Name: ________________________________

Instructions:
The examination lasts for 75 minutes and is closed book, closed notes. No electronic devices are permitted, including but not limited to calculators, cellphones, and other handheld devices. (Any such items in the examination room must be off and put away, subject to a 20 point penalty for the first violation and a score of 0 on the exam for the second violation.)

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. An extra worksheet follows each of problems 3, 4, 5 and 6, and attached at the back of the exam booklet is one more extra work page. You may write on the backs of the pages if you need to.

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. ________________ (10 pts.)
2. ________________ (10 pts.)
3. ________________ (24 pts.)
4. ________________ (12 pts.)
5. ________________ (20 pts.)
5. ________________ (24 pts.)

Total ________________ (100 pts.)
1. **[10 points]** For the signal $x(t)$ shown below, express $x(t)$ as a linear combination of shifted steps and ramps.
2. **[10 points]** Sketch $x[n]$ as a function of $n$ for $-6 \leq n \leq 12$.

3. [24 points total, 6 points each part] For each of the following systems, circle either “Causal” or “Noncausal” to characterize the system as being causal or noncausal, and circle either “Time-invariant” or “Time-varying” to characterize the system as being time-invariant or time-varying.

(a) Causal Noncausal Time-invariant Time-varying
\[ y(t) = \int_{-\infty}^{+\infty} (\lambda^2 - 3\lambda + 4) \left[ u(\lambda) - u(\lambda - 6) \right] x(t - \lambda) d\lambda \]

(b) Causal Noncausal Time-invariant Time-varying
\[ y(t) = \int_{-\infty}^{t+10} e^{-(t-\lambda)} x(\lambda) d\lambda \]

(c) Causal Noncausal Time-invariant Time-varying
\[ y(t) = \int_{-\infty}^{+\infty} e^{-(t-\lambda)} u(t - \lambda) x(\lambda) d\lambda \]

(d) Causal Noncausal Time-invariant Time-varying
\[ y(t) = \int_{-\infty}^{+\infty} e^{-(t-\lambda)} u(\lambda) x(t - \lambda) d\lambda \]
EXTRA WORKSHEET for problem 3
4. [12 points] Find $y[n] = h[n] * x[n]$ for all $n$ given that $h[n]$ and $x[n]$ are the signals shown below.
EXTRA WORKSHEET for problem 4
5. [20 points, 10 points each part] A linear, time-invariant system has an impulse response given by 

\[ h(t) = 2e^{-2t}u(t). \]

Find the system’s output \( y(t) \) if the input is

(a) \( x(t) = 3e^{-3t}u(t) \)
(b) \( x(t) = e^{-3(t-1)}u(t-1) - e^{-3(t-2)}u(t-2). \)
EXTRA WORKSHEET for problem 5
6. **[24 points total]** You receive a communications signal as the output $y(t)$ of an LTI system with impulse response

$$h(t) = \begin{cases} 
1, & 0 \leq t \leq 2 \\
0, & \text{otherwise}
\end{cases}$$

(a) **[15 points]** The transmitter at the input $x(t)$ sends a pulse $x(t) = +p(t - t_0)$ with

$$p(t) = u(t) - u(t - 2)$$

to represent a +1 digital signal at time $t_0$, and sends $x(t) = -p(t - t_0)$ to represent a −1 digital signal at time $t_0$. Determine an expression for the system output $y(t)$ if $x(t) = p(t)$, and also sketch a plot of $y(t)$.

(b) **[9 points]** Suppose that

$$x(t) = a_1 p(t - t_1) + a_2 p(t - t_2) + a_3 p(t - t_3).$$

You know that $a_1$ is either +1 or −1, and similarly for $a_2$ and $a_3$. If you receive the signal $y(t)$ shown below, determine $a_1$, $t_1$, $a_2$, $t_2$, $a_3$, and $t_3$. 

![Signal Plot](image-url)
EXTRA WORKSHEET for problem 6
EXTRA WORKSHEET (indicate problem number clearly)
EXTRA WORKSHEET (indicate problem number clearly)