Name Answers

**EE3032 – Dr. Durant – Quiz 4**
**Fall 2017, Week 4**

1. (3 points) Prove whether the following system is linear: $y(t) = 2x(t) - 3x(t-1)$
2. (2 points) Prove whether the following system is linear: $y(t) = \sin(x(t))$
3. (3 points) Prove whether the following system is time-invariant: $y(t) = \ln(t)\, x(t)$
4. (2 points) Prove whether the following system is BIBO stable: $y(t) = \ln(t)\, x(t)$

(1) Let $x(t) = x_1(t) + x_2(t)$

$x_1(t)$: $y_1(t) = 2x_1(t) - 3x_1(t-1)$

$x_2(t)$: $y_2(t) = 2x_2(t) - 3x_2(t-1)$

$y_1(t) + y_2(t) = 2x_1(t) - 3x_1(t-1) + 2x_2(t) - 3x_2(t-1) = 2(x_1(t) + x_2(t)) - 3(x_1(t-1) + x_2(t-1))$

$= 2x(t) - 3x(t-1) = y(t)$ ∴ **linear**

(2) $y_1(t) + y_2(t) \stackrel{?}{=} y(t)$

$\sin(x_1(t)) + \sin(x_2(t)) \stackrel{?}{=} \sin(x_1(t) + x_2(t))$

Not true, would require $\sin(a) + \sin(b) = \sin(a+b)$ !

∴ **non-linear**

(3) System, then delay: $y(t) = \ln(t)\, x(t) \rightarrow y(t-d) = \ln(t-d)\, x(t-d)$

Delay, then system: Input $x(t-d) \rightarrow y^+(t) = \ln(t)\, x(t-d)$

not equal

∴ **not time-invariant**

(4) Let $|x(t)| \le M \quad \forall t$

$y(t) \le \ln(t)\, M$

$\ln(t)$ grows w/o bound as $t \rightarrow \infty$

∴ **not BIBO stable**