DE2 Electronics 2: Signals, Systems and Control

Tutorial Sheet 1 – Signals in Time and Frequency Domains

(Lectures 1 - 3)

* indicates level of difficulty

1.* Sketch each of the following continuous-time signals. For each case, specify if the signal is causal/non-causal, periodic/non-periodic, odd/even. If the signal is periodic specify its period.

(i) $x(t) = 2\sin(2\pi t)$

(ii) $x(t) = \begin{cases} 3e^{-2t}, & t \geq 0 \\ 0, & t < 0 \end{cases}$

(iii) $x(t) = 1/|t|$

2.* Sketch the signal

$$x(t) = \begin{cases} 1-t, & 0 \leq t \leq 1 \\ 0, & \text{otherwise} \end{cases}$$

Now sketch each of the following and describe briefly in words how each of the signals can be derived from the original signal $x(t)$.

(i) $x(t+3)$

(ii) $x(t/3)$

(iii) $x(t/3+1)$

(iv) $x(-t+2)$

(v) $x(-2t+1)$

3.** Sketch each of the following signals. For each case, specify if the signal is causal/non-causal, periodic/non-periodic, odd/even. If the signal is periodic specify its period.

(i) $x[n] = \cos(n\pi)$

(ii) $x[n] = \begin{cases} 0.5^{-n}, & n \leq 0 \\ 0, & n > 0 \end{cases}$

4.** Sketch the spectrum of the time domain signal.

(i) $x(t) = \sin(2\pi \times 350t) + 0.35 \times \sin(6283t) + 0.1$

(ii) $y(t) = 1.5 \times \cos(2199t) + \sin(2\pi \times 1000t + \pi/2)$

5.** Proof that the Fourier series of the pulse signal shown below is:

$$x(t) = \frac{1}{2} + \frac{2}{\pi}\left(\cos t - \frac{1}{3}\cos 3t + \frac{1}{5}\cos 5t - \frac{1}{7}\cos 7t + \ldots.\right)$$