} = 1.099\,\sqrt{K_I}$$

$$n_I = \left[\frac{-K_I + \sqrt{2\,K_I^2}}{2}\right]^{1/2} = \sqrt{K_I}\left(\frac{-1 + \sqrt{2}}{2}\right)^{1/2} = 0.455\,\sqrt{K_I}$$

25-7. (a) $\delta_{\text{Al}} = \left(\dfrac{2}{\sigma\,\mu_0\,\omega}\right)^{1/2} = \left(\dfrac{2}{3.54\times 10^7\,(4\,\pi\times 10^{-7})\,2\,\pi\times 6\times 10^4}\right)^{1/2}\ \text{m} = 0.345\,\text{mm}$

(b) $\delta_{\text{s.w.}} = \left(\dfrac{3.54\times 10^7}{4.3}\right)\times \delta_{\text{Al}} = 0.991\ \text{m} \approx 1\,\text{m}$

25-8. $\delta_{\text{Ag}} = \left(\dfrac{\lambda}{\sigma\,\mu_0\,\pi\,c}\right)^{1/2} = \left(\dfrac{0.1}{3\times 10^7(4\,\pi\times 10^{-7})\,\pi\,(3\times 10^8)}\right)^{1/2}\ \text{m} = 1.68\times 10^{-6}\,\text{m} = 1.68\,\mu\text{m}$

As long as the silver coating is thicker than this the silver-plated brass component would work.

25-9. (a) $I = I_0\,e^{-\alpha x} \Rightarrow (I/I_0) = (1/4) = e^{-\alpha x} = e^{-\alpha(3.42\,\text{m})} \Rightarrow 3.42\,\alpha = \ln(4) \Rightarrow \alpha = 0.405\,\text{m}^{-1}$

(b) $(I/I_0) = (1/100) = e^{-(0.405\,\text{m}^{-1})x} \Rightarrow (0.405\,\text{m}^{-1}) = \ln(100) \Rightarrow x = 11.37\,\text{m}$