KNOWLEDGE PROBE 3: DIGITAL SIGNAL PROCESSING
The DFT and FFT

Learning Objectives

1. Identify the Fourier theory.
2. Describe how the discrete Fourier transform and fast Fourier transform are used to perform calculations in digital signal processing.
3. Distinguish between the terms correlation and convolution.

1. The Fourier theory states that
   a. A sine wave is made up of harmonically related square waves
   b. All non-sinusoidal waves contain varying levels of all frequency sine waves
   c. All signals are a function of time
   d. Any non-sinusoidal wave is made up of a fundamental sine wave and harmonically related sine waves

2. DFT and FFT analyze signals in the
   a. Frequency domain
   b. Time domain

3. The output of a DFT/FFT will be
   a. An analog signal
   b. Digital samples at harmonic frequencies
   c. Digital samples that convert to harmonics in a DAC
   d. Digital values that represent sine and cosine and phase amplitudes at harmonic frequencies

4. Correlation is a mathematical technique for
   a. Comparing two binary numbers
   b. Determining how closely one wave resembles another
   c. Performing multiplication
   d. Relating one signal to another in some predetermined way

5. Correlation is performed by
   a. Adding all samples of each input then comparing
   b. Multiplying all samples of one wave by all samples of the other then adding, shifting, and repeating
   c. Multiplying input samples by some constant
   d. Reversing the samples of one input

6. Convolution is
   a. Is a calculus operation
   b. Similar to correlation but samples are multiplied and added in reverse order
   c. Similar to correlation but the order of samples of one input is flipped
   d. The same as correlation

7. What are the samples of the input signal correlated with in a DFT operation?
   a. DC value
   b. Sine and cosine basis functions
   c. The input samples of a signal generator
   d. Themselves

8. Which of the following is NOT one of the outputs of a DFT?
   a. An analog signal in the time domain
   b. Cosine frequency spectrum plot
   c. Phase plot
   d. Sine frequency spectrum plot

9. To create a single frequency plot for the DFT output, the sine and cosine values are
   a. Added
   b. Added as phasors
   c. Divided
   d. Multiplied

10. An FFT gives the same output as a DFT.
    a. True
    b. False

11. Why is the FFT used over the DFT?
    a. It is significantly faster
    b. It is simpler
    c. It produces more accurate results
    d. It uses less memory

12. Using more sample points in an FFT produces
    a. Faster processing
    b. Greater accuracy or precision
    c. Less memory usage
    d. No difference from a DFT