Chapter 2 - Wireless Data Transmission

TRUE/FALSE

1. The ASCII code uses 16 bits to represent 128 different characters.

   ANS: F PTS: 1 REF: 42

2. Infrared light interferes with radio signals but is not affected by radio signals.

   ANS: F PTS: 1 REF: 46

3. The height of a radio wave is called the amplitude of the wave.

   ANS: T PTS: 1 REF: 57

4. Spread-spectrum signals are more susceptible to outside interference than narrow-band transmissions.

   ANS: F PTS: 1 REF: 68

5. Hopping codes used in FHSS transmissions are configured on the base station by the network administrator.

   ANS: F PTS: 1 REF: 69

MULTIPLE CHOICE

1. Which of the following is true about wireless radio signal transmissions?
   a. they travel at the speed of light
   b. they require an atmosphere to move
   c. they travel as discrete particles
   d. they require visible light

   ANS: A PTS: 1 REF: 43

2. Which of the following is NOT true about infrared light?
   a. it can be used in directed transmissions
   b. it can be used in diffused transmissions
   c. it is less susceptible to interference from visible light sources
   d. all infrared signals are invisible

   ANS: D PTS: 1 REF: 44-45

3. Which of the following transmits a signal in an infrared device?
   a. diffuser
   b. emitter
   c. detector
   d. antenna

   ANS: B PTS: 1 REF: 45

4. Which of the following is NOT a limitation of using infrared wireless systems?
   a. they lack mobility
   b. they use a line-of-sight principle
   c. someone can eavesdrop from another room
   d. diffused transmissions have a range of 50 feet

   ANS: C PTS: 1 REF: 46-47

5. Which of the following is a good application for an infrared wireless system?
   a. stream movies from a server
   b. wireless outdoor speakers
   c. whole house wireless network
   d. data transfer between laptop and camera

   ANS: D PTS: 1 REF: 47

6. Which best describes an analog signal?
   a. it starts and stops
   b. intensity varies and is continuous
   c. consists of discrete pulses
   d. Morse code is an example

   ANS: B PTS: 1 REF: 50

7. What process must occur to transmit a digital signal over an analog medium?
   a. modulation
   b. decoupling
   c. decoding
   d. emitting

   ANS: A PTS: 1 REF: 51

8. The distance between a point in one wave cycle and the same point in the next wave cycle is called which of the following?
   a. amplitude
   b. wavelength
   c. carrier
   d. frequency

   ANS: B PTS: 1 REF: 51

9. The frequency of a wave is best defined as which of the following?
   a. encoding of bits onto an analog wave
   b. the voltage difference between the peak and trough of the wave
   c. a carrier wave that has been modulated
   d. the number of times a cycle occurs within one second

   ANS: D PTS: 1 REF: 52

10. What is the unit of measurement for radio frequency?
    a. volt
    b. rpm
    c. Hz
    d. amp

    ANS: C PTS: 1 REF: 53

11. What is the role of an antenna on a wireless device?
    a. it receives data
    b. it demodulates
    c. it serves as a ground signal
    d. it transmits and receives data

    ANS: D PTS: 1 REF: 54

12. Which of the following is true about baud rate?
    a. only one bit can be transferred per signal unit (baud)
    b. multiple bits can be transferred with each signal unit
    c. a baud rate of 2400 always means a bandwidth of 2400 bps
    d. multiple signal units are needed to represent each bit

    ANS: B PTS: 1 REF: 55

13. Which of the following best describes bandwidth in an analog system?
    a. the range of frequencies that can be transmitted by a system
    c. the number of bytes transmitted per minute

b. the number of bits transmitted per second
d. the maximum frequency supported by the medium

ANS: A PTS: 1 REF: 56

14. Which of the following is NOT a type of modulation that can be applied to an analog signal?
a. phase
b. carrier
c. frequency
d. amplitude

ANS: B PTS: 1 REF: 57

15. Which type of radio signal is most susceptible from interference sources such as lightning?
a. AM
b. FM
c. PM
d. DM

ANS: A PTS: 1 REF: 57

16. Which of the following is NOT an advantage of digital modulation over analog modulation?
a. better use of bandwidth
b. requires less power
c. better performance during interference
d. modulation techniques are simpler

ANS: D PTS: 1 REF: 61

17. Which binary signaling technique reduces the voltage to zero during the transmission of a 1 bit before the bit period ends.
a. NRZ-L
b. NRZ-I
c. RZ
d. NRZ

ANS: C PTS: 1 REF: 61

18. Which binary modulation technique employs NRZ coding such that the absence of a carrier signal represents a 0 bit?
a. ASK
b. BPSK
c. FSK
d. PSK

