Name:

Problem	Points	Score
1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
8	10	
9	10	
10	10	
TOTAL	100	

What grade do you think you deserve in this course? _____

Explain why:

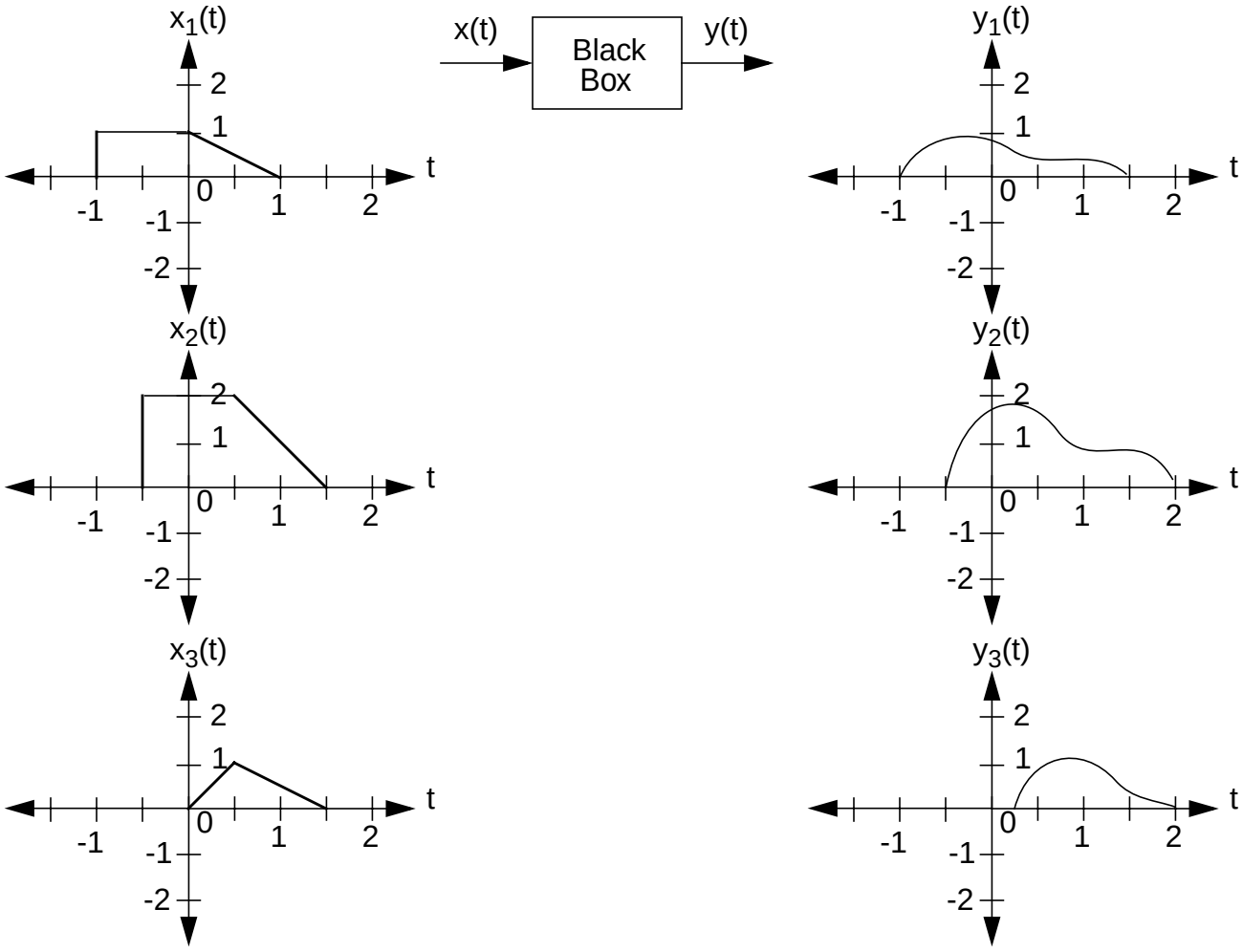
Notes:

1. The exam is closed books/closed notes - except for four pages of notes.

2. Please show ALL work. If I can't read it, it is wrong. Be neat, use a logical flow in presenting your solutions, etc.

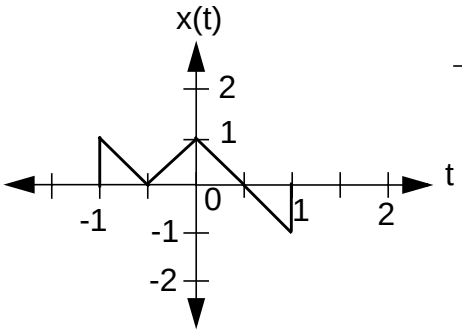
3. Correct answers are not enough. You must supply coherent and rigorous explanations with your answers. You will be graded more on the way you justify your answers than whether or not the answers are correct.

