

National University of Singapore
Department of Electrical & Computer Engineering

EE2023 Signals and Systems Assignment 1

1. Is the complex exponential signal $x(t) = e^{j3t}$ periodic? If so, what is its fundamental frequency?
2. Is the complex exponential signal $x(t) = e^{-(2+j3)t}$ periodic? If so, what is its fundamental frequency?
3. Let $x(t)$ be a periodic signal with period T_0 . What is the period of the signal $x(\alpha t)$ where $\alpha > 0$? *Ans : T_0/α*
4. Determine the complex exponential form of the Fourier series of the full wave rectified sinusoidal signal, $y(t)$, shown in Figure 1. Is $y(t)$ a power or energy signal?

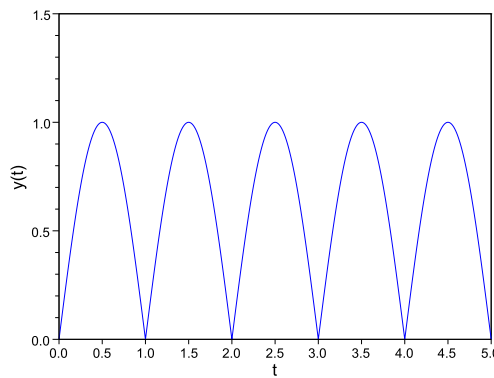


Figure 1: Full-wave rectified sinusoidal signal

5. Show that the Fourier transform of $y(t) = x(t) \cos 2\pi f_0 t$ is given by

$$Y(f) = \frac{1}{2} [X(f + f_0) + X(f - f_0)].$$

Using this result, find the Fourier transform of

$$v(t) = \text{rect}\left(\frac{t}{\epsilon}\right) \cos 2\pi f_0 t.$$

Sketch its spectrum.

$$\text{Ans : } V(f) = 0.5\epsilon [\text{sinc}((f - f_0)\epsilon) + \text{sinc}((f + f_0)\epsilon)]$$

6. Suppose the Fourier transform of a signal is given by :

$$X(f) = 0.5 \left[\text{rect}\left(\frac{f - 5}{100}\right) + \text{rect}\left(\frac{f + 5}{100}\right) \right].$$

Find the corresponding time domain signal $x(t)$.

$$\text{Ans : } x(t) = 100 \text{sinc}(100t) \cos(10\pi t)$$