Ch #14 Exercises Exercises

Due on August 11th, 2019
Computer Organization & Programming
CS550WS—Summer I
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Problem 14.12. A waveform travels in space at a rate of approximately 300 million meters per second. The wavelength of sine wave is the actual distance in space that is used by one sine wave as it travels. What is the wavelength of a 100-MHz sine wave? What is the wavelength of a 500-MHz sine wave? Antenna to send and receive electromagnetic waves are often sized to be one-half of the wavelength for the particular wave being used. Compare your previous calculations to the size of VHF and UHF television antennas. How large would be a $\frac{1}{2}$ wavelength antenna have to be to transmit a 60-Hz wave?

Solution

$$\lambda = \frac{c}{f} \tag{1}$$

$$\lambda_{100\text{ MHz}} = \frac{3 \times 10^{-10}\,\mathrm{m\,s^{-1}}}{100 \times 10^{6}\,\mathrm{Hz}} = \mathbf{3\,m}$$

$$\lambda_{500\text{ MHz}} = \frac{3 \times 10^{-10}\,\mathrm{m\,s^{-1}}}{500 \times 10^{6}\,\mathrm{Hz}} = \mathbf{0.6\,m}$$

$$\lambda_{60\text{ Hz}} = \frac{3 \times 10^{-10}\,\mathrm{m\,s^{-1}}}{60\,\mathrm{Hz}} = 5 \times 10^{6}\,\mathrm{m}$$

$$d = \frac{\lambda}{2} = \frac{5 \times 10^{6}\,\mathrm{m}}{2} = \mathbf{2500\,km}$$

Problem . What is the carrier frequency of your favorite radio station? Is the station amplitude modulated or frequency modulated? How do you know? What is the bandwidth of this station? (Hint: what is the carrier frequency of the next nearest possible station on the dial?)

Solution

My favorite radio station is, WNYC specifically WNYC-FM. The carrier frequency of WNYC-FM is 93.9 MHz. The station is frequency modulated. This is known because the name of the station lists "FM", the call signs required by FCC to announce every hour lists their carrier frequency and modulation, and because I need to use the FM settings on my radio to reach 93.9 MHz (AM only operates from 5351605 kHz). The bandwidth of the radio station is 0.8 MHz.