Name: _____

Problem	Points	Score
1(a)	10	
1(b)	10	
1(c)	5	
1(d)	5	
1(e)	5	
1(f)	5	
2(a)	15	
2(b)	15	
3(a)	10	
3(b)	10	
3(c)	10	
Total	100	

Notes:

(1) The exam is closed books and notes except for one double-sided sheet of notes.
(2) Please indicate clearly your answer to the problem.
(3) If I can't read or follow your solution, it is wrong and no partial credit will be awarded.

Problem No. 1: Consider the linear time-invariant constant coefficient difference equation: $y[n] = 0.5y[n-2] + 0.25x[n-1]$. Assume the initial conditions are zero.

(10 pts) (a) Compute the z-Transform.

(10 pts) (b) Find the impulse response by taking the inverse z-Transform.

(5 pts) (c) Apply an impulse function to the difference equation and compute the impulse response.

(5 pts) (d) Demonstrate that the answers to (b) and (c) match.

(5 pts) (e) Apply a unit step function. Compute the output using z-Transforms. Demonstrate that the value you obtain for large values of time (e.g., n=10e06) makes sense.

(5 pts) (f) Is the system stable? Justify your answer using the results above.

Problem No. 2: Assuming a sample frequency of 8 kHz:

(15 pts) (a) Design a second-order digital resonator such that resonant frequency is 500 Hz and the 3 dB bandwidth is 100 Hz.

(15 pts) (b) Plot the location of the poles of this filter in the z-plane.

Problem No. 3: A linear system is described by the difference equation:

$$v[n] = x[n] + v[n-1]$$
$$y[n] = v[n] + v[n-2] + v[n-4]$$

(10 pts) (a) Determine the transfer function.

(10 pts) (b) Draw the direct form realization.

(10 pts) (c) Draw the canonical realization.