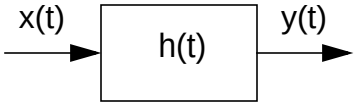
Problem No. 1: You are given the black box shown below. Given the inputs shown, and their corresponding outputs, completely characterize the black box using as many concepts discussed in this course as possible.

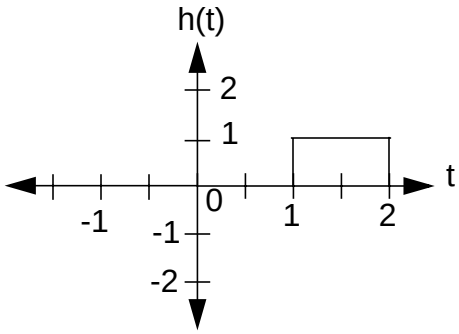


Explanation:

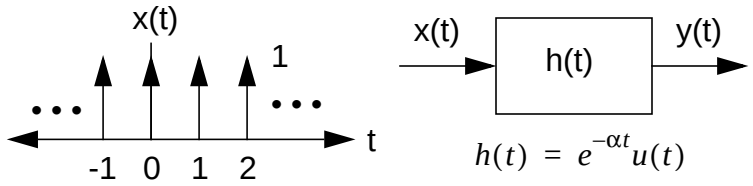
Problem No. 2: Compute the output of the linear time-invariant system shown.





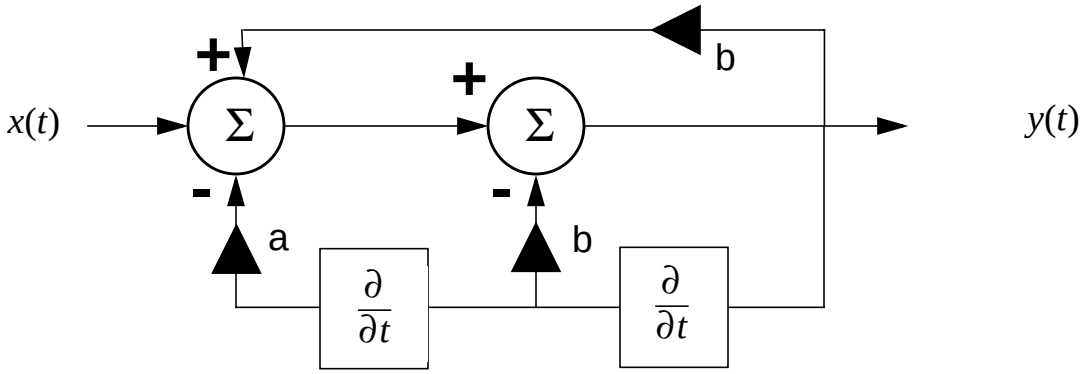


Problem No. 3: Compute the frequency response of the output signal.



$$h(t) = e^{-\alpha t}u(t)$$

Problem No. 4: Under what conditions is the following system stable?



Problem No. 5: For the discrete-time system shown, compute the output if the input is given by the sequence {0,1,-1,0,-1,1,0,0,0,...}:

$$H(z) = \frac{(1 + 0.5z^{-1})}{(1 + 0.5z^{-1} + 0.25z^{-2})}$$

Problem No. 6: Plot the magnitude of the frequency response of the system in Problem No. 5 as a function of frequency (Hz). Assume a sample frequency of 1000 Hz, use a dB scale for the magnitude, and a linear scale for frequency.

Problem No. 7: Compute the z-transform of the signal $x(n) = a^n u(n) + b^n u(n-3)$.

Problem No. 8: State and prove the Time-Delay Theorem for the z-transform.

Problem No. 9: Compute the Discrete Fourier Transforms (DFT) of the following signals: $x_1(n) = \{0, 1, 0, 0\}$ and $x_2(n) = \{0, 0, 0, 1\}$. Explain whether these results make sense.

Problem No. 10: Two guys named Scott and Jason decide to go fishing after their Net III final, and celebrate their anticipated perfect score. Being a couple of “interesting” characters, the fact that they forgot their fishing poles doesn’t stop them from fishing. Recalling a famous television commercial, they decide to stand on each side of the creek, string a rope across the creek (width 2 meters), and hang a six-pack in the middle of the rope (see the sketch made in class). Figuring the fish they would like to catch has good taste in beverages, they expect to have a great afternoon of fishing.

Plot and describe the frequency response of the function generated by the fishing line as they slide the six-pack from one side of the line to the center. Plot a “spectrogram” — the frequency response of the displacement of the rope as a function of time.

Next, plot the frequency response of the rope as a function of time when a big fish strikes the bait (grabs the six-pack, pulls a little, and releases it).