Lecture Version for
An Introduction to the Fourier Transform

By

Scott Van Bramer
Department of Chemistry
Widener University
One University Place
Chester, PA 19013

svanbram@science.widener.edu

This document was specially prepared for use in lecture. It is designed for the instructor or student to change variables and observe their effect on a time domain waveform and a frequency domain spectrum.

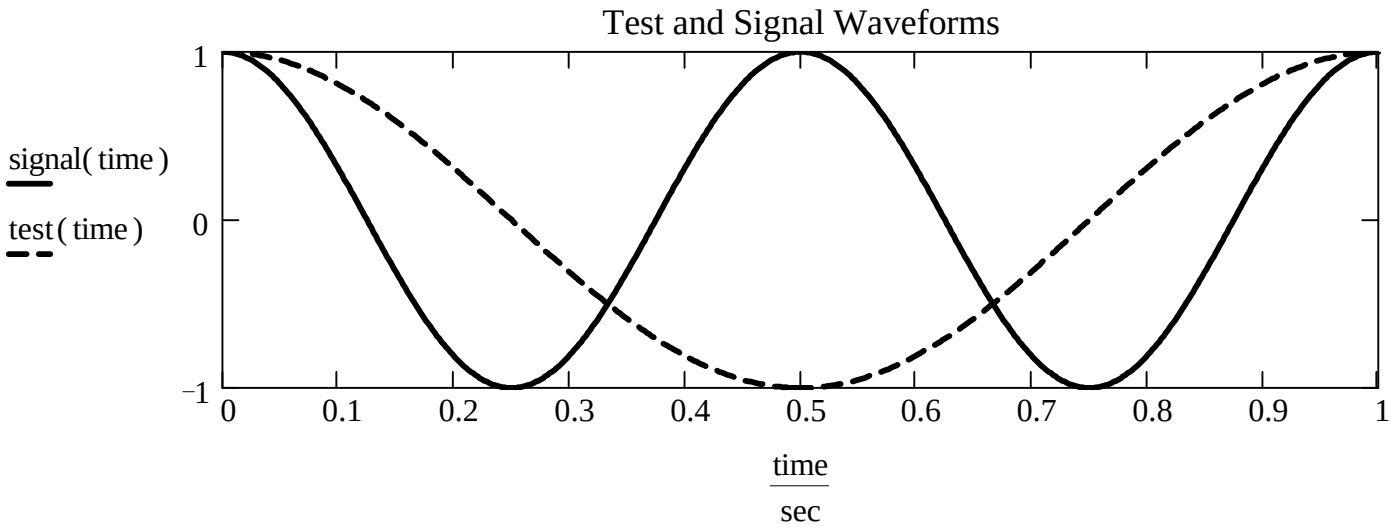
The Test Waveform and Integration

Sample and signal parameters:

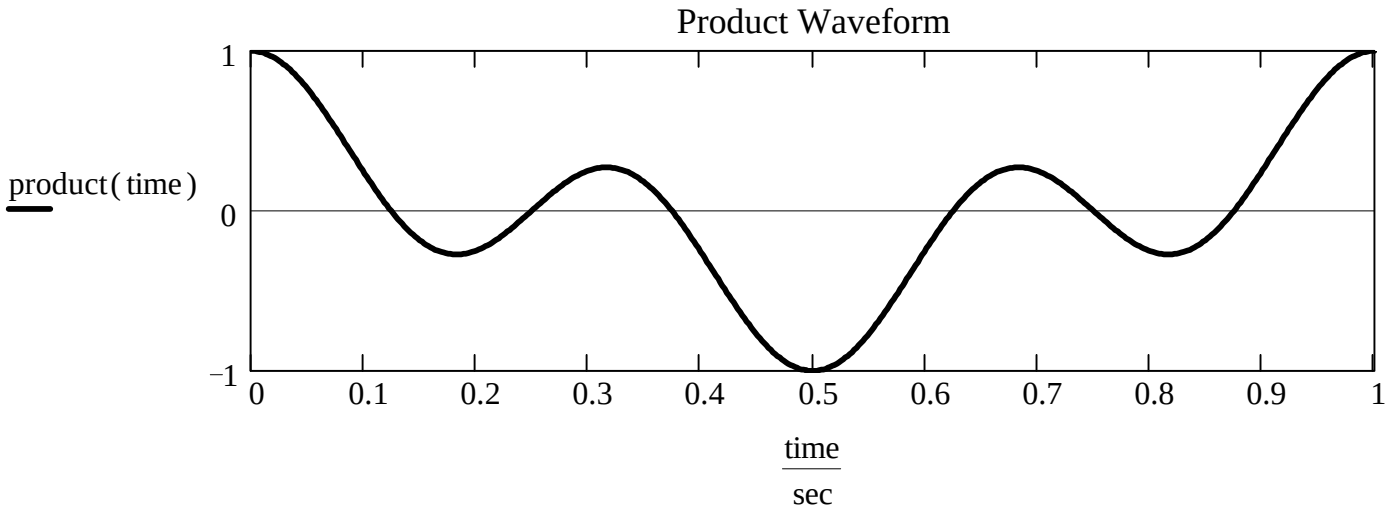
$$\omega_{signal} := 2\cdot\pi\cdot(2\cdot Hz) \qquad \omega_{test} := 2\cdot\pi\cdot(1\cdot Hz)$$

Equation for the signal wave, test wave and time.

$$time := 0\cdot sec, \frac{1}{512}\cdot 1\cdot sec .. 1\cdot sec \qquad signal(t) := \cos\left(\omega_{signal}\cdot t\right) \qquad test(t) := \cos\left(\omega_{test}\cdot t\right)$$



$$product(t) := test(t)\cdot signal(t)$$



Integrate:

$$\int_{0\cdot sec}^{1\cdot sec} product(t)\, dt = 0\cdot sec$$

The Frequency Spectrum

Setup Calculations

$N := 1024$ $\quad t_{acquire} = 50 \cdot sec$ $\quad i := 0, 1 .. N - 1$ $\quad A := 1$

$t_i := \frac{i}{N} \cdot t_{acquire}$ $\quad j := 0, 1 .. \frac{N}{2} - 1$ $\quad frequency_j := \frac{j}{t_{acquire}}$

$signal_i := A \cdot \cos\left(t_i \cdot \omega + \phi\right) \cdot e^{\frac{-t_i}{T_1}}$ $\quad F := fft(signal)$

Variables:

Signal Frequency	$\omega \equiv 2 \cdot \pi \cdot (5 \cdot Hz)$
Signal Phase	$\phi \equiv 0 \cdot deg$
Acquisition Time	$t_{acquire} \equiv 50 \cdot sec$
Relaxation Rate	$T_1 \equiv 5 \cdot sec$