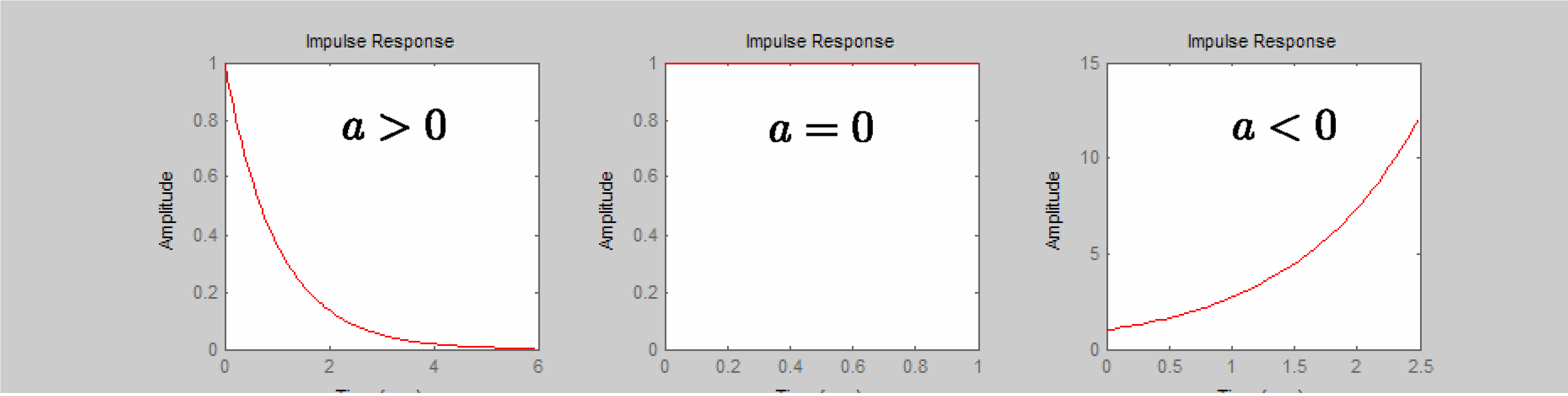
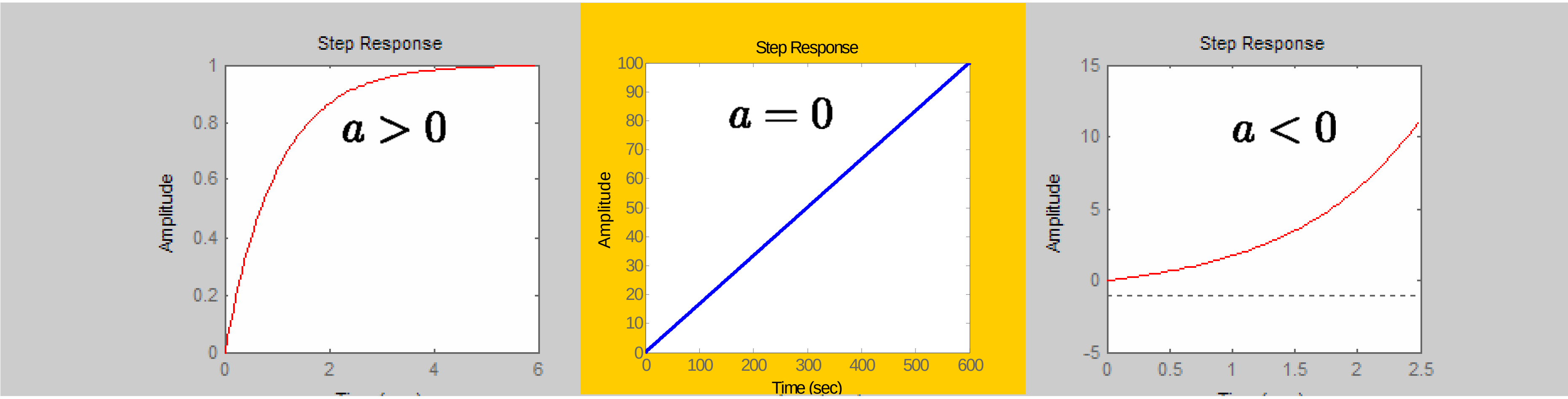
First order system response

