

Theory Assignment 1

Answer in no more than 10 pages total
Minimum 10pt font size

August 14, 2015

1. (**Complex arithmetic**) With $j = \sqrt{-1}$ find the real part, the imaginary part, the complex amplitude, and the complex argument in radians of the following complex numbers.

- (a) $e^{j\pi}$
- (b) $(1 + \sqrt{3}j)^2$
- (c) $\frac{e^{j\pi/4}}{1-j}$
- (d) $2 \sin(j)$

All answers must be written as an exact rational expression perhaps involving square roots and the transcendental numbers π and e . Answers correct to only a finite number of decimal places are not acceptable. Answers involving functions such as \sin , \cos , \tan and their inverses are also not acceptable. Draw/mark each number on the complex plane.

2. (**Properties of signals**) Plot each of the following signals and show whether they are: bounded, periodic, right sided, left sided, of finite support, absolutely integrable, square integrable.

- (a) $u(t+1)e^{-t}$ where $u(t)$ is the step function
- (b) $\sin(\pi t/4) + \cos(\pi t/3)$
- (c) $\cos(t) \cos(\pi t)$
- (d) $\Pi(t - \frac{1}{2})t^{-1/3}$ where $\Pi(t)$ is the rectangle pulse

3. (**Spaces of signals**) Show that the set of signals x such that $x(t) = 0$ for all $t < 0$ is a linear space, but not a shift-invariant space.

4. (**Properties of systems**) State whether each of the following systems are: causal, linear, shift-invariant, stable.

- (a) $Hx(t) = 3x(t-5) + x(t+1)$
- (b) $Hx(t) = e^{-|x(t)|}$
- (c) $Hx(t) = t$
- (d) $Hx(t) = \int_0^1 \sin(\pi\tau)x(t+\tau)d\tau$