ECE 45 – Circuits and Systems
Winter 2025

Homework #5
Due: February 6 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. (50 %) Consider an LTI system with the specified impulse response $h(t) = e^{-2t}u(t)$.
   (a) Find the transfer function $H(s)$ for this system and also the range of values of s for which the integral converges. This is known as the region of convergence. NOTE: The region of convergence and Laplace transforms are dealt with in other courses, this aspect of the problem is just provided here to make the problem complete. You will not need to be able to solve for the region of convergence for this coures in general.
   (b) Find the frequency response $H(j\omega)$ for this system.
   (c) Determine the output if the input is e^{-3t}.
   (d) Determine the output if the input is 3.
   (e) Determine the output if the input is $3\delta(t-1)$.
   (f) Determine the output if the input is $\cos(100\pi t)$.
   (g) Determine the output if the input is $2e^{j2\pi 10t}$.
   (h) Determine the output if the input is $e^{-3t}u(t)$.
2. (30 %) Write the frequency response for the following systems described by differential equations related input $x(t)$ to output $y(t)$.
   (a) $y(t) + \frac{1}{2}\frac{d}{dt}y(t) = x(t)$
   (b) $y(t) = x(t) - \frac{1}{2}\frac{d}{dt}y(t)$
   (c) $y(t) = x(t) - \frac{1}{2}\frac{d}{dt}x(t)$
   (d) $\frac{d^2}{dt^2}y(t) + y(t) + \frac{1}{2}\frac{d}{dt}y(t) = \frac{d}{dt}x(t)$
3. (20 %) Based on the solutions, 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.