E2.5 Signals & Linear Systems

Tutorial Sheet 1 – Introduction to Signals & Systems

1. Sketch each of the following continuous-time signals, specify if the signal is 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) $x(t) = 1/|t|$

   (iv) $x(t) = \sin(\frac{2\pi}{5}t) + \sin(\frac{2\pi}{3}t)$

   (v) $x(t) = \sin(2\pi t) + \sin(\sqrt{2}\pi t)$

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 periodic/non-periodic, odd/even. If the signal is periodic specify its period.

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

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

   (iii) What is the maximum possible frequency of $e^{j\omega_0 n}$ (compare this result with the case $e^{j\omega_0 t}$)?

4. Consider the rectangular function

$$\Pi(t) = \begin{cases} 1, & |t| < 1/2 \\ 1/2, & |t| = 1/2 \\ 0, & \text{otherwise} \end{cases}$$

   (i) Sketch $x(t) = \sum_{k=0}^{1} \Pi(t-k)$

   (ii) Sketch $x(t) = \sum_{k=-\infty}^{+\infty} \Pi(t-k)$. (Hint: there is a simple way to express this signal.)