EE 313 Signals and Systems Examination 3 Example

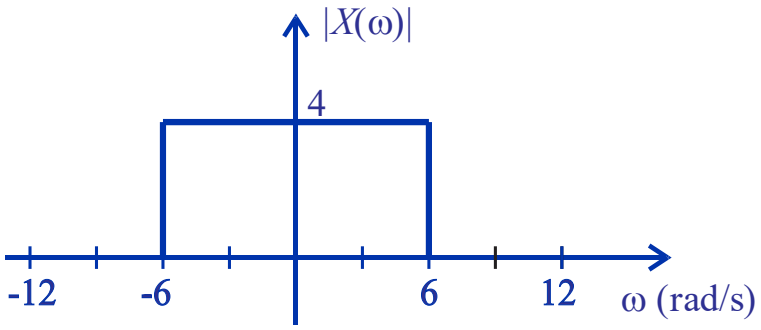
Name _____

Instructions: Show all work for full credit. Write answers in indicated places.

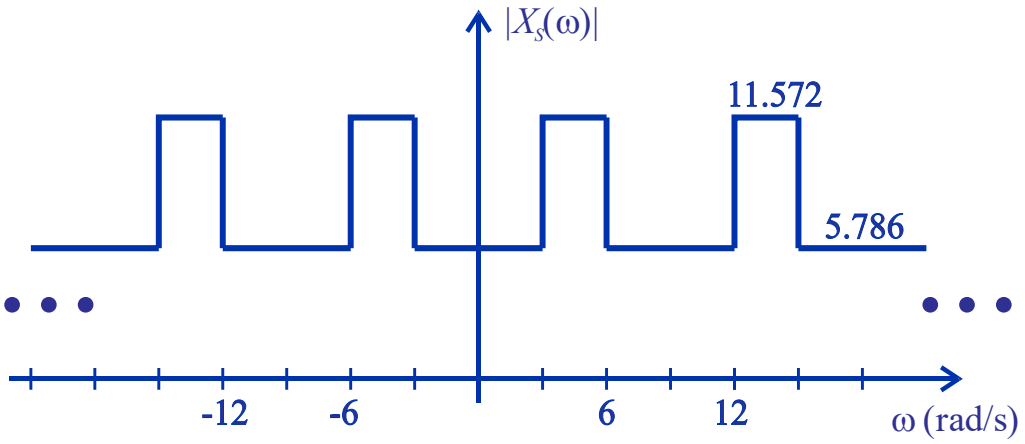
1) Given the transfer function $H(z)=\dfrac{2z^3-0.6z^2+0.4z-0.8}{(z-0.4)^2(z+0.8)}$, find an analytical expression for the impulse response $h[n]$ for all n using partial fractions.

$$h[n]=-6.25\delta[n]+6.0\overline{55}(0.4)^n u[n]-1.2\overline{66}n(0.4)^{n-1}u[n]+2.19\overline{44}(-0.8)^n u[n]$$

2) A signal $x(t)$ has the Fourier transform $X(\omega) = 4\,p_{12}(\omega)\,e^{-j4\omega}$. Draw a fully labeled sketch of $|X(\omega)|$ on the provided axes. If $x(t)$ is to be sampled, determine the maximum sampling rate $T_{s,\max}$ and corresponding minimum sampling frequency $f_{s,\min}$ that will prevent aliasing error. If $x(t)$ is then sampled at a rate $T = 0.691317$ s, will there be aliasing? Then, draw a fully labeled sketch of the magnitude of the sampled frequency spectrum $|X_S(\omega)|$ on the provided axes.



$T_{s,\max}$ = 0.5236 s **$f_{s,\min}$ = 1.91 Hz** **Aliasing? Yes / No**



3) A filter is characterized by the transfer function of $H(\omega) = \dfrac{j\omega 200}{(200 + j\omega)(50 + j\omega)}$, $-\infty < \omega < \infty$. If the filter has an input signal $x(t) = 4 + 6\cos(20t - 20°) + 5\cos(100t + 45°) - 3\cos(300t + 25°)$, find the output $y(t)$ for all time.

$y(t) = 2.2173\cos(20t + 42.488°) + 4\cos(100t + 45°) - 1.6415\cos(300t - 21.848°)$

4) A discrete-time signal $h[n]$ has the z-transform $H(z)=\dfrac{2z^2+1}{z^2+1.2z+0.27}$. Calculate

a) $h[0]$

$h[0] = 2$

b) $h[n\to\infty]$

$h[n\to\infty] = 0$

c) $Y(z)$ when $y[n]=h[n+1]$

$$Y(z)=\frac{-2.4z^2+0.46z}{z^2+1.2z+0.27}$$

d) $W(z)$ when $w[n]=(0.3)^n h[n]$

$$W(z)=\frac{22.\overline{2}z^2+1}{11.\overline{1}z^2+4z+0.27}=\frac{2z^2+0.09}{z^2+0.36z+0.0243}$$