EECS 361
Homework #1

1. Participation activities
2.2.1: Phase angles and quadrants in the complex plane.
2.2.2: Complex number products and quotient
2.2.3: Complex algebra

2. (Concept: Complex numbers)

a. $z_1 = 3.5 - j7$ find
$\mathrm{Re}(z_1)$, $\mathrm{Im}(z_1)$, $|z_1|$, $|z_1|^2$, find α and β in $z_1 = \alpha e^{j\beta}$

b. Repeat a. for $z_2 = 3.5 + j7$

Hint: see **https://www.intmath.com/complex-numbers/convert-polar-rectangular-interactive.php**

3. (Concept: Time varying complex values, i.e., complex functions)
Let $z_1 = 3.5 - j7$
a. Find $x(t) = \mathrm{Re}[z_1 e^{-j2\pi 1000t}]$
b. For $z_2 = 7.8\,e^{-j\,1.1}$ find $y(t) = \mathrm{Re}[z_2 e^{-j2\pi 1000t}]$

4. (Concepts: Magnitude and phase of complex function of the frequency variable ω rad/sec and plotting magnitude of complex functions, and 3dB frequency)
Put the following expressions into rectangular (real and imaginary) and polar (amplitude and phase) form.

a. $H_a(\omega) = \frac{1}{1+j\omega 8}$

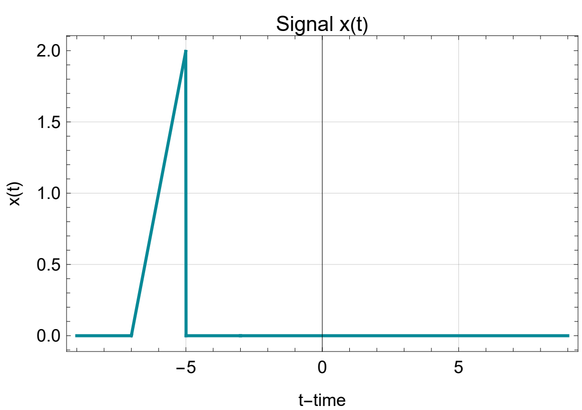
b. $H_b(\omega) = \frac{j\omega 8}{1+j\omega 8}$

c. Plot the magnitude of $H_a(\omega)$ and $H_b(\omega)$ for $-1.5<\omega<1.5$

d. What is the value of $H_a(\omega)$, $H_b(\omega)$, $10\mathrm{Log}(|H_a(\omega)|^2)$, and $10\mathrm{Log}(|H_b(\omega)|^2)$ at $\omega = \frac{1}{8}$?

5. Section 2.3 Participation activities
2.3.1: Time shift
2.3.2: Time shift
2.3.3: Time scale transformation
2.3.4: Time scale transformation
2.3.5: Time scale.
2.3.7: Time reversal
2.3.11: Combined transformations

6. (Concept: Time scaling and shifting signals)
Given x(t) defined below plot the specified signals.



a. y_a(t)=x(2t-4)

b. y_b(t) = 2x(.5(t+2))

c. y_c(t) = x(-t)

d. y_d(t) =x(-2t-4)

7. Section 2.4 Participation activities
2.4.1 Odd and even symmetric components of a sine-pulse signal.
2.4.2 Even/odd symmetry
2.4.3 Even/odd symmetry, scaling, and time-shifting.
2.4.7 Determining period
2.4.9 Periodicity after linear transformations.

8. (Concept: Symmetry properties)
Identify the symmetry properties of the following signals, even, odd, neither.

a. $x_1(t) = 3t^3$

b. $x_3(t) = 7e^{-|t|}$

c. $x_4(t) = u(t)\, e^{-3t}$

d. $x_5(t) = \cos^2(2000\pi t)$

9. (Concept: Finding the complex value of a complex function on the unit circle)
Let $H(z) = \frac{z}{z-0.5}$
a. Find H(z) for $z = e^{j0},\ e^{j\frac{\pi}{4}},\ e^{j\frac{3\pi}{4}},\ e^{j\frac{5\pi}{4}},\ e^{j\frac{7\pi}{4}}$
b. What is the relationship between H(z) for $z= e^{j\frac{\pi}{4}}$ and $z= e^{j\frac{7\pi}{4}}$

10. (Concept: A time delay is a linear phase in frequency)
The frequency of $\cos(2\pi f_1 t)$ is f_1(Hz). Let $x(t) = \cos(2\pi f_1 t) + \cos(2\pi 2 f_1 t)+\cos(2\pi 3 f_1 t)+\cos(2\pi 4 f_1 t)$ with f_1=500 Hz and y(t)=x(t-τ) with τ=0.25ms
a. Put y(t) is the form of $\cos(2\pi f_1 t+\theta_1) + \cos(2\pi 2 f_1 t+\theta_2)+\cos(2\pi 3 f_1 t+\theta_3)+\cos(2\pi 4 f_1 t+\theta_4)$
b. Plot the phase of each cosine (θ_i) as a function of the frequency (f_i) of the associated cosine. Note that this plot is linear.

11. (Concept: Finding the period of real and complex signals)
Find the period of the following signals.

a. $x_1(t) = 10\cos(2\pi f_1 t)$ where f_1=200Hz

b. $x_2(t) = 10\cos(\omega_1 t)$ where ω_1=200 rad/sec

c. $x_3(t) = 10\sin(2\pi 200 t)$

d. $x_4(t) = e^{-j2\pi f_1 t}$ where f_1=200Hz

e. $x_5(t) = e^{-j\omega_1 t}$ where where ω_1=200 rad/sec