

Homework 6

Chapter 6

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Class 1. Find the complex exponential Fourier series and then plot the double sided amplitude and phase spectra for the following signals. Hints: $\sin(\theta) = \cos(\theta - \frac{\pi}{2})$ and $-\sin(\theta) = \cos(\theta + \frac{\pi}{2})$.

a) $x(t) = 2\cos(2\pi 100t)$

b) $x(t) = 4\cos(2\pi 100t - \frac{\pi}{3})$

c) $x(t) = 4\sin(2\pi 100t - \frac{\pi}{4})$

d) $x(t) = 2\cos(2\pi 100t) - 4\sin(2\pi 150t)$

e) $x(t) = \sin^2(2\pi 100t)$

Class 2.

- a) Find the complex exponential Fourier series for $x(t)$ below and then plot the double sided amplitude spectrum for $|f| \leq 10\text{kHz}$. Carefully label the axis.

$$x(t) = \sum_{k=-\infty}^{\infty} \text{rect}\left(\frac{t - kT_0}{\tau}\right) \quad \text{with } T_0 = 1\text{ms} \text{ and } \tau = 0.25\text{ms}$$

- b) What is the total power in $x(t)$?
c) What is the power in the 3rd harmonic?
d) What is the % power in the frequency range $|f| \leq 10\text{kHz}$?

Class 3. Find the complex exponential Fourier series for $x(t)$ below and then plot the double sided amplitude spectrum for $|f| \leq 10\text{kHz}$. Carefully label the axis.

$$x(t) = \sum_{k=-\infty}^{\infty} \text{rect}\left(\frac{t - kT_0}{\tau}\right) \quad \text{with } T_0 = 2\text{ms} \text{ and } \tau = 0.25\text{ms}$$

Class 4. Find the complex exponential Fourier series for $x(t)$ below and then plot the double sided amplitude spectrum for $|f| \leq 10\text{kHz}$. Carefully label the axis.

$$x(t) = \sum_{k=-\infty}^{\infty} \text{rect}\left(\frac{t - kT_0}{\tau}\right) \quad \text{with } T_0 = 1\text{ms} \text{ and } \tau = 0.1\text{ms}$$

Class 5. Examine the results of problems Class 2-Class 4.

- a) Describe how changing T_0 changes the double sided amplitude spectra.
b) Describe how changing τ changes the double sided amplitude spectra.

See [Fourier Series Coefficients of a Rectangular Pulse Signal](http://demonstrations.wolfram.com/FourierSeriesCoefficientsOfARectangularPulseSignal/)

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Class 6. a) Find the complex exponential Fourier series X_n for $y(t)$ for $|f| \leq 6kHz$ and then plot the double sided phase spectrum for $|f| \leq 6kHz$. Hint: use the result from problem Class 2. Carefully label the axis.

$$y(t) = \sum_{k=-\infty}^{\infty} \text{rect}\left(\frac{t - kT_0 - d}{\tau}\right) \quad \text{with } T_0 = 1ms \text{ and } \tau = 0.25ms \text{ and } d = 0.125ms$$

- b) What is the difference between the amplitude spectrum of $y(t)$ above and $x(t)$ in problem Class 2?
- c) What is the difference between the phase spectrum of $y(t)$ above and $x(t)$ in problem Class 2?