

## EE110B Lab 3

Consider the signal

$$x[n] = a^n \cos(2\pi f_0 n + \phi) u[n] \quad (1)$$

where  $0 < a < 1$ . Its DTFT is

$$\begin{aligned} X(f) &= \frac{0.5e^{j\phi}}{1 - ae^{j2\pi f_0}e^{-j2\pi f}} + \frac{0.5e^{-j\phi}}{1 - ae^{-j2\pi f_0}e^{-j2\pi f}} \\ &= \frac{\cos(\phi) - a\cos(2\pi f_0 - \phi)e^{-j2\pi f}}{1 - 2a\cos(2\pi f_0)e^{-j2\pi f} + a^2e^{-j4\pi f}} \end{aligned} \quad (2)$$

Compute and plot the amplitude spectrum  $|X(f)|$  and the phase spectrum  $\angle X(f)$  over  $f$  within  $[-0.5, 0.5]$  under various choices of  $f_0$ ,  $a$  and  $\phi$ , and discuss the effects of these parameters on the spectra. For example, you can consider the following cases:

- 1) Choose  $a = 0.9$  and  $\phi = 0$  and various values of  $f_0$  within  $(0, 0.5)$ .
- 2) Choose  $f_0 = 0.2$  and  $\phi = 0$  and various values of  $a$  within  $(0, 1)$ .
- 3) Choose  $f_0 = 0.2$  and  $a = 0.9$  and various values of  $\phi$  within  $(0, \pi)$ .

Note that  $X(f) = |X(f)| \exp(j\angle X(f))$ .