ELEN3801 - Fall 2009
Homework 1

Due Thursday September 17th at the beginning of class
(Mudd 227 9:10am)

Carefully justify ALL your answers

1.1 Express the following complex numbers in polar form:

(a) $3 + j4$ (b) $7 - j5$ (c) $23 - j7$ (d) $-100 - j46$

1.2 Express the following numbers in cartesian form and represent them in the complex plane:

(a) $e^{j\frac{\pi}{2}}$ (b) $5e^{j\frac{\pi}{3}}$ (c) $-4e^{-j\frac{2\pi}{3}}$ (d) $6e^{j\left(3\pi+\frac{\pi}{2}\right)}$ (e) $7e^{j\frac{4\pi}{3}}$

1.3 Let $z_1 = 7 - j5$ and $z_2 = -3 + j4$. Determine the following quantities in both cartesian and polar forms:

(a) $z_1 z_2$ (b) z_1/z_2 (c) z_2/z_1

1.4 In the following cases, express $f(t)$ as a single sinusoid of the form $C\cos(\omega t + \theta)$:

(a) $f(t) = 6\cos(\omega t) - \sqrt{5}\sin(\omega t)$ (b) $f(t) = -18\cos(\omega t) + 2\sin(\omega t)$

1.5 Use Euler's formula to deduce the expressions for the cosine and sine of the sum of two angles, that is $\cos(\alpha+\beta)$ and $\sin(\alpha+\beta)$ expressed as functions of $\cos(\alpha)$, $\sin(\alpha)$, $\sin(\beta)$ and $\cos(\beta)$. (**Hint:** multiply the two complex numbers $e^{j\alpha}$ and $e^{j\beta}$ in both the polar and cartesian forms).

1.6 Classify the signals below as periodic or aperiodic. If periodic identify the period.

(a) $f(t) = \cos\left(\frac{2\pi}{3}t\right) + 3\sin\left(\frac{2\pi}{4}t\right)$ (b) $f(t) = \cos(2\pi t) + \cos\left(\sqrt{2}\pi t\right)$

1.7 (*Optional*) We have seen in class that signals with non-zero power have infinite energy. Are there signals with zero power but infinity energy ($P_f = 0$ and $E_f = \infty$)? If your answer is no give a justification and if your answer is yes give an example of such a signal.