Quiz #1

Given
\[ x(t) = 3 + 6 \cos(20\pi t - \pi/3) + 4 \sin(40\pi t) + 6 \cos(80\pi t - \pi/6) \]

(a) Find the fundamental frequency \((w_0)\)

\[ w_0 = \gcd(20\pi, 40\pi, 80\pi) = 20\pi \]

\[ \therefore w_0 = 20\pi \text{ [has a unit of rad/sec]} \]

(b) Find the fundamental period \((T_0)\)

- \(6 \cos(20\pi t - \pi/3)\) has a frequency of 10 Hz and a period of 0.1 sec.
- \(4 \sin(40\pi t)\) has a frequency of 20 Hz and a period of 0.05 sec.
- \(6 \cos(80\pi t - \pi/6)\) has a frequency of 40 Hz and a period of 0.025 sec. We see that the 10 Hz is going to "limit" how often the signal repeats. Therefore, \[ T_0 = 0.1 \text{ sec} \]

(c) Evaluate \(a_0\) (It is possible to evaluate this \((a_0)\) without evaluating any integrals)

\[ a_0 \text{ is just the DC component of the signal defined} \]

\[ \therefore a_0 = 3 \]

(d) If a new signal is defined by adding one more sinusoid such that
\[ y(t) = x(t) + 5 \cos(70\pi t - \pi/4) \], does the fundamental frequency \((w_0)\) change and if so what is it?

Yes, it does change to \(10\pi\)
Quiz #1

Given
\[ x(t) = 4 + 8 \cos(30\pi t - \pi/3) + 7 \sin(30\pi t) + 6 \cos(60\pi t - \pi/6) \]

(a) Find the fundamental frequency \((w_0)\)

\[ w_0 = \text{gcd}(30\pi, 30\pi, 60\pi) \]

\[ w_0 = 30\pi \]

(b) Find the fundamental period \((T_0)\)

\[ 8 \cos(30\pi t - \pi/3) \text{ repeats every } \frac{1}{15} \text{ sec}, \]
\[ 7 \sin(30\pi t) \text{ repeats every } \frac{1}{15} \text{ sec}, \]
\[ 6 \cos(60\pi t - \pi/6) \text{ repeats every } \frac{1}{30} \text{ sec}. \]

The repetition of the signal is limited by a period of \(\frac{1}{15}\) sec.

\[ T_0 = \frac{1}{15} \text{ sec} \]

(c) Evaluate \(a_0\) (It is possible to evaluate this \((a_0)\) without evaluating any integrals)

\(a_0\) is the DC component of the defined signal.

\[ a_0 = 4 \]

(d) If a new signal is defined by adding one more sinusoid such that

\[ y(t) = x(t) + 5 \cos(70\pi t - \pi/4), \]

does the fundamental frequency \((w_0)\) change and if so, what is it?

Yes, it does change to \(10\pi\)
Given

\[ x(t) = 6 + 5 \cos(40\pi t - \pi/3) + 7 \sin(80\pi t) + 4 \cos(40\pi t - \pi/6) \]

(a) Find the fundamental frequency \( (w_o) \)

\[ w_o = \gcd(40\pi, 80\pi, 40\pi) \]

\[ w_o = 40\pi \]

\( \left\{ \begin{array}{l} \text{\( w_o \) has a unit} \\ \text{8 rad/sec} \end{array} \right. \)

(b) Find the fundamental period \( (T_o) \)

\( 5 \cos(40\pi t - \pi/3) \) repeats every 0.05 secs, \( 7 \sin(80\pi t) \) 0.025 secs and \( 4 \cos(40\pi t - \pi/6) \) repeats every 0.05 secs.

The signal is "limited" by a period of 0.05 secs.

\[ T_o = 0.05 \text{ sec} \]

(c) Evaluate \( a_0 \). (It is possible to evaluate this \( (a_0) \) without evaluating any integrals)

\( a_0 \) is just the DC component of the signal defined.

\[ a_0 = 6 \]

(d) If a new signal is defined by adding one more sinusoid such that \( y(t) = x(t) + 9 \cos(20\pi t - \pi/4) \), does the fundamental frequency \( (w_o) \) change and if so what is it?

Yes it does change to 20\pi