24-2. Determine the path loss for a 3.4-GHz signal propagating 20,000 m.
   129 dB

24-4. Determine the noise power for a 20-MHz bandwidth at the input to a receiver with an
       input noise temperature of 290°C.
       -98.9 dBm

24-5. For a system gain of 120 dB, a minimum input C/N of 30 dB, and an input noise power of
       -115 dBm, determine the minimum transmit power ($P_t$).

24-6. Determine the amount of loss attributed to a reliability objective of 99.98%.
       37 dB

24-8. A frequency-diversity microwave system operates at an RF carrier frequency of 7.4 GHz. The IF is a low-index frequency-modulated subcarrier. The baseband signal is the 1800-channel FDM system described in Chapter 11 (564 kHz to 8284 kHz). The antennas are 4.8-m-diameter parabolic dishes. The feeder lengths are 150 in at one station and 50 in at the other station. The reliability objective is 99.999%. The system propagates over an average terrain that has a very dry climate. The distance between stations is 50 km. The minimum carrier-to-noise ratio at the receiver input is 30 dB. Determine the following: fade margin, antenna gain, free-space path loss, total branching and feeder losses, receiver input noise power ($C_{\text{min}}$), minimum transmit power, and system gain.
   \[ FM = 38.41 \text{ dB} \]
   \[ A_t = A_r = 49.1 \text{ dB} \]
   \[ L_p = 143.76 \text{ dB} \]
   \[ L_b = 6 \text{ dB} \]
   \[ L_f = 9.4 \text{ dB} \]
   \[ N = -101.78 \text{ dBm} \]
   \[ C_{\text{min}} = -71.8 \text{ dBm} \]
   \[ P_t = -27.57 \text{ dBm} \]

24-10. A microwave receiver has a total input noise power of -102 dBm and an overall noise figure of 4 dB. For a minimum C/N ratio of 20 dB at the input to the FM detector, determine the minimum receive carrier power.
       -78 dBm

24-11. Determine the path loss for the following frequencies and distances:
   \[
   \begin{array}{ccc}
   f (\text{MHz}) & D (\text{km}) & L_p (\text{db}) \\
   200 & 0.5 & 72.4 \\
   800 & 0.8 & 84.4 \\
   3000 & 5 & 115.9 \\
   5000 & 10 & 126.8 \\
   8000 & 25 & 138.8 \\
   18000 & 10 & 137.5 \\
   \end{array}
   \]
24-13. Determine the noise power for a 40-MHz bandwidth at the input to a receiver with an input temperature $T = 400^\circ C$.

$-94.3 \text{ dBm}$

24-14. For a system gain of 114 dB, a minimum input $C/N = 34$ dB, and an input noise power of $-111 \text{ dBm}$, determine the minimum transmit power ($P_t$), $-94.3 \text{ dBm}$

24-15. Determine the amount of loss contributed to a reliability objective of 99.9995%.

53 dB

24-17. A frequency-diversity microwave system operates at an $RF = 7.4$ GHz. The IF is a low-index frequency-modulated subcarrier. The baseband signal is a single mastergroup, FDM system. The antennas are 2.4-m parabolic dishes. The feeder lengths are 120 m at one station and 80 m at the other station. The reliability objective is 99.995%. The system propagates over an average terrain that has a very dry climate. The distance between stations is 40 km. The minimum carrier-to-noise ratio at the receiver input is 28 dB. Determine the following: fade margin, antenna gain, free-space path loss, total branching and feeder losses, receiver input power ($C_{\text{min}}$), minimum transmit power, and system gain.

$FM = 31.6$ dB, $A_t = A_r = 43.1$ dB,

$L_p = 141.8$ dB, $L_b = 6$ dB,

$L_f = 9.4$ dB, $N = -106 \text{ dBm}$,

$C_{\text{min}} = -78 \text{ dBm}$, $P_t = 21.6$ dBm

24-19. A microwave receiver has a total input noise power of $-108 \text{ dBm}$ and an overall noise figure of 5 dB. For a minimum $C/N$ ratio of 18 dB at the input to the FM detector, determine the minimum receive carrier power.

$-81 \text{ dBm}$