Fourier Series

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***Abstract*—This manual provides a simple introduction to Fourier Series**

1 Periodic Function

Let

$$x(t) = A_0 \left|\sin\left(2\pi f_0 t\right)\right| \tag{1.1}$$

1.1 Plot $x(t)$.

1.2 Show that $x(t)$ is periodic and find its period.

2 Fourier Series

Consider $A_0 = 12$ and $f_0 = 50$ for all numerical calculations.

2.1 If

$$x(t) = \sum_{k=-\infty}^{\infty} c_k e^{\mathrm{J}2\pi k f_0 t} \tag{2.1}$$

show that

$$c_k = f_0 \int_{-\frac{1}{2f_0}}^{\frac{1}{2f_0}} x(t) e^{-\mathrm{J}2\pi k f_0 t}\, dt \tag{2.2}$$

2.2 Find c_k for (1.1)

2.3 Verify (1.1) using python.

2.4 Show that

$$x(t) = \sum_{k=0}^{\infty} \left(a_k \cos \mathrm{J}2\pi k f_0 t + b_k \sin \mathrm{J}2\pi k f_0 t\right) \tag{2.3}$$

and obtain the formulae for a_k and b_k.

2.5 Find a_k and b_k for (1.1)

2.6 Verify (2.3) using python.

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