Scarlett Jones
CSCE 3010
Homework #1
Due: 9/19/2016 5:20 PM

1. Explain why $x(t)$ = $Ce^{\,j\omega 0t}$ is always periodic with fundamental period $T0$ = $2\pi/$ wo . (Hint: Use Euler's identity).

$x(t+\mathrm{T}_0)$ = $C\mathrm{e}^{\,j\omega 0(t+\mathrm{T}0)} = \mathrm{Ce}^{\mathrm{jw0(t+2\pi/w0)}} = \mathrm{C}(\mathrm{e}^{\mathrm{jw0t}}*\mathrm{e}^{\mathrm{jw02\pi/w0}}) = \mathrm{C}(\mathrm{e}^{\mathrm{jw0t}}*\mathrm{e}^{\mathrm{j2\pi}}) = \mathrm{C}(\mathrm{e}^{\mathrm{jw0t}}*1) = \mathrm{Ce}^{\mathrm{jw0t}}$

Because the signal repeats after the interval of time $\mathrm{T}_0$, the function is always periodic.

2. Explain why the rate of oscillation of discrete time exponential signal $x[n]$ = $e^{\,jw0n}$ does not increase with $w0$. At what value is the rate of oscillation maximum and why?

x'[n] = $e^{j(w0+2\pi)n}$=$e^{jw0n}e^{j2\pi n}$=$e^{jw0n}$(cos(2πn)+jsin(2πn)) = $e^{jw0n}$ = x[n]

Even though the frequency changed to $w_0$+2π, the signal x'[n]=x[n].

The value where the rate of oscillation is maximum is +π and –π because when you plug those into the equation a negative value returns. When it is negative, the sign of x[n] alternates between positive and negative.

3. Define x[n]u[n], where x[n] is a discrete time signal and u[n] is the discrete time unit step function.

$$x[n]u[n] = \begin{cases} x[n] \; if \; n \geq 0 \\ 0 \; if \; n < 0 \end{cases}$$

4. Is the system $y[n]$ = $2x[n]$ + 3 linear? Provide proof.

$y_1$[n] = 2(1) + 3 = 5

$y_2$[n] = 2(2) + 3 = 7

2(1+2) + 3 = 9

5+7=12

9 is not equal to 12

The system is NOT linear.

5. Chapter 2 Problem 35(a)… Graph the original and transformed function

$$g(t) = \begin{cases} -2, & t < -1 \\ 2t, & -1 < t < 1 \\ 3 - t^2, & 1 < t < 3 \\ -6, & t > 3 \end{cases}$$

$$-3g(4-t) vs. t$$

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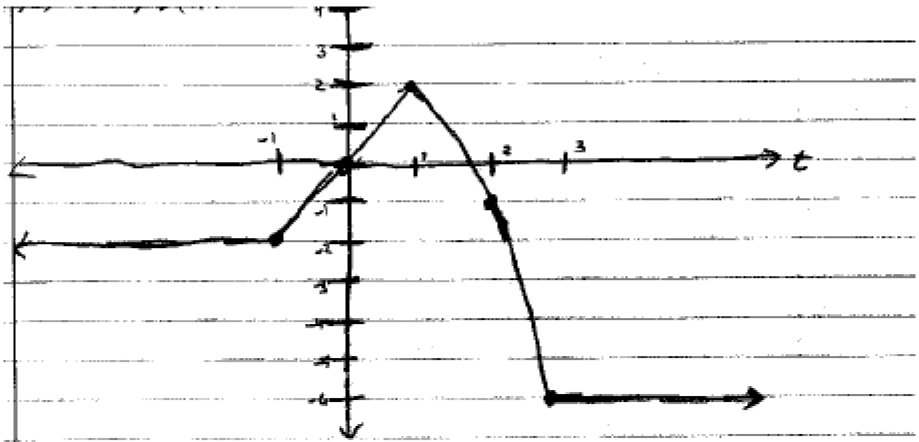


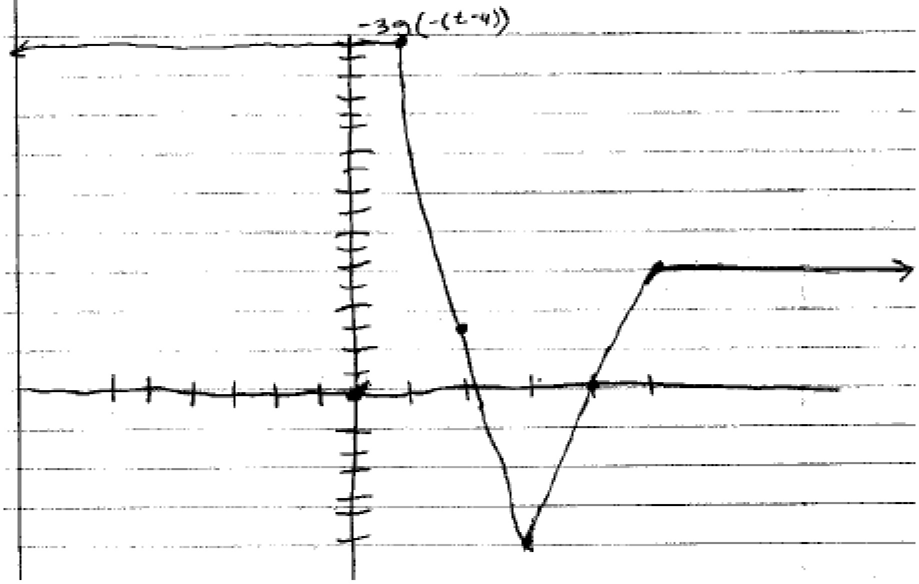


6. Chapter 2 Problem 52(h)

   $g(t) = 12 + \sin(4\pi t)\,/4\pi t$

$$g_e(t) = \frac{12 + \frac{\sin(4\pi t)}{4\pi t} + 12 + \frac{\sin(-4\pi t)}{-4\pi t}}{2} = \frac{24 + \frac{\sin(4\pi t)}{4\pi t} + \frac{\sin(-4\pi t)}{-4\pi t}}{2}$$

$$= \frac{24 + \frac{\sin(4\pi t)}{4\pi t} + \frac{\sin(4\pi t)}{4\pi t}}{2} = 12 + \frac{\sin(4\pi t)}{4\pi t}$$

$$g_o(t) = \frac{12 + \frac{\sin(4\pi t)}{4\pi t} - 12 - \frac{\sin(-4\pi t)}{-4\pi t}}{2} = \frac{12 + \frac{\sin(4\pi t)}{4\pi t} - 12 - \frac{\sin(4\pi t)}{4\pi t}}{2} = 0$$

7. Chapter 2 Problem 57(h)

Find the signal energy of the signal.

$$x(t) = e^{(-1-j8\pi)t}u(t)$$

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$$E = \int_{-\infty}^{\infty} \left|e^{(-1-j8\pi)t}u(t)\right|^2 dt = \int_0^{\infty} \left|e^{(-1-j8\pi)t}\right|^2 dt = \int_0^{\infty} \left|e^{2(-1-j8\pi)t}\right| dt = \int_0^{\infty} \left|e^{-2t}e^{-2tj8\pi}\right| dt$$

$$= \int_0^{\infty} e^{-2t} dt = \left[-\frac{1}{2}e^{-2t}\right]\Bigg|_0^{\infty} = -\frac{1}{2}(e^{-\infty} - e^0) = -\frac{1}{2}(0-1) = -\frac{1}{2}(-1) = \frac{1}{2}$$

8. Chapter 3 Problem 27(a)