2.111 The effective antenna temperature of an antenna looking toward zenith is approximately 5 K. Assuming that the temperature of the transmission line (waveguide) is 72°F, find the effective temperature at the receiver terminals when the attenuation of the transmission line is 4 dB/100 ft and its length is
(a) 2 ft (b) 100 ft
Compare it to a receiver noise temperature of about 54 K.

- Modified so the transmission line temperature is 76°F and attenuation is 2.5 dB/100 ft. You may assume the effective antenna temperature incorporates both the antenna noise temperature as well as that due to the antenna physical temperature at the terminals.

Given: $T_{A,eff} = T_A + T_{AP} = 5\,K$

$$T_0 = 76°F = (76-32)\tfrac{5}{9} + 273.15 = 297.59\overline{4}\,K$$

$$\alpha = \frac{2.5\,dB}{100\,ft}\left(\frac{1\,Np}{20\log_{10} e\; dB}\right) = 0.00287823\ \frac{Np}{ft}$$

Per (2-140), the effective antenna temperature at the receiver terminals is

$$T_a = T_A e^{-2\alpha\ell} + T_{AP} e^{-2\alpha\ell} + T_0\left(1-e^{-2\alpha\ell}\right)$$
$$= (T_A + T_{AP})e^{-2\alpha\ell} + T_0\left(1-e^{-2\alpha\ell}\right)$$

a) $\ell = 2\,ft$

$$T_a = (5K)e^{-2(0.002878)2} + 297.59\overline{4}\left(1-e^{-2(0.002878)2}\right)$$

$$\underline{\underline{T_a = 8.3493\ K}}$$ much less than $T_{rcvr} = 54\,K$

b) $\ell = 100\,ft$

$$T_a = (5K)\,e^{-2(0.002878)100} + 297.59\overline{4}\left(1-e^{-2(0.002878)100}\right)$$

$$\underline{\underline{T_a = 133.0565\ K}}$$ much more than $T_{rcvr} = 54\,K$