- System transfer function : $H(s) = \dfrac{b}{s+a}$
- Impulse response : $h(t) = \mathcal{L}^{-1}[H(s)] = b\,e^{-at}\,1(t)$

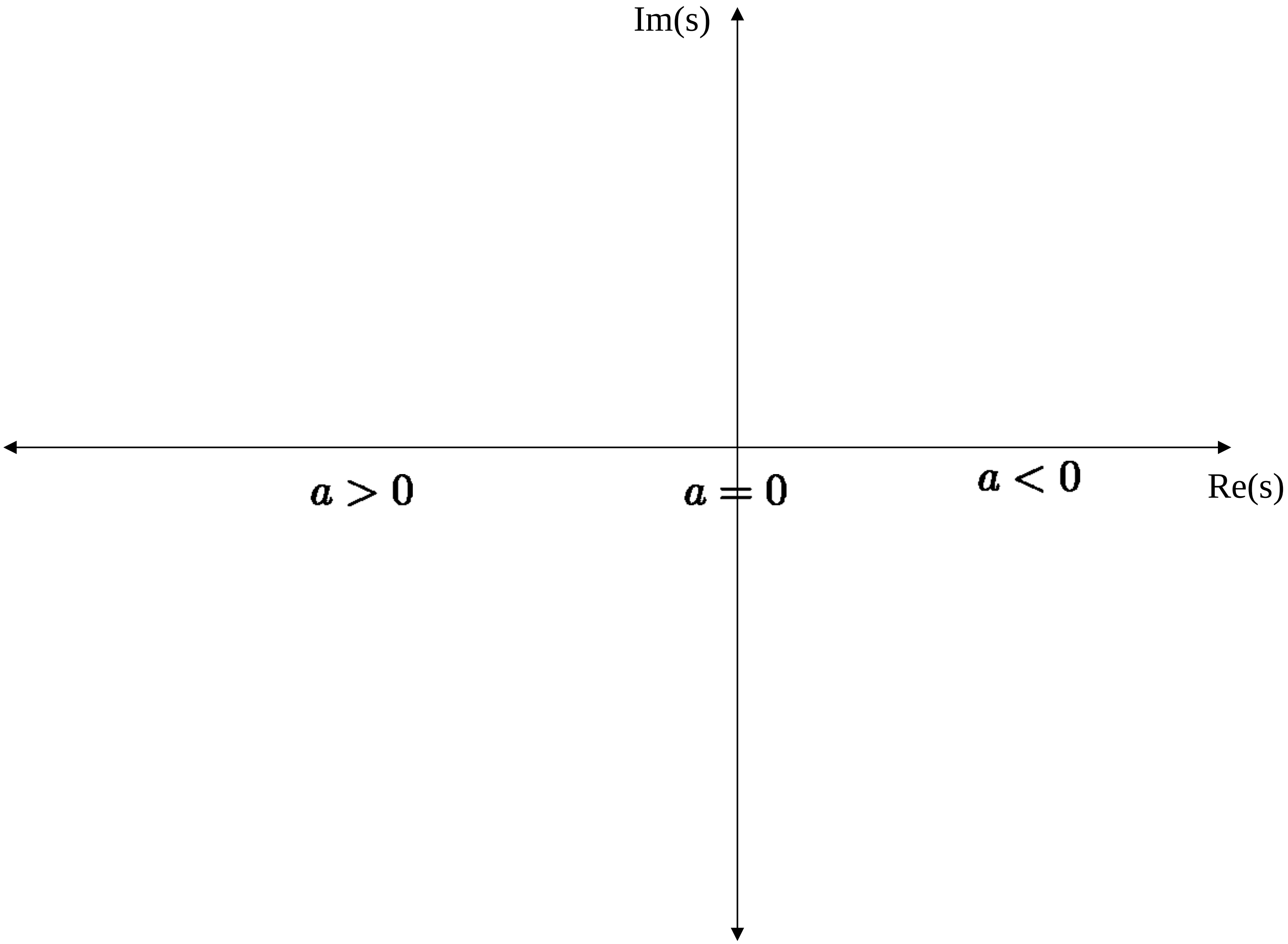


First order system response

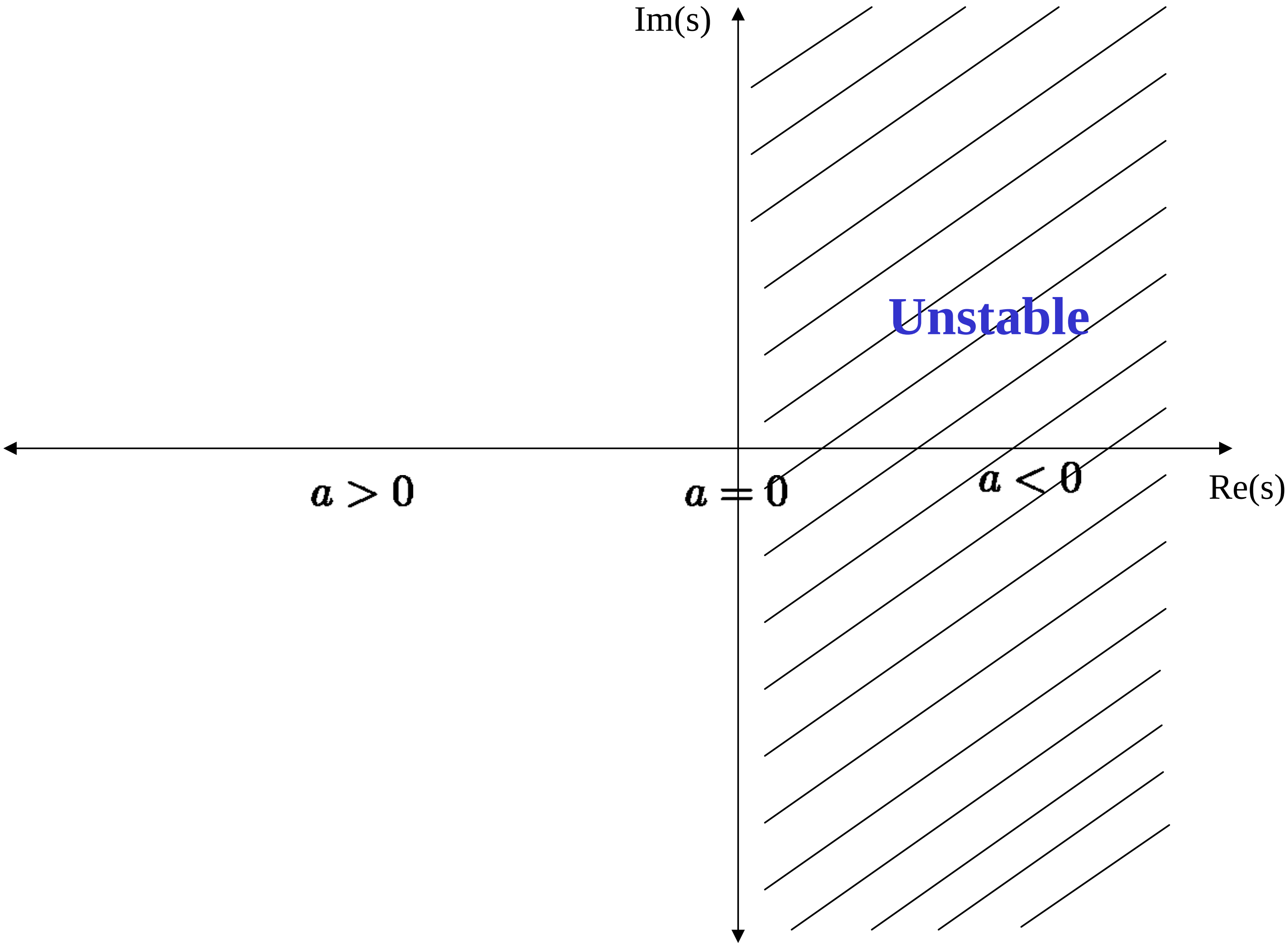
- System transfer function : $H(s) = \dfrac{b}{s+a}$
- Impulse response : $h(t) \;=\; \mathcal{L}^{-1}[H(s)] \;=\; b\,e^{-at}\,1(t)$
- Step response : $y_{step}(t) \;=\; \mathcal{L}^{-1}[H(s)/s] \;=\; \dfrac{b}{a}(1-e^{-at})1(t)$