ANS: A PTS: 1 REF: 64

19. Which radio transmission method uses a chipping code?
a. FM
b. FHSS
c. DSSS
d. AM

ANS: C PTS: 1 REF: 72

20. Which of the following is a spread spectrum technique that employs mathematical algorithms to recover lost data bits?
a. frequency hopping
b. direct sequence
c. narrow band
d. wide band

ANS: B PTS: 1 REF: 74

COMPLETION

1. Data signals in a wireless communication system travel on _____ waves.

ANS: electromagnetic

PTS: 1 REF: 43

2. A signal that is broadcast as a continuous wave is called a(n) _____ signal.

   ANS: analog

   PTS: 1 REF: 49-50

3. When representing a wave with a garden hose, the distance between the peaks of the waves represents the _____.

   ANS: wavelength

   PTS: 1 REF: 51

4. The _____ non-return-to-zero encoding method represents a 1 bit by increasing voltage to a positive value and a 0 bit by decreasing the voltage to a negative value.

   ANS: polar

   PTS: 1 REF: 62

5. In the presence of background interference, receivers can detect a _____ change more reliably than a frequency or amplitude change.

   ANS: phase

   PTS: 1 REF: 67

MATCHING

a. ASCII
b. amplitude modulation
c. analog signal
d. baud rate
e. carrier signal
f. digital modulation
g. frequency modulation
h. hopping code
i. NRZ
j. PM

1. a method of encoding a digital signal onto an analog carrier wave for transmission over media that does not support direct digital signal transmission
2. the number of times that a carrier signal changes per second
3. a technique that changes the number of wave cycles in response to a change in the amplitude of the input signal
4. a binary signaling technique that increases the voltage to represent a 1 bit but provides no voltage for a 0 bit
5. a technique that changes the height of a carrier wave in response to a change in the height of the input signal
6. a signal of a particular frequency that is modulated to contain either analog or digital data
7. a technique that changes the starting point of a wave cycle in response to a change in the amplitude of the input signal
8. the sequence of changing frequencies used in FHSS
9. a coding scheme that uses the numbers from 0 to 127 to represent alphanumeric characters and symbols

10. a signal in which the intensity (amplitude or voltage) varies continuously and smoothly over a period of time

1. ANS: F PTS: 1 REF: 76,60
2. ANS: D PTS: 1 REF: 76,55
3. ANS: G PTS: 1 REF: 76,58
4. ANS: I PTS: 1 REF: 77,62
5. ANS: B PTS: 1 REF: 75,57
6. ANS: E PTS: 1 REF: 76,52
7. ANS: J PTS: 1 REF: 77,59
8. ANS: H PTS: 1 REF: 76,69
9. ANS: A PTS: 1 REF: 75,42
10. ANS: C PTS: 1 REF: 75,50

SHORT ANSWER

1. Describe the components in an infrared wireless system.

   ANS:
   Infrared wireless systems require that each device have two components: an emitter, which transmits a signal, and a detector, which receives the signal. (These two components are almost always combined into one device.) An emitter is usually a laser diode or a light emitting diode (LED). Infrared wireless systems send data by the intensity of the light wave instead of whether the light signal is on or off. To transmit a 1, the emitter increases the intensity of the electrical current and, consequently, the intensity of the infrared light, which indicates a pulse to the receiver. The detector senses the higher-intensity pulse of light and produces a proportional electrical current

   PTS: 1 REF: 45

2. What are the advantages and limitations of an infrared wireless system?

   ANS:
   Infrared wireless systems have several advantages. Infrared light neither interferes with other types of communications signals (such as radio signals) nor is it affected by other signals, except light. In addition, because infrared light does not penetrate walls, the signals are kept inside a room. This makes it impossible for someone elsewhere to listen in on the transmitted signal.

   However, there are several serious limitations to infrared wireless systems. The first limitation involves the lack of mobility. Directed infrared wireless systems use a line-of-sight principle, which makes it challenging for mobile users because the alignment between the emitter and the detector would have to be continually adjusted. The second limitation is the range of coverage. Directed infrared systems, which require line of sight, cannot be placed in an environment where there is the possibility that anything could get in the way of the infrared beam (think of someone standing in front of your remote control while you are trying to change TV channels). This means that devices using infrared transmissions must be placed close enough to one another to eliminate the possibility of something moving between them. Due to the angle of deflection, diffused infrared can cover a range of only 50 feet (15 meters). And because diffused infrared requires a reflection point, it can only be used indoors. These restrictions limit the range of coverage.

