CHAPTER 7

Transmission Media

7.1 REVIEW QUESTIONS

1. Power and voice: 0 to 3 KHz; radio communications: 3 KHz to 300 GHz; visible light: 430 THz to 750 THz.
3. Guided media has physical boundaries, while unguided media is unbounded.
5. STP has a metal casing that prevents the penetration of electromagnetic noise.
7. When a light beam travels to a less dense medium, the angle of incidence is less than the angle of refraction (I < R). When a light beam travels to a denser medium, the angle of incidence is greater than the angle of refraction (I > R).
9. Reflection may occur when a beam of light travels into a less dense medium and the angle of incidence is greater than the critical angle.
11. The inner core of an optical fiber is surrounded by cladding. The core is denser than the cladding, so a light beam traveling through the core is reflected at the boundary between the core and the cladding if the incident angle is more than the critical angle.
13. Fiber optic cabling is expensive, installation/maintenance is difficult, and fragility
15. Surface, tropospheric, ionospheric, line of sight, and space propagation
17. For constant communication, satellites have to move at the same speed as the earth.
19. Attenuation, distortion, and noise
21. Throughput, propagation speed, and propagation time
23. The wavelength is the distance a simple signal can travel in one period. Wavelength = propagation speed x period
25. Crosstalk occurs when one line picks up some of the signals from another line. One wire acts as a sending antenna, the other as a receiving antenna. Twisting and shielding can reduce it.
27. If a light beam is refractive, it would go through the cladding and get lost. To keep the beam within the core, it should be reflective.

29. In ionospheric propagation HF radio waves radiate upward into the ionosphere where they are reflected back to earth. The difference between the density of the troposphere and the ionosphere sends the radio waves back to earth.

31. In multimode step index, the light beam is bouncing back and forth down the channel until it reaches its destination. The number of bounces depends on the angle of incidence. Each bounce takes out some energy from the signal, which means that the signal needs to be regenerated more often if the angle of incidence is small (more bounces). In multimode grade index, the signal bounces less, therefore it can travel farther without regeneration. Single mode propagation uses almost horizontal light beams due to the design of the fiber optic cable and the light source. These beams require less regeneration than the other two methods.

7.2 MULTIPLE CHOICE QUESTIONS

33. b 35. b 37. b 39. d 41. c 43. a 45. d 47. b 49. b 51. b
53. a 55. c 57. a 59. a 61. c 63. a 65. d 67. b 69. b 71. d
73. a 75. d 77. d 79. b

7.3 EXERCISES

81. 22,287.83 miles / 186,000 miles per second = 0.120 s = 120 ms
83. dB = 10 $\log_{10}$ (90 / 100) = –0.46 dB
85. The total gain is $3 \times 4 = 12$ dB. The signal is amplified by a factor $10^{1.2} = 15.85$.
87. 100,000 bits / 5 Kbps = 20 s
89. 480 s $\times$ 300,000 km/s = 144,000,000 km
91. 1 μm $\times$ 5 = 5 μm
93. 4,000 $\log_2$ (1 + 1,000) = 40 Kbps (approximately)