

CHAPTER 3 : Data and Signals

Solutions to Review Questions

Review Questions

1. **Baseband transmission** means sending a digital or an analog signal without modulation using a low-pass channel. **Broadband transmission** means modulating a digital or an analog signal using a band-pass channel.
2. This is **baseband transmission** because no modulation is involved.
3. The frequency domain of a voice signal is normally **continuous** because voice is a **nonperiodic** signal.
4. **Optical signals** have very high frequencies. A high frequency means a short wave length because the wave length is inversely proportional to the frequency ($\lambda = v/f$), where v is the propagation speed in the media.
5. Using Fourier analysis. **Fourier series** gives the frequency domain of a periodic signal; **Fourier analysis** gives the frequency domain of a nonperiodic signal.
6. Three types of transmission impairment are **attenuation**, **distortion**, and **noise**.
7. This is **broadband transmission** because it involves modulation.
8. A **low-pass channel** has a bandwidth starting from zero; a **band-pass** channel has a bandwidth that does not start from zero.
9. **Frequency** and **period** are the inverse of each other. $T = 1/f$ and $f = 1/T$.
10. The **amplitude** of a signal measures the value of the signal at any point. The **frequency** of a signal refers to the number of periods in one second. The phase describes the position of the waveform relative to time zero.

11. **Optical signals** have very high frequencies. A high frequency means a short wave length because the wave length is inversely proportional to the frequency ($\lambda = v/f$), where v is the propagation speed in the media.
12. A signal is **periodic** if its frequency domain plot is **discrete**; a signal is **nonperiodic** if its frequency domain plot is **continuous**.
13. This is **baseband transmission** because no modulation is involved.
14. The **Nyquist theorem** defines the maximum bit rate of a noiseless channel.
15. An alarm system is normally **periodic**. Its frequency domain plot is therefore **discrete**.

Exercises

23.

Using the first harmonic, data rate = $2 \times 6 \text{ MHz} = 12 \text{ Mbps}$

Using three harmonics, data rate = $(2 \times 6 \text{ MHz}) / 3 = 4 \text{ Mbps}$

Using five harmonics, data rate = $(2 \times 6 \text{ MHz}) / 5 = 2.4 \text{ Mbps}$

35. The bandwidth is $5 \times 5 = 25 \text{ Hz}$.

36.

a. 90 degrees ($\pi/2$ radian)

b. 0 degrees (0 radian)

c. 90 degrees ($\pi/2$ radian)

47. $480 \text{ s} \times 300,000 \text{ km/s} = 144,000,000 \text{ km}$