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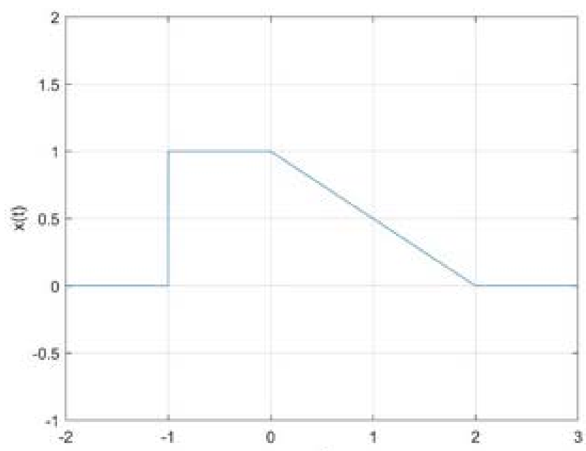
**HW03**

1. The signal $x(t)$ shown is piecewise defined as



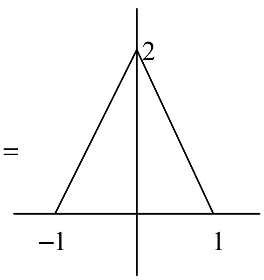

Plot the time-domain signal of

a) $x(3t)$
b) $x\left(\frac{1}{2}\cdot t\right)$
c) $x(-2t - 4)$
d) $x(-2t + 4)$

2. Assume that the frequency response of the $x(t)$ is $\left[X(f) = 2\Lambda\left(\frac{t}{2}\right)\right]$

*Note: Just like the rectangular functios, a triangle function is defined as* $\left[\mathrm{A}\cdot\Lambda\left(\frac{t}{\mathrm{W}}\right)\right]$ *(A: Amplitude, t: center at t=, & W: width)*

$2\Lambda\left(\frac{t}{2}\right) =$




**<u>Find</u> and <u>plot</u>** the frequency response in magnitude and phase based on the $\left[X(f) = 2\Lambda\left(\frac{t}{2}\right)\right]$

a) $x(2t)$

b) $x\left(\frac{1}{4}\cdot t\right)$

c) $x(-3t - 6)$

d) $x(-2t + 6)$

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3. In the class we talked about the Dirac Delta function. The key features are defined as

| | |
|---|---|
| **Dirac delta** function | $\begin{cases} x(t)\cdot\delta(t)=x(0)\cdot\delta(t) \\ x(t)\cdot\delta(t-5)=x(5)\cdot\delta(t-5) \text{ This is impulse@5} \\ \int_{t=-\infty}^{\infty}\delta(t)\,dt=1 \\ \int x(t)\cdot\delta(t-5)\,dt=\int x(5)\cdot\delta(t-5)\,dt=x(5)\int\delta(t-5)\,dt=x(5) \text{ This is constant} \end{cases}$ |
| | |

Find the following integrations (it is supposed to be simple questions)

a. $\int_{-\infty}^{+\infty} e^{-t}\delta(t-1)\,dt$

b. $\int_{0}^{+\infty} e^{-t}\delta(t-1)\,dt$

c. $\int_{0}^{+\infty} e^{-t}\delta(t+1)\,dt$

d. $\int_{-\infty}^{+\infty} (t^3+t^2+t+1)\delta(t)\,dt$

e. $\int_{-\infty}^{+\infty} \cos^2(2\pi t+0.1\pi)\delta(t+1)\,dt$

f. $\int_{-\infty}^{+\infty} e^{-t}\delta(-t-1)\,dt$

g. $\int_{-\infty}^{+\infty} t^2\delta\left(\frac{-1}{2}t+\frac{1}{2}\right)dt$

h. $\int_{-\infty}^{+\infty} e^{t}\delta(3t-1)\,dt$

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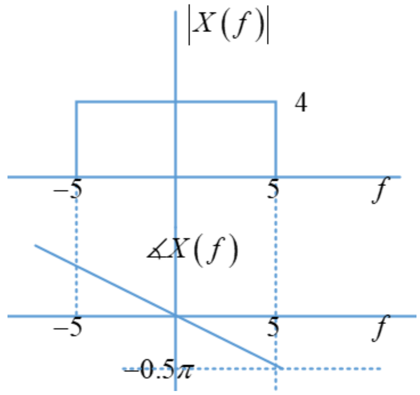
4. If a frequency response of $x(t)$ is defined as $X(f)$ and plotted below




*Note: I want to make sure that the figure above is the representation in the frequency domain.*

a) Write $X(f)$ in the polar format as defined below (hint: magnitude is 4 and phase is the linear function shown in the plot)

$$X(f) = |X(f)| \cdot e^{-j2\pi ft}$$

b) Find $x(t)$, signals in the time domain (Basically do the inverse Fourier transform). For this case you need to remember that what we did in the class. For an example

$$F\{x(t)\} \to X(f)$$
$$F\{x(t-t_0)\} \to X(f) \cdot e^{-j2\pi ft_0} \quad where \quad \theta = -2\pi t_0 f$$

c) Plot $x(t)$

Let's define another function $\left[F\{x_2(t)\} = X_2(f)\right]$

$$X_2(f) = 3 \cdot e^{-j10\pi f}$$

d) Plot the magnitude and phase just like figure $X(f)$ the figure shown above

Now let

$$Y(f) = X(f) \cdot X_2(f)$$

e) Find $Y(f)$ in polar format and rectangular format

f) $y(t)$, inverse Fourier transform of $Y(f)$

g) plot $y(t)$

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5. Convolutions (find $y(t) = x(t) * h(t)$)

a) $\left[x(t) = -2\Pi\left(\frac{t+3}{4}\right)\right] * \left[h(t) = 2\Pi\left(\frac{t}{2}\right)\right]$

b) $\left[x(t) = 2\Pi\left(\frac{t+3}{3}\right) - 3\Pi\left(\frac{t+3}{4}\right)\right] * \left[h(t) = 2\Pi\left(\frac{t}{2}\right)\right]$