EE1101 Signals and Systems JAN—MAY 2019
Tutorial 3: Extra Questions

1. Find the fundamental period of the signal $x(t) = \sin(\frac{3\pi}{5}t)$. Let $x[n]$ be obtained from $x(t)$ by sampling at $t = nT_s$ where (a) $T_s = 1$ *sec*, (b) $T_s = 5$ *sec*, and (c) $T_s = 1/\pi$ *sec*. Determine whether $x[n]$ is periodic for each case. If so, find its fundamental period.

2. Let $y_1[n] = x[2n]$ and

$$\begin{aligned} y_2[n] &= x[n/2], \ n \ \text{ even} \\ &= 0, \qquad n \ \text{ odd} \end{aligned}$$

   If x[n] is periodic, are $y_1[n]$ and $y_2[n]$ periodic? If so, find their fundamental period.

3. Consider a time-invariant system with input $x(t)$ and output $y(t)$. Show that if $x(t)$ is periodic with period T, $y(t)$ is also periodic.

4. The impulse response to an LTI system is given as,

$$h(t) = \begin{cases} 2e^{-t}, & 0 \le t < 3 \\ 0, & t \ge 3. \end{cases}$$

   Find the response to an input,

$$i(t) = \begin{cases} 4u(t), & 0 \le t < 2 \\ 0, & t \ge 2. \end{cases}$$

5. (Oppenheim Basic Problem 2.6) Compute and plot the convolution $y[n] = x[n] * h[n]$, where $x[n] = (\frac{1}{3})^{-n}u[-n-1]$ and $h[n] = u[n-1]$.

6. Let $x(t) = 1, 0 \le t < 1$ and zero elsewhere. And, let $h(t) = x\left(\frac{t}{\alpha}\right)$, with $0 < \alpha \le 1$.

   (a) Plot $y(t) = x(t) \star h(t)$, where $\star$ denotes convolution operation.

   (b) Plot the first derivative of $y(t)$.

   (c) What should be the value of α such that the first derivative of $y(t)$ contains exactly three discontinuities?

— END —