Name: _____________________________________________

Instructions:

The examination lasts for 120 minutes and is an open book, open notes exam. No electronic devices are permitted, including but not limited to calculators, cellphones, and other handheld devices.

Do all your work on the pages in this exam booklet. **Do not unstaple these pages. Any unstapled or restapled pages will NOT be graded.** There is an extra work page immediately following each problem. If for some reason you need more space than this, write on the backs of the pages (please clearly mark the problem number for such work).

Show your work and clearly indicate your final answers. Neatness and organization in your work is important and will influence your grade.

Each problem is weighted toward the final total as shown below.

**Grades**

1. ___________________ (20 pts.)
2. ___________________ (20 pts.)
3. ___________________ (20 pts.)
4. ___________________ (20 pts.)
5. ___________________ (20 pts.)

Total ___________________ (100 pts.)
1. [20 points] An LTI system has impulse response $h(t) = e^{-t}u(t)$. Find the output $y(t)$ when the input $x(t)$ is

(a) $x(t) = e^{-2t}u(t)$.
(b) $x(t) = e^{-2(t-2)}u(t - 2)$.
(c) $x(t) = e^{-2t} (u(t) - u(t - 2))$. 
Extra worksheet for problem 1
2. [20 points total] A discrete-time LTI system has impulse response

\[ h[n] = \begin{cases} 
2, & n = 0 \\
1, & n = 1 \\
1, & n = 2 \\
0, & \text{otherwise} 
\end{cases} \]

If the input to the system is

\[ x[n] = 3 + \cos\left(\frac{\pi}{2}n\right), \]

what is the output \( y[n] \)?
Extra worksheet for problem 2
3. [20 points] A signal \( x(t) \) is applied to an LTI system with frequency response

\[
H(\omega) = \begin{cases} 
\frac{4}{j\omega + 4}, & |\omega| \leq 6 \\
0, & |\omega| > 6 
\end{cases}
\]

(a) If \( x(t) \) is

\[
x(t) = a_0 + \sum_{k=1}^{\infty} a_k \cos(k4t) + \sum_{k=1}^{\infty} b_k \sin(k4t)
\]

what is \( y(t) \)?

(b) If \( x(t) \) is the periodic signal

![Signal Waveform](image)

then what is \( y(t) \)?
Extra worksheet for problem 3
4. [20 points] A signal $x(t)$ has Fourier transform

$$X(\omega) = \frac{6}{\omega^2 + 9}.$$

Find the Fourier transform $Y(\omega)$ of $y(t)$ when

$$y(t) = x(t) \cos(2t + 4).$$
Extra worksheet for problem 4
5. [20 points] Solve

\[ \frac{d^2 y(t)}{dt^2} + 6 \frac{dy(t)}{dt} + 8 y(t) = 4 x(t) \]

to find \( y(t) \) for \( t \geq 0 \) when \( x(t) = 2 u(t) \) for \( t \geq 0 \), \( y(0) = 1 \), and \( \dot{y}(0) = -4 \).
Extra worksheet for problem 5