

Student Full Name:
Student Number:

Question I: Calculate signal Power P_∞ for $x(t) = e^{-5t}u(t)$.

(2 Marks)

$$P_\infty = \lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^T |x(t)|^2 dt$$

Answer:

$$\begin{aligned} P_\infty &= \lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^T |x(t)|^2 dt = \lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^T |e^{-5t}u(t)|^2 dt = \lim_{T \rightarrow \infty} \frac{1}{2T} \int_0^T e^{-10t} dt \\ &= \lim_{T \rightarrow \infty} \frac{1}{2T} \left[-\frac{1}{10} e^{-10t} \right]_0^T = \lim_{T \rightarrow \infty} \frac{1}{2T} \left[-\frac{1}{10} e^{-10T} + \frac{1}{10} e^0 \right] = \lim_{T \rightarrow \infty} \frac{\frac{1}{10}}{2T} = 0 \end{aligned}$$



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Question II: Determine if the following systems are: causal and time invariant. Justify your answers shortly.

$$y[n] = \cos(3n) x[n]$$

(3 Marks)

Answer:

- a) The system is casual, since the output at any time instance t_0 depends only on the input at t_0 .
- b)

If the system would be Time-Invariant, then for an input with time delay like $x_2[n] = x[n - 1]$, the output should be $y_2[n] = y[n - 1]$.

So, if the input would be $x_2[n] = x[n - 1]$, the output is
 $y_2[n] = \cos(3n) x_2[n] = \cos(3n) x_1[n - 1]$ (1)

However, from the equation we see that $y[n - 1] = \cos(3(n - 1)) x[n - 1]$. (2)

(1) and (2) $\Rightarrow y_2[n] \neq y_1[n - 1]$, then the system is not Time-Invariant.