Australian National University

Research School of Engineering
College of Engineering and Computer Science

ENGN2228 Signal Processing

HOMEWORK 1

A quick refresher on complex numbers. Complex numbers are used in much of engineering. They are an near ideal shorthand in signal representation and they simplify expressions.

Homework 1-1

(a) Prove the Euler identity:

$$e^{j\theta} = \cos\theta + j\sin\theta.$$

(b) Find expressions for $\cos\theta$ and $\sin\theta$ in terms of $e^{j\theta}$ and its conjugate $e^{-j\theta}$.

Homework 1-2

What is the difference between taking the conjugate of an expression and replacing every occurrence of j with $-j$?

Homework 1-3

Write each of the following in polar form, that is, in $re^{j\theta}$ find r (such that $r \geq 0$) and θ.

(a) $1 + j\sqrt{3}$

(b) $(\sqrt{3} + j^3)(1 - j)$

(c) $\dfrac{e^{j\pi/3} - 1}{1 + j\sqrt{3}}$

(d) $j^{1,222,444,667,099,987,676,222,091,345,222,822,822,282,228}$

Homework 1-4

With $j = \sqrt{-1}$ what is j^j (j to the power j)?

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