**SIMON FRASER UNIVERSITY**
School of Mechatronic Systems Engineering
MSE 280 Linear Systems, Quiz I – Spring 2017

Student Full Name:
Student Number:

**Question I:** Calculate signal Energy $E_\infty$ for $x(t) = e^{3t}u(-t)$.

(2 Marks)

$$E_\infty = \lim_{T\to\infty}\int_{-T}^{T}|x(t)|^2dt = \int_{-\infty}^{+\infty}|x(t)|^2dt$$

Answer:

$$E_\infty = \lim_{T\to\infty}\int_{-T}^{T}|x(t)|^2dt = \lim_{T\to\infty}\int_{-T}^{T}[e^{3t}u(-t)]^2dt = \lim_{T\to\infty}\int_{-T}^{0}e^{6t}dt = \lim_{T\to\infty}\frac{1}{6}e^{6t}\Big|_{-T}^{0} = \frac{1}{6}e^{0} - \frac{1}{6}e^{-\infty}$$

$$= \frac{1}{6}$$

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

$y(t) = x(t-1) + x(2-t)$

(3 Marks)

**Answer:**

a) The system is NOT causal, since the output for $t < 0$ is dependent to the input of the system after that time.
For example at $t = -1$,

$y(-1) = x(-2) + x(3)$

shows that $y(-1)$ depends on $x(3)$.

b)

$y_1(t) = x_1(t-1) + x_1(2-t)$

$y_2(t) = x_2(t-1) + x_2(2-t)$

$x_3(t) = \alpha x_1(t) + \beta x_2(t) \rightarrow \; y_3(t) = \alpha x_1(t-1) + \beta x_2(t-1) + \alpha x_1(2-t) + \beta x_2(2-t)$

$= \alpha x_1(t-1) + \alpha x_1(2-t) + \beta x_2(t-1) + \beta x_2(2-t) = a y_1(t) + \beta y_2(t)$

Then the system is linear