ECE 45 – Circuits and Systems
Winter 2025

Homework #3
Due: January 23 at 11:59pm, submitted via GradeScope.

You can make multiple upload attempts to experiment with the system and the best way to upload. You must correctly mark the answers to the problems in GradeScope, e.g. problem 1, problem 2, problem 3, to get full credit. Note that you must tag your problems when uploading to GradeScope or they will not be graded and you will not receive credit. Any regrade requests must be placed through GradeScope within one week of the return of the homework.

Remember, discussion of homework questions is encouraged. Please be absolutely sure to submit your own independent homework solution.

1. Simplify the following expressions. Be mindful of the cases where the expression simplifies to a signal, simplifies to a number, or does not simplify.
   (a) $\left(1+v+v^2\right)\delta(v)$
   (b) $\int_{-\infty}^{\infty}\delta(t-1)x(1-t)dt$ where $x(t)$ is a signal
   (c) $\int_{-\infty}^{\infty}\delta(t-4)\frac{\sin(\pi t^2)}{\pi t^2}dt$
   (d) $\sum_{n=0}^{\infty}(t+1)^n\delta(t)$
   (e) $f(t)=\int_{-\infty}^{t}\delta(\tau-3)d\tau$
   (f) $\sin(2\pi t)\delta(1/2-2t)$
   (g) $\int_{-\infty}^{\infty}\left(du(t)/dt-\text{rect}(t)\right)dt$
2. Determine (with justification) whether the following systems are (i) time invariant and (ii) linear. In the following $x(t)$ is the input to the system and $y(t)$ is the output of the system.
   (a) $y(t)=2x(t-3)$
   (b) $y(t)=\int_{-\infty}^{t}x(\gamma)d\gamma$
   (c) $y(t)=\text{Re}\{x(t)\}$
   (d) $y(t)=x(t-2)+x(2-t)$
   (e) $y(t)=\log_2(1+|x(t)|^2)$
   (f) $y(t)=\cos(x(t))$
   (g) $y(t)=\begin{cases}0, & x(t)<1\\ \int_0^1 x(t-\tau)d\tau & x(t)\geq 1\end{cases}$
3. Correct your previous week's homework using a colored pen (or annotation) so it's obvious what you've corrected. If you got a problem exactly right, just use a red check mark to indicate as such.