Homework # 1

Due: Tuesday, June 6th

Problem 1. (5 points each) Describe the following complex numbers in polar forms

a) `(10 − 1j)×(5 − 2j)²` 291.446<-.861 rads
b) `(2 + 5j)² − 4j` 26.401<2.491 rads
c) `(0.1 + 0.5j)* − (1 + 2j)` 2.657<-1.916 rads
d) `(11 + 3j)²+(2 + 2j)` 132.740<.538 rads

Problem 2. (5 points each) Describe the following complex numbers in Cartesian forms.

a) $e^{-j\frac{\pi}{2}} \times \frac{1}{10} e^{j\frac{\pi}{4}}$ .070711-.070711j
b) $\frac{(1-2j)\times(1+2j)}{1+3j}$ .5-1.5j
c) $10e^{j\frac{\pi}{8}} \times e^{j\pi}$ -9.239-3.827j
d) $20e^{-j\frac{2\pi}{3}} + 2e^{j\pi}$ -12+17.321j

Problem 3. (15 points each) Compute the energy and power of these signals. You need to provide all the steps for your calculation.

a) $f_1(t) = cos(2t)$
b) $f_2(t) = t^2$

a) Energy: lim T->\infty \int_{-T}^T (cos(2t))^2 dt = DNE
Power: lim T->\infty 1/(2T) \int_{-T}^T (cos(2t))^2 dt =
= 1/(2\pi) \int_{-\pi}^\pi (cos(2t))^2 dt
= 1/(2\pi) 1/8*(sin(4t)+4t) |_{-\pi}^\pi
= 1/(2\pi) (\pi/2+\pi/2) = 1/2 = 0.5
b) Energy: lim T->\infty \int_{-T}^T (t^2)^2 dt = DNE
Power: lim T->\infty 1/(2T) \int_{-T}^T (t^2)^2 dt = DNE

Problem 4. (10 points each) Decompose the following functions into their even and odd components.

a) $f_1(t) = sin(\omega t + \pi/4)$
b) $f_2(t) = exp(-j\,\omega t)$

a) (sin(wt+pi/4)+sin(-wt+pi/4))/2+(sin(wt+pi/4)-sin(-wt+pi/4))/2
=1/sqrt2 cos(wt) + 1/sqrt2 sin(wt)
b) (exp(-jwt)+exp(jwt))/2+(exp(-jwt)-exp(jwt))/2
=cos(wt)-i sin(wt)

Problem 5. (10 points) Determine if the following function is even or odd

$$f_1(t) = \begin{cases} 1+t, & -1 \le t \le 0 \\ 1-t, & 0 \le t \le 1 \end{cases}$$

f(x)=f(-x)
even