Laplace Transforms and the Transfer Function

$$Y(s) = H(s)U(s), \qquad \text{where } H(s) = \int_{-\infty}^{\infty} h(\tau)e^{-s\tau}\mathrm{d}\tau$$

Limits of integration:

- We only deal with *causal* systems — output at time t is not affected by inputs at future times $t' > t$
- If the system is causal, then $h(t) = 0$ for $t < 0$ — $h(t)$ is the response at time t to a unit impulse at time 0
- We will take all other possible inputs (not just impulses) to be 0 for $t < 0$, and work with *one-sided* Laplace transforms:

$$y(t) = \int_{0}^{\infty} u(\tau)h(t-\tau)\mathrm{d}\tau$$

$$H(s) = \int_{0}^{\infty} h(\tau)e^{-s\tau}\mathrm{d}\tau$$