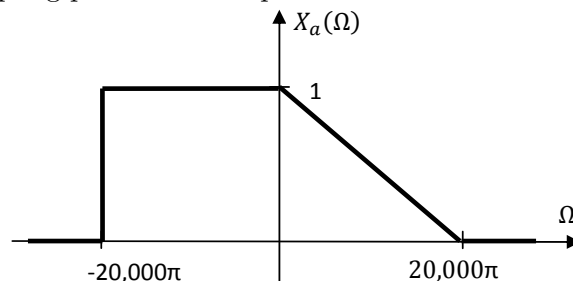


**ECE 310: Problem Set 7****Due:** 5pm, Friday October 19, 2018

1. The continuous-time signal  $x_a(t)$  has the Fourier transform shown below. The signal  $x_a(t)$  is sampled with a sampling period of  $T$  to produce the discrete-time signal  $x[n] = x_a(nT)$ .



- Sketch the DTFT  $X_d(\omega)$  of  $x[n]$  for  $|\omega| \leq 2\pi$  for the sampling frequencies  $F_s$  of (i) 20 kHz and (ii) 30 kHz.
  - What is the Nyquist rate (minimum sampling rate needed to avoid aliasing) for the signal  $x_a(t)$ ?
  - Is the signal  $x[n]$  real-valued? Why or why not?
2. A continuous-time signal  $x_a(t) = \cos(\Omega_0 t)$  was sampled at a rate of 80 samples/sec to produce  $x[n] = \cos(7\pi n/12)$ . Find the three lowest possible different values of  $|\Omega_0|$  that could produce the sequence  $x[n]$ . Are there more possible values?
3. Consider the continuous-time signal  $x_c(t)$  with Fourier transform given by

$$X_c(\Omega) = \begin{cases} 10 & \text{if } |\Omega| \leq 250\pi \\ 20 & \text{if } 250\pi < |\Omega| \leq 500\pi \\ 0 & \text{if } 500\pi < |\Omega| \end{cases}$$

The signal  $x_c(t)$  is sampled with a period  $T$  to obtain the discrete-time signal  $x[n] = x_c(nT)$ .

- Determine a closed-form expression for  $x_c(t)$ .
  - Determine the discrete-time signal  $x[n]$  for  $T = 10^{-3}$  sec.
  - Determine and sketch the discrete-time Fourier transform  $X_d(\omega)$  of  $x[n]$ , for the value of  $T$  in Part (b).
4. The continuous-time signal  $x_c(t) = \cos(10\pi t)$  is sampled at rate of 3 samples per second, producing the discrete time signal  $x[n]$ .
- Determine a closed-form expression for the output  $y_c(t)$  of an ideal D/A operating at a rate of 3 samples per second that has  $x[n]$  as a input.
  - Sketch the spectra of  $x_c(t)$ ,  $x[n]$  and  $y_c(t)$  and comment on the relation between them.