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 88°F and attenuation is 3 dB/100 ft. The effective antenna temperature incorporates both the antenna noise temperature as well as that due to the antenna physical temperature at the terminals.

Given effective antenna temperature $= T_A + T_{AP} = 5\ K$

Given transmission line temp $= T_0 = 88°F = 304.261\ K$

Given trans. line attenuation constant $= \alpha = \frac{3dB}{100ft}\left(\frac{1Np}{20\log_{10}e}\right)$

$= 0.003453878\ Np/ft$

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

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

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

a) When $l = 2\ ft$

$$T_a = (5K)\, e^{-2(0.00345)2} + 304.261 \left(1 - e^{-2(0.00345)2}\right)$$

$$T_a = 4.9314 + 4.17462 \Rightarrow \underline{\underline{T_a(l=2ft) = 9.106\ K}}$$

much less than $T_r = 54K$

b) when $l = 100\ ft$

$$T_a = (5\ K)\, e^{-2(0.00345)100} + 304.261\left[1 - e^{-2(0.00345)100}\right]$$

$$= 2.50594 + 151.7693 \Rightarrow \underline{\underline{T_a(l=100ft) = 154.275\ K}}$$

much bigger than $T_r = 54K$