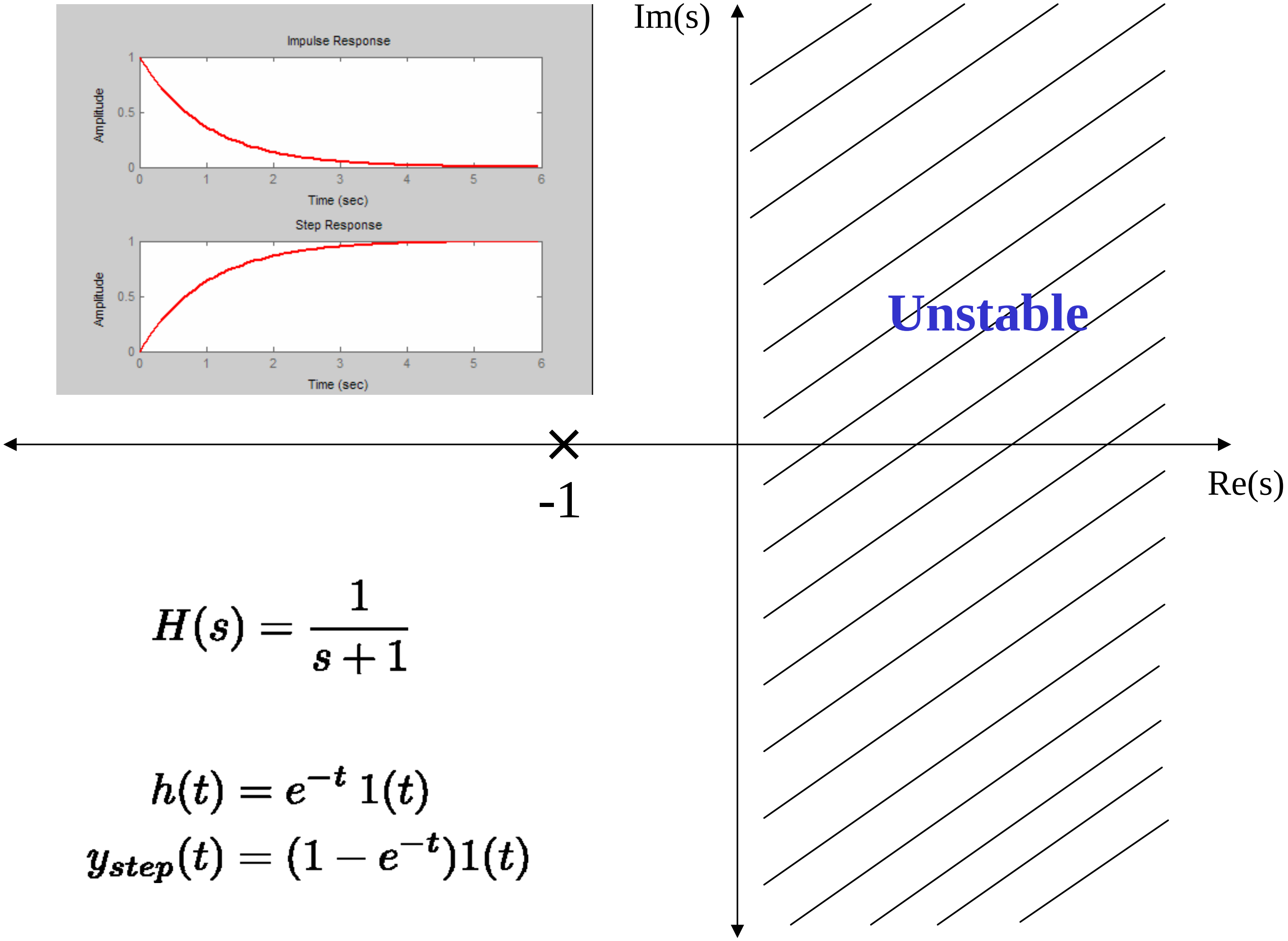
First order system response



First order system response



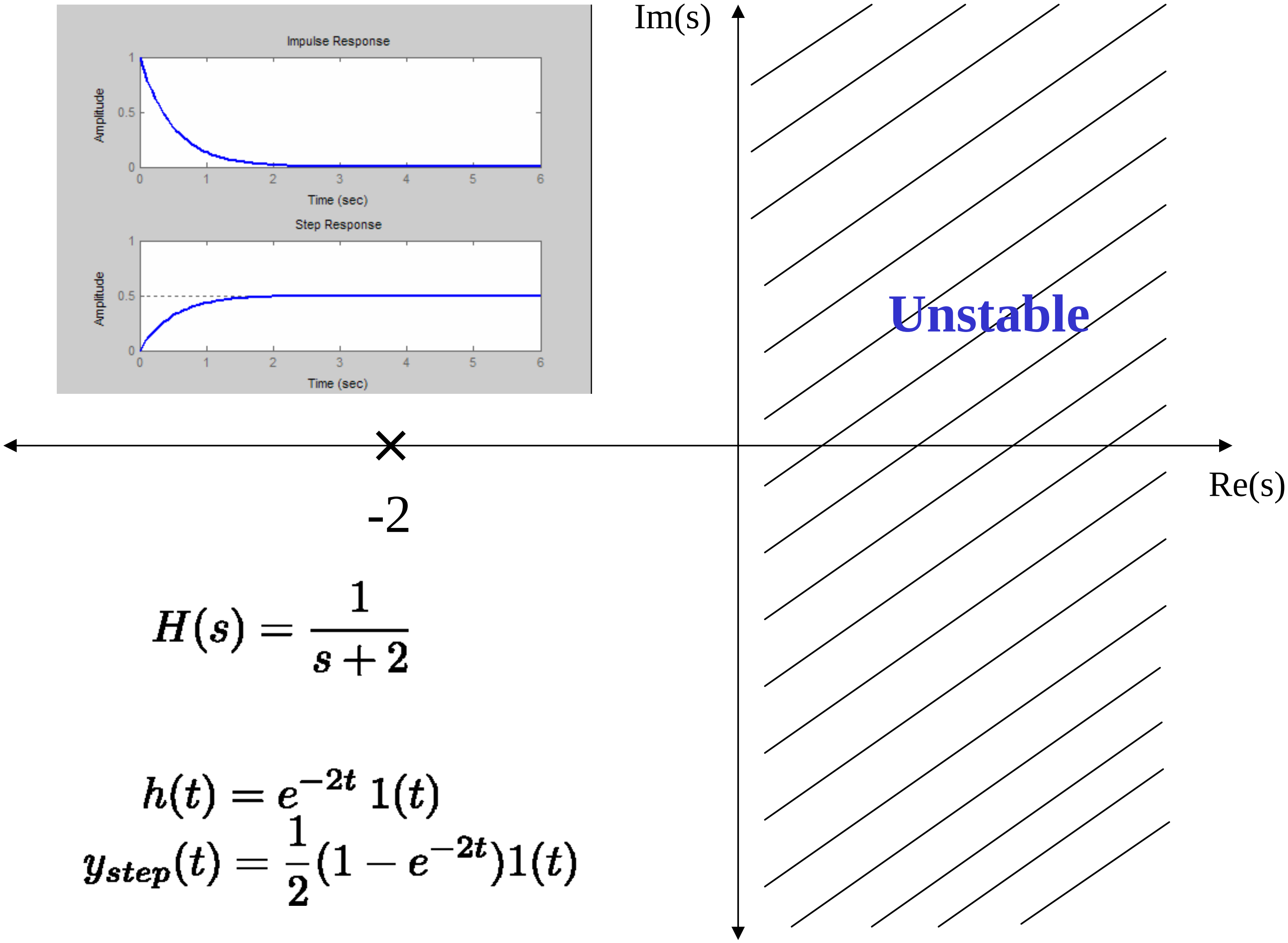
First order system response



$$H(s) = \frac{1}{s+1}$$

$$h(t) = e^{-t}\,1(t)$$
$$y_{step}(t) = (1 - e^{-t})1(t)$$

