11-15. (a) According to Eq. (11-30) the condition for missing orders is, $a=(p/m)\,b$. The fourth order interference maxima are missing so $p=4\,m$ and $a=4\,b=4\,(0.1\,\text{mm})=0.4\,\text{mm}$.
(b) The irradiance is given by,

$$I=4\,I_0\left(\frac{\sin\beta}{\beta}\right)^2\cos^2\alpha$$

In zeroth order $I=4\,I_0$. The interference maxima occur for,

$$p\,\lambda=a\sin\theta\Rightarrow\sin\theta=0,\pm\,\lambda/a,\pm\,2\,\lambda/a,\pm\,3\,\lambda/a,...$$

Also $\cos^2\alpha=1$, so at the interference maxima

$$I=4\,I_0\left(\frac{\sin\beta}{\beta}\right)^2$$

where $\beta=(k\,b/2)\sin\theta=(\pi\,b/\lambda)\sin\theta$. Then:

$$p=1:\ \sin\theta=\lambda/a;\ \beta=\frac{\pi\,b}{\lambda}\frac{\lambda}{a}=\pi\,(b/a);\ \frac{I}{4\,I_0}=\left(\frac{\sin\beta}{\beta}\right)^2=\left(\frac{\sin\,(\pi/4)}{\pi/4}\right)^2=0.8106$$

$$p=2:\ \sin\theta=2\lambda/a;\ \beta=\frac{\pi\,b}{\lambda}\frac{2\lambda}{a}=2\pi\,(b/a);\ \frac{I}{4\,I_0}=\left(\frac{\sin\beta}{\beta}\right)^2=\left(\frac{\sin\,(\pi/2)}{\pi/2}\right)^2=0.4053$$

$$p=3:\ \sin\theta=3\lambda/a;\ \beta=\frac{\pi\,b}{\lambda}\frac{3\lambda}{a}=3\pi\,(b/a);\ \frac{I}{4\,I_0}=\left(\frac{\sin\beta}{\beta}\right)^2=\left(\frac{\sin\,(3\,\pi/4)}{3\,\pi/4}\right)^2=0.0.0901$$

11-20. The irradiance is given by,

$$I=I_0\left(\frac{\sin\beta}{\beta}\right)^2\left(\frac{\sin N\alpha}{\alpha}\right)^2$$

with $N=10$, $a=5\,b$, $b=10^{-4}$ cm, $\lambda=435.8$ nm. Recall that $\beta=\frac{\pi}{\lambda}\,b\sin\theta$, so $\alpha=4\,\beta$. For interference maxima,

$$\left(\frac{\sin N\alpha}{\alpha}\right)^2=1\Rightarrow I=I_0\left(\frac{\sin\beta}{\beta}\right)^2$$

Also, $\sin\theta=m\,\lambda/a$ and $\beta=\frac{\pi\,b}{\lambda}\left(\frac{m\,\lambda}{a}\right)=m\,\pi\,(b/a)=m\,\pi/5$. Then,

For $m=1$: $I/I_0=\left(\frac{\sin\beta}{\beta}\right)^2=\left(\frac{\sin(\pi/5)}{\pi/5}\right)^2=0.875$

For $m=2$: $I/I_0=\left(\frac{\sin(2\,\pi/5)}{2\,\pi/5}\right)^2=0.573$. For $m=3$: $I/I_0=\left(\frac{\sin(3\,\pi/5)}{3\,\pi/5}\right)^2=0.255$

For $m=4$: $I/I_0=\left(\frac{\sin(4\,\pi/5)}{4\,\pi/5}\right)^2=0.0547$. For $m=5$: $I/I_0=\left(\frac{\sin(5\,\pi/5)}{5\pi/5}\right)^2=0$.

12-4. $\mathfrak{R}=m\,N=\frac{\lambda\,a\,v}{\Delta\,\lambda}=\frac{589.2935}{0.597}=987$; $N=\frac{a}{m}$. So, for $m=1$, $N=987$ and for $m=2$, $N=494$.

12-6. See Figure 12-14 that accompanies the statement of this problem in the text.

$$\mathfrak{R}\,(m=3)=m\,N=(3)\,(16,000\times 2.5)=120,000$$
$$\mathfrak{R}\,(m=2)=m\,N=(2)\,(16,000\times 2.5)=80,000$$
$$\Delta\,\lambda=\lambda/\mathfrak{R}=550\,\text{nm}/80,000=0.006875\,\text{nm}=0.069\,\text{Å}$$

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 $\alpha=\frac{1}{|z|_{1/e}}=6.089\,\mu\text{m}^{-1}$,

$$\frac{I}{I_0}=e^{-2\alpha|z|}=e^{-2(6.089\,\mu\text{m}^{-1})(1\mu\text{m})}=5.1\times10^{-6}$$

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) $\delta_{\text{Al}}=\left(\frac{2}{\sigma\,\mu_0\,\omega}\right)^{1/2}=\left(\frac{2}{3.54\times10^7\,(4\,\pi\times10^{-7})\,2\,\pi\times6\times10^4}\right)^{1/2}\text{m}=0.345\,\text{mm}$

(b) $\delta_{\text{s.w.}}=\left(\frac{3.54\times10^7}{4.3}\right)\times\delta_{\text{Al}}=0.991\,\text{m}\approx1\,\text{m}$

25-8. $\delta_{\mathrm{Ag}} = \left(\dfrac{\lambda}{\sigma\,\mu_0\,\pi\,c}\right)^{1/2} = \left(\dfrac{0.1}{3\times10^{7}(4\,\pi\times10^{-7})\,\pi\,(3\times10^{8})}\right)^{1/2}\mathrm{m} = 1.68\times10^{-6}\,\mathrm{m} = 1.68\,\mu\mathrm{m}$

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

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

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