Name:

Problem	Points	Score
1a	10	
1b	10	
1c	10	
2a	10	
2b	10	
2c	10	
2d	10	
3a	10	
3b	10	
3c	10	
Total	100	

Notes:

1. The exam is open books/open notes.

2. Please show ALL work. Incorrect answers with no supporting explanations or work will be given no partial credit.

3. If I can't read or follow your solution, it is wrong, and no partial credit will be given — BE NEAT!

4. Please indicate clearly your answer to the problem.

5. Several problems on this exam are fairly open-ended. Since the evaluation of your answers is obviously a subjective process, we will use a marketplace strategy in determining the grade. Papers will be rank-ordered in terms of the quality of the solutions, and grades distributed accordingly.

Problem No. 1: Theory

(a) Prove if $x_o(n) = \frac{1}{2}[x(n) - x^*(-n)]$, then $F\{x_o(n)\} = jX_I(\omega)$,

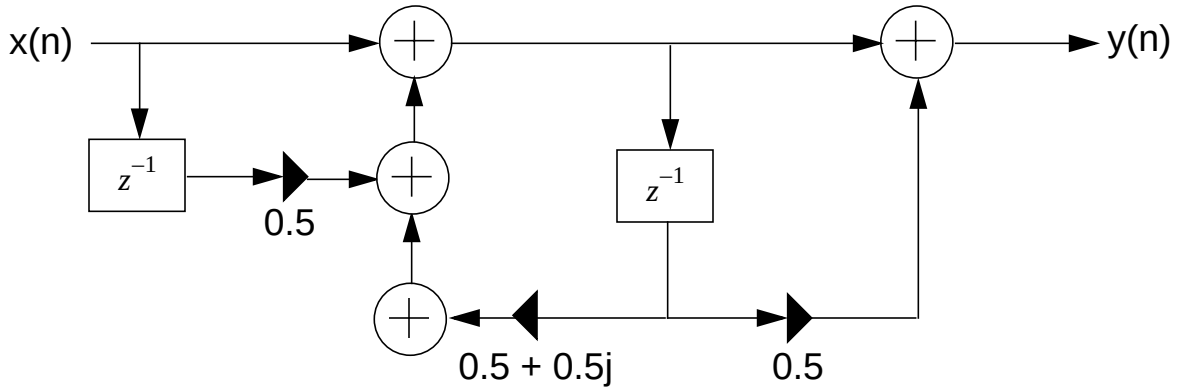
where $jX_I(\omega) = j \bullet Imag[F\{x(n)\}]$.

(b) Prove if $x(n)$ is real, then $|X(\omega)|$ is an even function.

(c) For the signal $y(n) = x(n) - a\,x(n-1)$, derive an expression for a that minimizes the energy in $y(n)$: $E_y = \sum_{n=-\infty}^{\infty} y^2(n)$.

Problem No. 2: Systems

For the following system:



(a) Characterize the system using as many concepts from our course as possible.

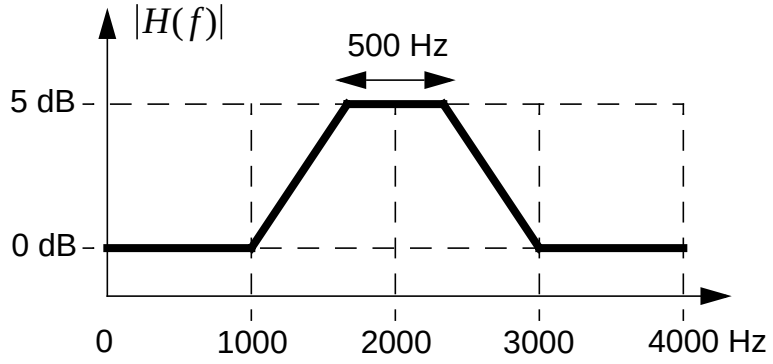
(b) Compute the bandwidth of all poles and zeroes in the system.

(c) Compute the impulse response.

(d) Prove whether or not this system is stable. Note that the answer to this question does not require the solution to part (c).

Problem No. 3: Practice

(a) Design a filter that uses no more than 10 parameters that best meets the specification shown below.



(b) Compute and plot, in great detail, the frequency response of your filter. Explain any discrepancies in your design (math errors don't count!).

(c) For the signal $x(n) = \left\{ \begin{matrix} 1 & n = -1 \\ -1 & n = 0 \\ 1 & n = 1 \\ 0 & elsewhere \end{matrix} \right\}$, find the output signal when this signal is filtered by your filter.