ENEE 322: Signals and Systems
Test 02
November 18, 2004

University of Maryland, College Park

Rules:

• This exam is CLOSED book and CLOSED notes. No calculator is permitted.
• A page of potentially helpful formulas are attached.
• Perform all work on the provided paper. You may write on the backside of the pages.
• Clearly mark your final answers.
• You must show all of your work and explain your answers to obtain full credit.
• Your answers must be legible and organized; disorganized answers will be penalized.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>/10</td>
</tr>
<tr>
<td>2</td>
<td>/10</td>
</tr>
<tr>
<td>3</td>
<td>/10</td>
</tr>
<tr>
<td>4</td>
<td>/15</td>
</tr>
<tr>
<td>5</td>
<td>/05</td>
</tr>
<tr>
<td></td>
<td>/50</td>
</tr>
</tbody>
</table>

Name: ______________________
Student ID: ______________________
Signature: ______________________
1. (10 pts) The Fourier series coefficients for a discrete-time periodic signal are given by

\[ a_k = e^{jk(4\pi)/9}. \]

(a) (3 pts) Determine the period of \( x[n] \).
(b) (3 pts) Is \( x[n] \) an even signal?
(c) (4 pts) Determine \( x[n] \).
2. (10 pts) Consider the following

\[ X_z(j\omega) \]

(a) (4 pts) Is \( x_z(t) \) a real signal? You must explain your answer.

(b) (6 pts) Determine and sketch the Fourier transform, \( X_c(j\omega) \), for the following signal

\[ x_c(t) = \Re \{ x_z(t)e^{j\omega_c t} \} \]

where \( \omega_c > W \).
3. (10 pts) Let $x[n]$ be a discrete-time signal with period $N$ and Fourier series coefficients $a_k$. Let $y[n]$ be a discrete-time signal with period $2N$ and Fourier series coefficients $b_k$. Determine the Fourier series representation of $z[n] = x[n] + y[n]$. Specifically, determine the coefficients, $c_k$, and fundamental frequency, $\Omega_z$. 
4. (15 pts) Consider an LTI system with impulse response

\[ h(t) = \frac{3}{2} [e^{-2t} + e^{-4t}] u(t) \]

(a) (3 pts) Determine the frequency response, \( H(j\omega) \).

(b) (4 pts) Find a differential equation relating the input, \( x(t) \), and output, \( y(t) \).

(c) (4 pts) Sketch a block diagram of the system using the minimum number of elements.

(d) (4 pts) Determine the output, \( y(t) \), when the input is

\[ x(t) = [e^{-t} + e^{-3t}] u(t) \]
5. (5 pts) Let $y(t)$ be a periodic power signal with period $T$ and power $P_y$, and let $x(t)$ be an aperiodic energy signal with energy $E_x$. Define $z(t)$ as the product of $x(t)$ and $y(t)$, i.e.

$$z(t) = x(t) \cdot y(t)$$

Determine the Fourier representation for $z(t)$. 