ECE 5/4625 • Quiz 1 • January 30, 2020

Topic: Basic Signal Theory **Name:** _____

1.) Consider the sum of sinusoids signal

$$x(t) = 2 + 10\cos\left(200\pi t + \frac{\pi}{4}\right) - 25\cos(350\pi t)$$

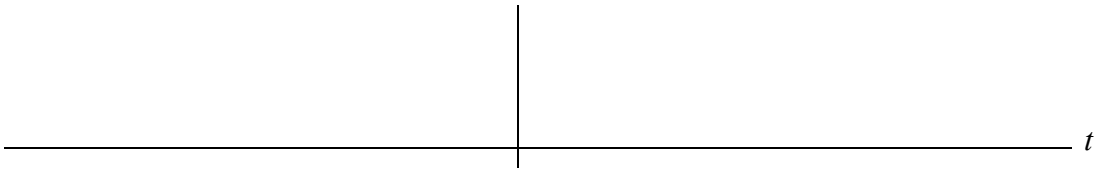
10 pts. a.) Sketch and label the one-sided amplitude (only) line spectrum of $x(t)$.

5 pts. b.) Find the period or fundamental frequency if it exists. **Hint**: The DC term is not a concern.

2.) Consider the pulse-type signal

$$x(t) = \Pi\left(\frac{t}{10}\right) + 2\Lambda\left(\frac{t}{2}\right)$$

5 pts. a.) Sketch $x(t)$ including labels.



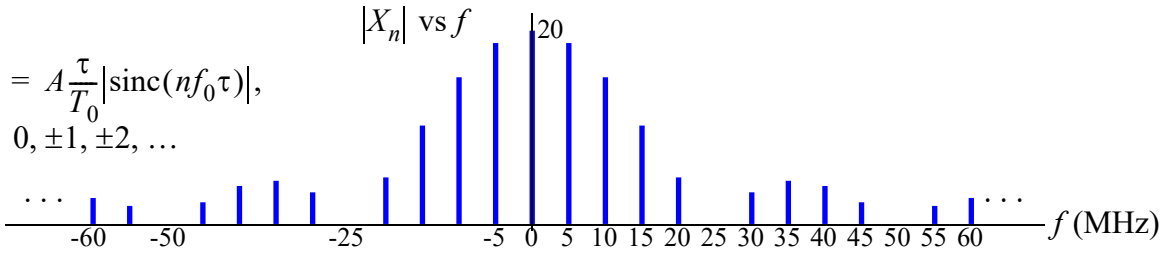
20 pts. b.) Find the energy in $x(t)$. If it is not an energy signal find the average power. **Hint**: Use symmetry in the integration and don't forget to include units.

ECE 5/4625 • Quiz 2 • February 6, 2020

Topic: Set #2 FS & FT **Name:** _____

1.) A pulse train has the following line spectrum magnitude (amplitude):

$$|X_n| = A\frac{\tau}{T_0}|\text{sinc}(nf_0\tau)|,$$
$$n = 0, \pm 1, \pm 2, \ldots$$

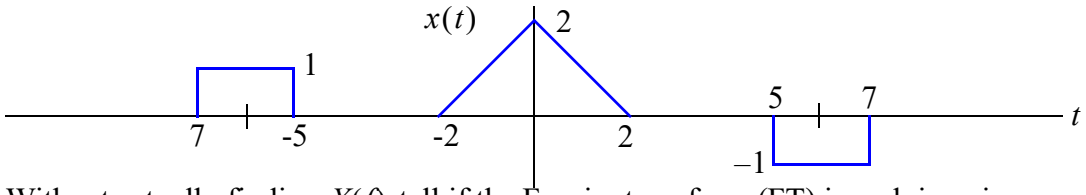


6 pts. a.) Find the pulse train period T_0.

6 pts. b.) Find the pulse train duty cycle τ / T_0.

8 pts. c.) Find the amplitude A.

2.) Consider the aperiodic signal



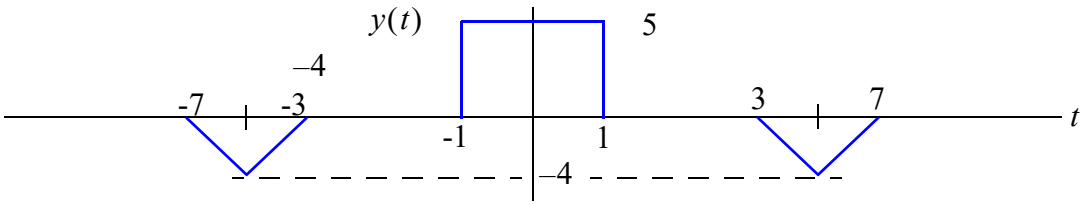
5 pts. a.) Without actually finding $X(f)$ tell if the Fourier transform (FT) is real, imaginary, or neither. Explain.

15 pts. b.) Find $X(f)$, the FT of $x(t)$. Try to simplify to two terms.

ECE 5/4625 • Quiz 3 • February 13, 2020

Topic: FT and PSD/Autocorrelation **Name:** _____

1.) Consider the aperiodic signal



5 pts. a.) Without actually finding $Y(f)$ tell if the Fourier transform (FT) is real, imaginary, or neither. Explain.

