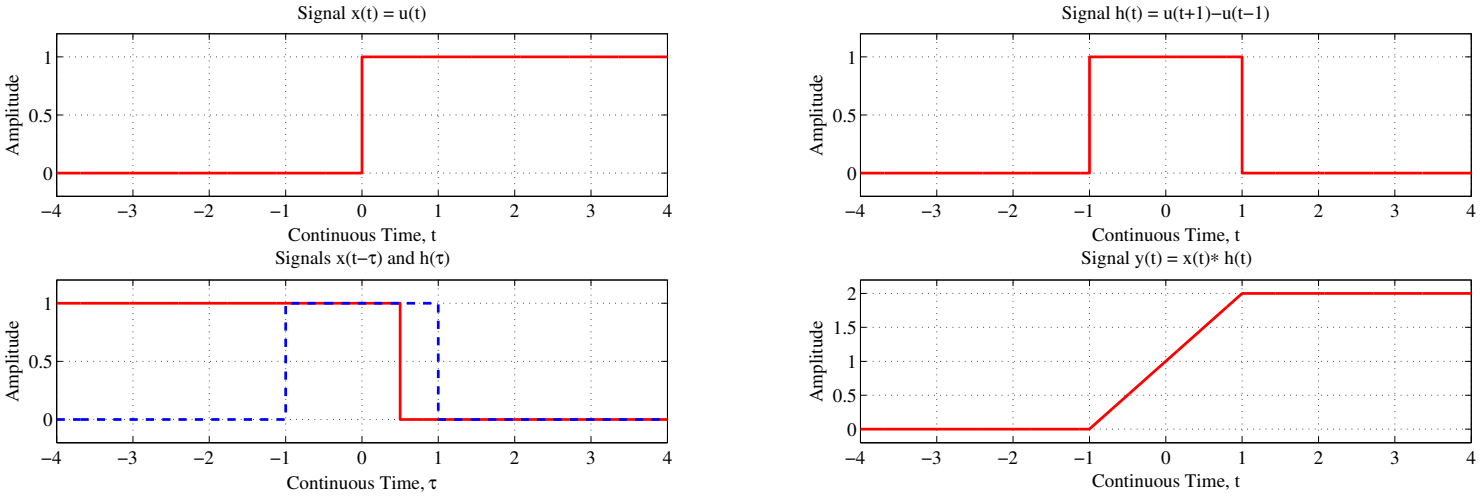
Name: SOLUTIONS

Quiz 2: ____/10 **ELEC 309 – Signals & Systems**

A continuous-time system has impulse response $h(t) = u(t+1) - u(t-1)$ and input signal $x(t) = u(t)$. Using convolution, determine the output signal $y(t)$.



In determining $h(t)*x(t)$, we need to consider three ranges of time t: $t < -1$, $-1 \le t < 1$, and $t \ge 1$.

For $t < -1$, $h(\tau)x(t-\tau) = 0$ for all τ. Therefore,

$$h(t) * x(t) = \int_{-\infty}^{\infty} h(\tau)x(t-\tau)d\tau = 0.$$

For $-1 \le t < 1$, $h(\tau)x(t-\tau) = 1$ for $-1 \le \tau \le t$. Therefore,

$$h(t) * x(t) = \int_{-\infty}^{\infty} h(\tau)x(t-\tau)d\tau = \int_{-1}^{t} d\tau = t+1.$$

For $t \ge 1$, $h(\tau)x(t-\tau) = 1$ for $-1 \le \tau \le 1$. Therefore,

$$h(t) * x(t) = \int_{-\infty}^{\infty} h(\tau)x(t-\tau)d\tau = \int_{-1}^{1} d\tau = 2.$$

Therefore,

$$h(t) * x(t) = \begin{cases} 0 & t < -1 \\ t+1 & -1 \le t < 1 \\ 2 & t \ge 1 \end{cases}$$

$$= (t+1)\left[u(t+1) - u(t-1)\right] + 2u(t-1) = (t+1)u(t+1) - (t-1)u(t-1)$$