Fourier Transform and LTI Systems

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$$S\{Ae^{j2\pi f_0 t}\} = H(f_0)e^{j2\pi f_0 t} A$$

for some $H: \mathbb{R} \to \mathbb{C}$. Complex exponentials are eigenfunctions of LTI systems. $H(f)$ is called the frequency response of S.

$$s(t) = \sum_{k=-\infty}^{k=+\infty} c_k e^{j\frac{2\pi k t}{T}}$$

$$S\{s(t)\} = \sum_{k=-\infty}^{k=+\infty} c_k H\left(\frac{k}{T}\right) e^{j\frac{2\pi k t}{T}}$$

if $s(t)$ is periodic. Otherwise, use FT instead of FS.

$$s(t) = \int_{-\infty}^{+\infty} S(f) e^{j2\pi f t}\, dt$$

$$S\{s(t)\} = \int_{-\infty}^{+\infty} \underbrace{S(f)H(f)}_{Y(f)} e^{j2\pi f t}\, dt$$

we can see $S(f)H(f)$ is the Fourier Transform of LTI system output $S\{s(t)\}$.