15 pts. b.) Find $Y(f)$, the FT of $y(t)$. Try to simplify the expression.

2.) A periodic power signal $y(t)$ has power spectral density

$$S_y(f) = 10\delta(f) + 15[\delta(f-20) + \delta(f+20)]$$

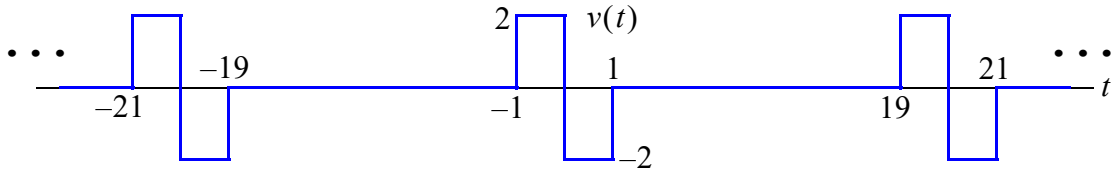
10 pts a.) Find the average power in $y(t)$, denoted P_y.

10 pts b.) Find the corresponding autocorrelation function $R_y(\tau)$.

ECE 5/4625 • Quiz 4 • February 20, 2020

Topic: FT/PSD/Autocorrelationn **Name:** _____

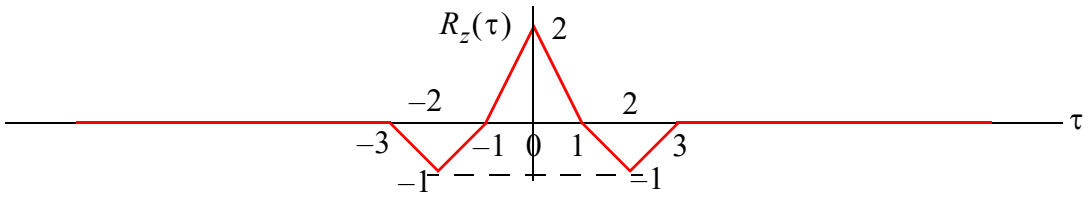
15 pts. 1.) Consider the periodic signal $v(t)$



Find the spectrum $V(f)$ starting from one period of $v(t)$, denoted $p(t)$.

15 pts. 2.) For the signal $x(t) = 5\cos(10\pi t + \pi/2) + 6$ find the autocorrelation $R_x(\tau)$ and then use $R_x(\tau)$ to quickly find the average power P_x.

10 pts 3.) A *random* signal is known to have aperiodic autocorrelation function $R_z(\tau)$ shown below:



Find the power spectral density $S_z(f)$. Note it will be a continuous function of f.

ECE 5/4625 • Quiz 5 • February 27, 2020

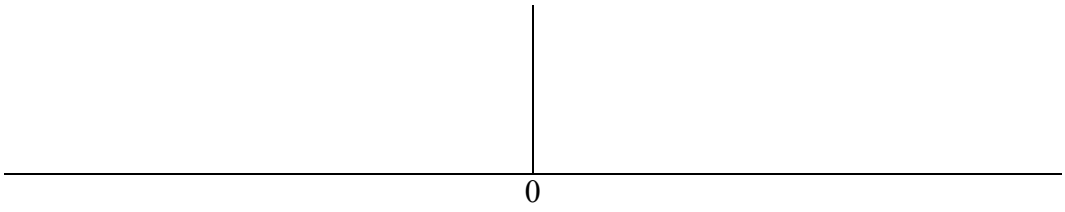
Topic: Freq Resp. & Distortion **Name:** _____

1.) The signal $x(t) = 3\cos[2\pi(2\times10^5)t] + 5\cos[2\pi(5\times10^6)t]$ is input to an ideal lowpass filter having cutoff frequency of 1 MHz and gain of 2, i.e.,

$$H(f) = 2\Pi\left(\frac{f}{2\times10^6}\right).$$

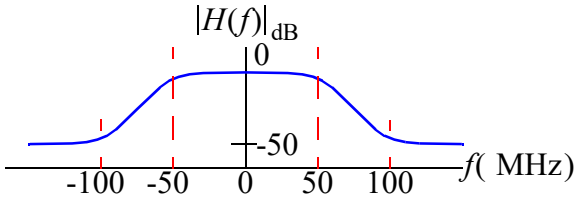
The filter output is $y(t)$.

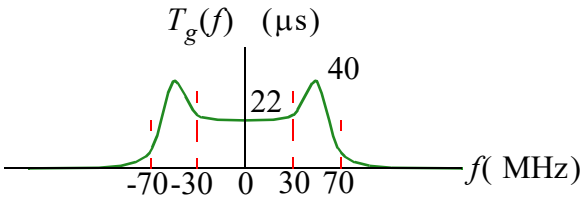
10 pts. a.) Sketch the two-sided power spectral density of $y(t)$, at the filter output. Recall that $S_y(f) = S_x(f)|H(f)|^2$. Label your axis.



10 pts. b.) Find the average power in $y(t)$.

2.) A lowpass filter has the following amplitude and group delay responses:





10 pts. a.) Find the usable lowpass bandwidth that is free of both amplitude and phase distortion?

10 pts. b.) Find the usable lowpass bandwidth that is free of amplitude distortion?.