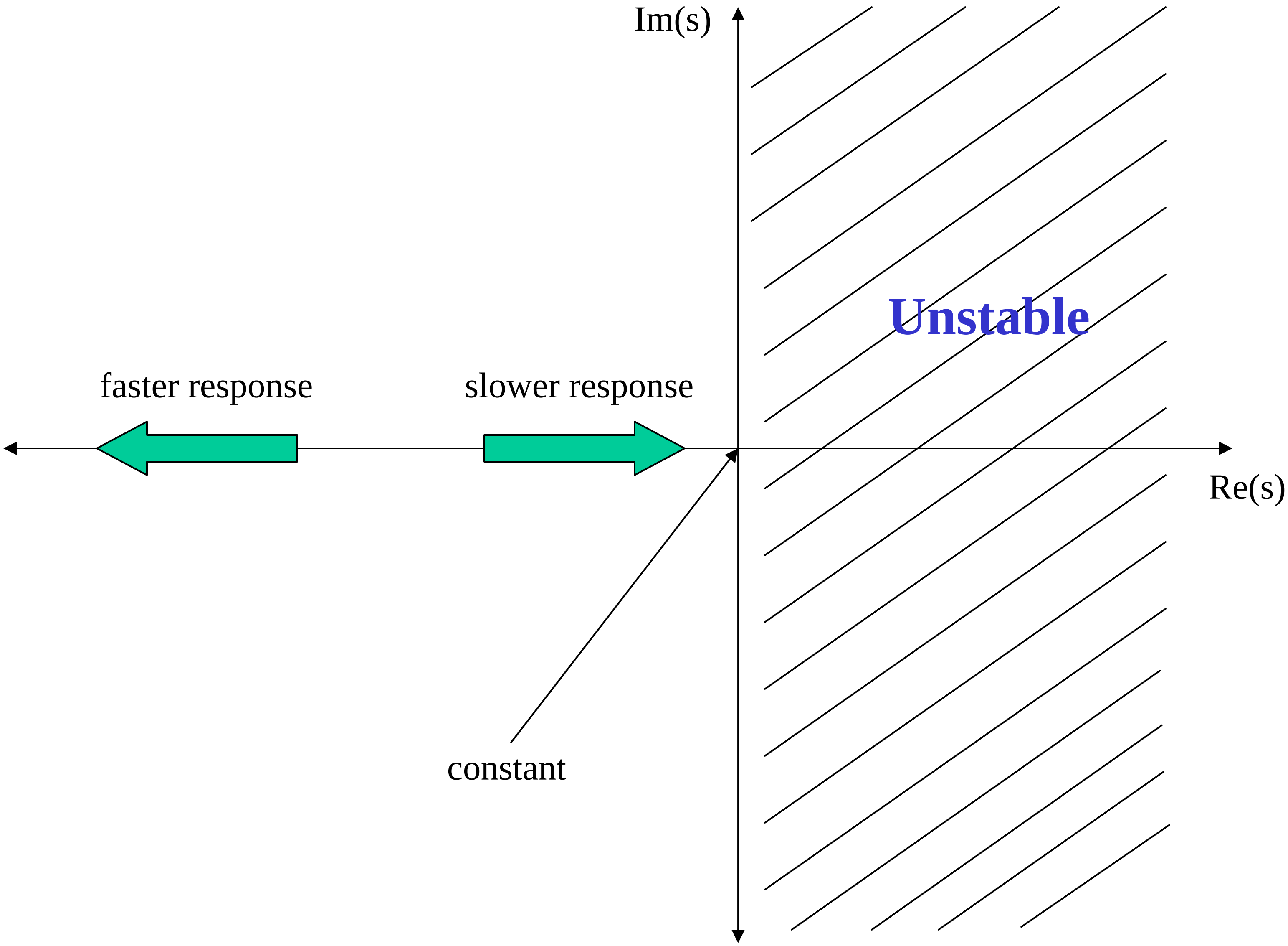
First order system response



$$H(s) = \frac{1}{s+2}$$

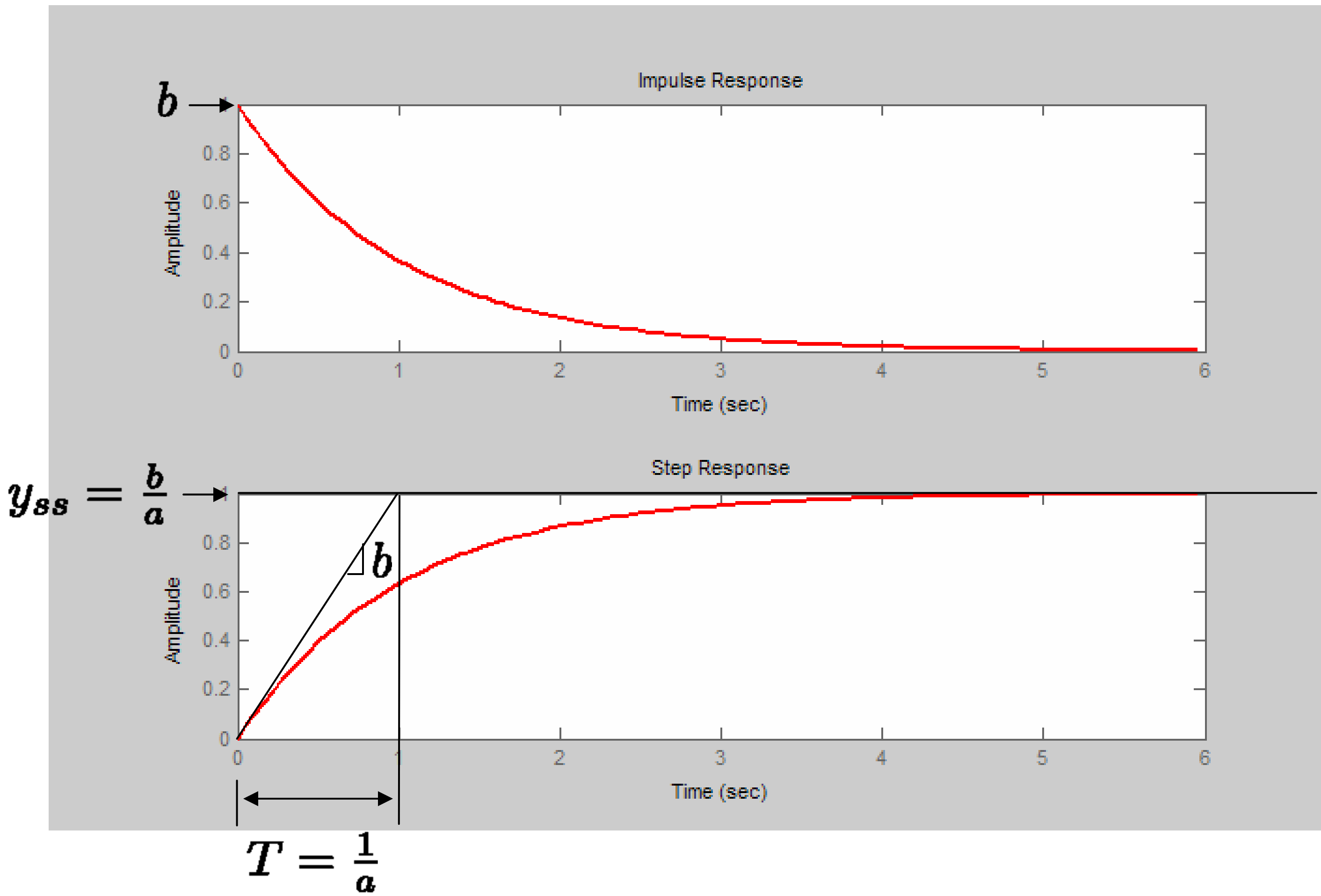
$$h(t) = e^{-2t}\,1(t)$$
$$y_{step}(t) = \frac{1}{2}(1 - e^{-2t})1(t)$$

First order system response



First order system – Time specifications.

$$H(s) = \frac{b}{s+a}$$



First order system – Time specifications.

$$H(s) = \frac{b}{s+a}$$

Time specs:

- Steady state value : $y_{ss} = \lim_{t \to \infty} y_{step}(t) = \frac{b}{a}$
- Time constant : $T = \frac{1}{a}$ $y_{step}(T) = 0.63\, y_{ss}$
- Rise time : $T_r = \frac{2.2}{a}$ Time to go from $0.1\, y_{ss}$ to $0.9\, y_{ss}$
- Settling time : $T_s = \frac{4}{a}$ $y_{step}(T_s) = 0.98\, y_{ss}$

First order system – Simple behavior.

$$H(s) = \frac{b}{s+a}$$

- No overshoot
- No oscillations