   Another significant limitation of an infrared system is the speed of transmission. Diffused infrared can send data at maximum speeds of only 4 Mbps. This is because the wide angle

of the beam loses energy as it reflects. The loss of energy results in a weakening signal. The weak signal cannot be transmitted over long distances, nor does it have sufficient energy to maintain a high transmission speed, resulting in a lower data rate.

PTS: 1 REF: 46-47

3. Contrast analog signals with digital signals.

ANS:
An analog signal is one in which the intensity of the waves (voltage or amplitude) varies and is broadcast continuously—in other words, the signal has no breaks in it. A digital signal consists of discrete or separate pulses, as opposed to an analog signal, which is continuous. A digital signal has numerous starts and stops throughout the signal stream—Morse code, for example, with its series of dots and dashes.

PTS: 1 REF: 50

4. Describe how radio transmitters use a carrier signal.

ANS:
Radio transmitters send what is known as a carrier signal. This is a continuous wave (CW) of constant amplitude (measured in volts) and frequency. This is essentially an up-and-down wave called an oscillating signal or a sine wave. A CW carries no useful information by itself. Only after it is modulated does it contain some kind of information signal, such as music, voice, or data; then, it is correctly called a carrier signal or carrier wave. A receiver is adjusted (or tuned) to the frequency of the carrier, and it ignores all the other frequencies.

PTS: 1 REF: 52

5. How are radio waves transmitted using an antenna?

ANS:
Radio waves are usually transmitted and received using an antenna. An antenna is a length of copper wire, or similar material, with one end free and the other end connected to a receiver or transmitter. When transmitting, the radio waves created by the electronic circuit of the transmitter are fed to this antenna wire. This sets up an electrical pressure (voltage) along the wire, which will cause a small electrical current to flow into the antenna. Because the current is alternating, it flows back and forth in the antenna at the same frequency as the radio waves. When the electricity moves back and forth in the antenna at the same frequency as the radio waves, it creates both a magnetic field and an electrical field around the antenna. This continuous (analog) combination of magnetism and electrical pressure moves away (propagates) from the antenna the same way that water waves move away from the point of impact when you throw a rock in a pond. The result is an electromagnetic wave (EM wave).

PTS: 1 REF: 54

6. What are the three types of modulation that can be applied to an analog signal to enable it to carry information?

ANS:
The height of the signal, the frequency of the signal, and the relative starting point, or phase, of the signal.

PTS: 1

7. Describe amplitude modulation.

   ANS:
   The height of a wave, known as the amplitude, can be measured in volts (electrical pressure). In amplitude modulation (AM), the height of the wave is changed in accordance with the height of another analog signal, called the modulating signal. In the case of an AM radio station, the modulating signal is the voice of the announcer or the music, which is also an analog signal. The carrier wave's frequency and phase remain constant.

   PTS: 1 REF: 57

8. Describe the NRZ technique of representing bit signals.

   ANS:
   With non-return-to-zero, the voltage signal remains positive (high) for the entire length of the bit period. In addition, if the next bit to be transmitted is the same as the previous bit, the signal does not change, remaining high for a 1 and low (0 volts or no voltage) for a 0. This effectively reduces the number of signal transitions (baud) required to transmit the message.
   As with RZ, there is no voltage when transmitting a 0 bit

   PTS: 1 REF: 62

9. What is phase shift keying? Describe how it works.

   ANS:
   Phase shift keying (PSK) is a binary modulation technique, similar to phase modulation, in which the transmitter varies the starting point of the wave. The difference is that the PSK signal starts and stops because it is a binary signal. Whenever a bit being transmitted changes from 1 to 0 (or 0 to 1), the starting point (i.e., the direction of the wave) changes.

   PTS: 1 REF: 66

10. How are bits transmitted using DSSS? Include the chipping code in your answer.

    ANS:
    DSSS uses an expanded redundant code to transmit each data bit and then a modulation technique such as quadrature phase shift keying (QPSK). This means that a DSSS signal is effectively modulated twice. Instead of simply encoding these two bits over a carrier wave for transmission, the value of each data bit is first added to each individual 1 and 0 in a sequence of binary digits called a Barker code. A Barker code (or chipping code) is a particular sequence of 1s and 0s that has properties that make it ideal for modulating radio waves as well as for being detected correctly by the receiver. These 1s and 0s are called chips- instead of bits to avoid confusing them with the actual data bits. The chipping code is sometimes called a pseudorandom code because it is usually derived through a number of mathematical calculations as well as through practical experimentation.

    PTS: 1 REF: 72