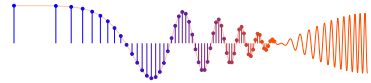


PROBLEM:

Suppose that MATLAB is used to plot a sinusoidal signal. The following MATLAB code generates a signal $x[n]$ and plots it. Unfortunately the plot does not have its time axis labeled properly.

```
dt = 1/200;
Duration = 0.3;
tt = 0 : dt : Duration;
xx = 3*imag( exp( j*1224*pi*tt ) );     %---  j = sqrt(-1)
stem( xx )     %<--- OOPS! there is no time axis
```

(a) Make a plot of the signal—either sketch it or do it via MATLAB.

(b) For the plot above, determine the correct formula for the discrete-time signal in the form:

$$x[n] = A\cos(\hat{\omega}_0 n + \phi)$$

Make sure that $\hat{\omega}_0$ lies between $-\pi$ and $+\pi$.

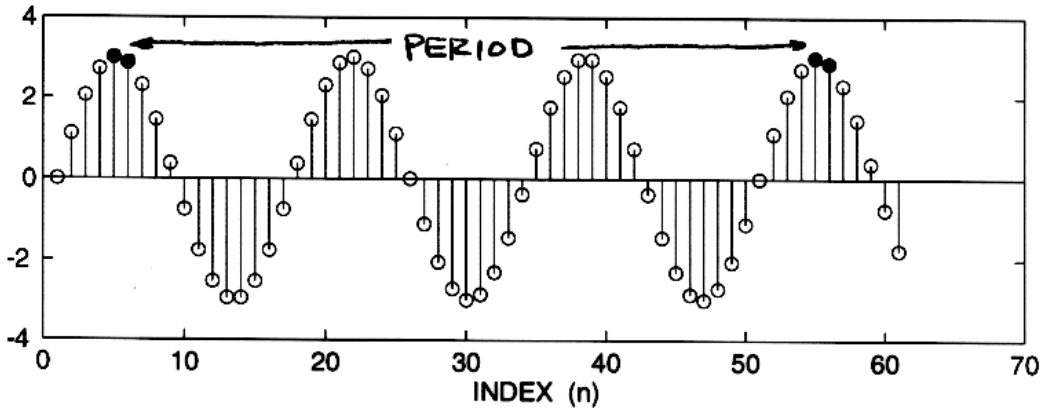
(c) Determine the period of $x[n]$, i.e., find N_0 where $x[n + N_0] = x[n]$.

(d) EXPLAIN how aliasing affects the plot that you see.

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

SOLUTION

(a)



(c) Measure period between peaks.

1ST PEAK @ n=5

Repeat peak @ n=55

PERIOD = 55 - 5 = 50

FROM PART (b) below

PERIOD = $2\pi/\omega_0 = 2\pi/0.12\pi = 1/0.06$

$\Rightarrow$ period = 50/3, but it must be integer

(b) $x[n] = x(t)\big|_{t=n/F_s} = 3\sin(1224\pi t)\big|_{t=n/200}$

$x[n] = 3\sin(1224\pi(n/200))$

$= 3\cos(6.12\pi n - \pi/2)$

$= 3\cos(0.12\pi n - \pi/2)$

Actually, $x[n]$ starts at n=1 where it crosses zero so the correct formula is

$x[n] = 3\cos(0.12\pi(n-1) - \pi/2) = 3\cos(0.12\pi n - 0.62\pi)$

(d) The same plot would be observed if the input frequency were $2\pi(412)$, $2\pi(212)$ or $2\pi(12)$ Since the plot look low freq, it appears to have come from the 12Hz case.