Name:

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| --- | --- | --- |
| Problem | Points | Score |
| 1(a) | 15 |  |
| 1(b) | 15 |  |
| 2(a) | 10 |  |
| 2(b) | 10 |  |
| 2(c) | 5 |  |
| 2(d) | 5 |  |
| 2(e) | 10 |  |
| 3(a) | 15 |  |
| 3(b) | 15 |  |
| 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 LTCC difference equation: $y\left[n\right]=0.5y\left[n-2\right]+0.25x[n-1]$. Assume the initial conditions are zero.

(a) Find the impulse response.

(b) Is the system stable? Justify your answer using a technique that does not depend on your answer to (a).

**Problem No. 2**: Students at Temple are graded on a 5 point scale: A,B,C,D, and F. The Registrar, a former graduate of ECE 4522, decides to put this class to good use by developing a program to model the fluctuation of the average GPA at the university. The model the Registrar uses predicts the average GPA for the current year as a function of the number of students enrolled at the beginning of the first semester, the unemployment rate on Jan. 1 of the current year, and the size of the US population for the year corresponding to the current year minus 18 years.

(a) Write an equation that represents a model of this signal.

Is the signal described above (circle all that apply):

one dimensional multidimensional

single channel multichannel

continuous discrete-time

continuous in amplitude digital in amplitude

(b) What is the Nyquist rate for the signal: $x\left(n\right)=(sin2π1000t+7.5π)^{2}$

(c) Given the signal, $x\left(t\right)=\left\{\begin{matrix}(-\frac{1}{2})^{1000t}&\left|t\right|<0.0015 secs\\0&elsewhere\end{matrix}\right.$, compute the value of $x\left(t\right)$ at $t=0.002 secs$ by sampling at $f\_{s}=1000 Hz$, upsampling the signal to a new sample frequency of $f\_{s}=2000 Hz$, and evaluating this new discrete signal at $n=4$ (which corresponds to $t=0.002 secs$).

(d) Why is the answer to (c) not equal to $x\left(t\right)$ evaluated at $t=0.002 secs$?

(e) In class, we discussed that a standard DVD disc can hold about 2 Gbytes of data. How many minutes of digital audio can this disc hold? Be careful to explain and justify any assumptions you make in your answer.

**Problem No. 3**: For the signal, $x\left[n\right]=\{1, 0, 1, 0\}$ and the impulse response, $h[\left[n\right]=\left\{0, 1, 0, 1\right\}$:

(a) Compute the output, $y\left[n\right]$.

(b) Is the system causal? stable? Time-invariant? Explain.