EE1101 Signals and Systems JAN—MAY 2019
Tutorial 1

1. Let $x[n]$ be a signal with $x[n] =$ for $n < -2$ and $n > 4$. For each of the signals given below, determine the ranges of n for which the signal is guaranteed to be zero.

   (a) $x[n-3]$, (b) $x[-n]$, (c) $x[-n+3]$, (d) $x[3n-1]$.

2. Determine whether or not each of the following signals is periodic.

   (a) $x(t) = 2e^{j(t+\frac{\pi}{4})}$, (b) $y[n] = u[n] + u[-n]$, (c) $z[n] = \sum_{n=-\infty}^{\infty} \big(\delta[n-4k] - \delta[n-1-4k]\big)$.

3. For each of the following signals, determine all values of the independent variable at which the even part of the signal is guaranteed to be zero.

   (a) $x_1[n] = \big(\frac{1}{2}\big)^n u[n-3]$, (b) $x_2(t) = sin(\frac{t}{2})$, (c)$x_3(t) = e^{-5t}u(t+2)$.

4. Consider the signal $x(t) = \delta(t+2) - \delta(t-2)$. Calculate energy of the signal $y(t) = \int_{-\infty}^{t} x(\tau)d\tau$.

5. (a) Show that if $x[n]$ is an odd signal, then

   $$\sum_{n=-\infty}^{\infty} x[n] = 0$$

   (b) Show that if $x_1[n]$ is an odd signal and $x_2[n]$ is an even signal, then $x_1[n]x_2[n]$ is an odd signal.

   (c) Show that if $x[n]$ is an arbitrary signal with even and odd parts $x_e[n]$ and $x_o[n]$, then

   $$\sum_{n=-\infty}^{\infty} x^2[n] = \sum_{n=-\infty}^{\infty} x_e^2[n] + \sum_{n=-\infty}^{\infty} x_o^2[n]$$

6. An important concept in many communication applications is the 'correlation' between two signals. Let $x(t)$ and $y(t)$ be two signals, then the correlation between them is defined as:

   $$\Phi_{xy}(t) = \int_{-\infty}^{\infty} x(t+\tau)y(\tau)d\tau$$

   The function $\Phi_{xx}(t)$ is known as the autocorrelation function of $x(t)$ and the function $\Phi_{xy}(t)$ is known as the cross correlation function.

   (a) What would be the relationship between $\Phi_{xy}(t)$ and $\Phi_{yx}(t)$?

   (b) Compute the odd and even parts of $\Phi_{xx}(t)$.

   (c) If $y(t) = x(t+T)$, mod $T < \infty$, express $\Phi_{xy}(t)$ and $\Phi_{yy}(t)$ in terms of $\Phi_{xx}(t)$.