# Homework #2

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| **EE 242**  **Spring 2025** | **Yehoshua Luna**  **2322458** |

## Problem #1

* 1. is nonlinear.
  2. is time-invariant.
  3. is stable.
  4. is causal because it only depends on .
  5. is invertible. As the graph below shows, for each , there is a unique value . We can also easily see that , which proves this.

A graph of a function

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* 1. is linear.
  2. is time-variant.
  3. is unstable. If , then for all . This clearly violates BIBO stability, so is therefore unstable.
  4. is not causal. It depends on at from integration bounds.
  5. is not invertible because it loses information about the input through integration over the given bounds. For example, if and , then . Both of the input functions produced the same result, so this system cannot be invertible. It is impossible to mathematically characterize the input function from this system’s output.

## Problem #2

Using the associative property, we can add and together into one response, namely, . This can then be convolved with to produce the equivalent system response. The calculations are as follows:

The equivalent system response is . (Was there supposed to be another ?)

## Problem #3

Because is only nonzero at and , we can simplify the discrete convolution to . We must have , but is causal, so and . Increasing n by one gives , so . , so . , so . , so we finally have . Thus, .

## Problem #4

, so by the distributive property. Because we know what the response looks like, we can then graph .A graph of a line

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## Problem #5

shifts the input signal to the left by . shifts the impulse response to the right by . However, these two shifts cancel during the process of convolution, so the output is simply .

## Problem #6

According to the textbook, , so .

## Problem #7

and . Using the given Eigenfunction properties of the system, we must have .

## Problem #8

1. 1. for , so the system is causal.
   2. for . , so the system is unstable.
2. 1. for , so the system is not causal.
   2. for , so and the system is stable.

## Problem #9

When , evaluates to 1, so . Therefore for .

## Problem #10

## Problem #11

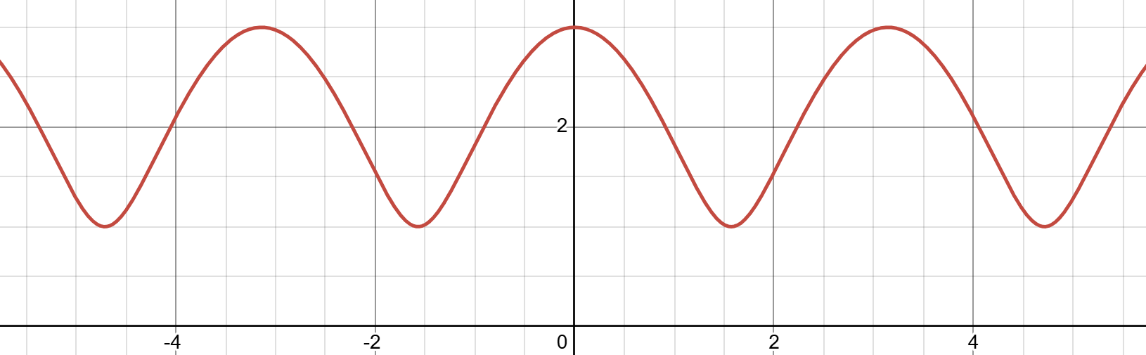
1. A graph of a line

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2. A graph of a line

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## Problem #12

1. is just the Fourier Transform of , so we can find by calculating the inverse Fourier Transform of . Using the tables provided in my textbook and the distributive property of integrals, I can easily see that .
2. We need to separate the real and imaginary parts of to find the magnitude and phase of the transfer function. Expanding gives . Now we can find the magnitude and phase:

We can then graph the magnitude and phase of as functions of for fixed values to get an understanding of how the output varies with . Magnitude graph:

Phase graph:A graph of a graph with blue lines

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