EE 318, Fall 2005, Exam 1
13 September 2005
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Name: __________________________

KEY

Exam Number: __________

Rules:

You may use calculators, pens and pencils, and the text book and your brain.
You may NOT work with anyone else on this exam. Do not discuss this test with anyone
until both of you have handed-in your papers. This is a test of what you know.
Show All Work. Attach extra paper if needed. Clearly label all work done outside of
the indicated areas.
Clearly indicate your final answers.
The test is due at the end of the class.

Good Luck! I know you all have the ability to do well.

After you have finished the exam, please answer the following questions. They will
NOT affect your grade.

What grade do you think you made on this exam: ________

How difficult is this exam? (10 = way too hard, 0 = way too easy): ________

Comments:
Sketch the following functions:

\[ x[n] = \begin{cases} (-0.5)^n & n = 0,1,2,3,4,5 \\ 0 & otherwise \end{cases} \]

\[ x(t) = \begin{cases} e^{3-t} & 3 < t \\ 0 & otherwise \end{cases} \]
Sketch the following functions:

\[ x(t) = 2 \sin(4 \pi t) + 3u(t - 2) + \delta(t - 1) \]

\[ x(t) = \begin{cases} 
0.5t - 1 & 2 < t < 6 \\
2 & 6 < t < 8 \\
18 - 2t & 8 < t < 9 \\
0 & \text{otherwise} 
\end{cases} \]
Are the following functions periodic? If so, state their period.

\( x(t) = 2\sin(4\pi t) + 3\cos(\pi t) \)  

**Periodic**  

\[ T_1 = \frac{1}{2}, \quad T_2 = 2 \]

**Total Period = 2.**

\( x(t) = 3\sin(\pi t) - \cos(\sqrt{2}t) \)

**Not Periodic**

\[ T_1 = 2, \quad T_2 = \frac{2\pi}{\sqrt{2}} \]

\( x(t) = \sin(4t) - \sin(3t) \)

**Periodic**

\[ T_1 = \frac{2\pi}{4} = \frac{\pi}{2}, \quad T_2 = \frac{2\pi}{3} \]

\[ mT_1 = nT_2, \quad 4T_1 = 3T_2 = 2\pi \]

**Total Period = 2\pi.**
Answer Yes or No for each case. Are the following systems Linear, Causal, Time-invariant, and do they have Memory?

<table>
<thead>
<tr>
<th>System</th>
<th>Linear</th>
<th>Causal</th>
<th>Time-Invariant</th>
<th>Has Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y(t) = 4\sin(t) + x(t)$</td>
<td>N</td>
<td>?</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>$y(t) = 5\sin(t) \cdot x(t)$</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>$y(t) = \log(x(t)) + x(t)$</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>$\frac{d}{dt} y(t) + 7y(t) = x(t)$</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
Write a differential equation relating \( y(t) \) to \( x(t) \) for the following circuit.

\[ C \frac{d}{dt} V_c(t) = i_c(t), \quad y(t) = V_c(t) \]

**KCL / Node Eqn.**

\[ i_r(t) + i_c(t) = 0 \]

\[ \frac{y(t) - x(t)}{R_1} + C \frac{d}{dt} y(t) = 0 \]

\[ \frac{d}{dt} y(t) + \frac{1}{R_c} y(t) = \frac{1}{R_c} x(t) \]