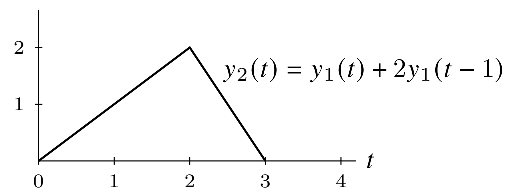
CHAPTER 2

연속시간 LTI 시스템

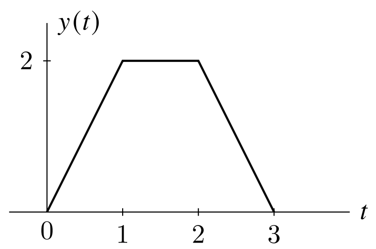
P2.1 (a) 선형 시변 (b) 선형 시불변 (c) 선형 시변
(d) 선형 시변 (e) 선형 시변 (f) 선형 시불변

P2.2 $h(t) = \delta(t) - [u(t) - u(t-2)]$

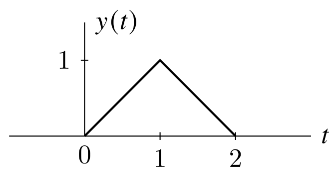
P2.3



P2.4



P2.5 $y(t) = tu(t) - 2(t-1)u(t-1) + (t-2)u(t-2)$



$y(t)$ 의 최대값은 $t = 1$ 에서 발생한다.

P2.6 (i) 수식 이용

$$y(t) = \frac{1}{2}t^2u(t) - (t-1)^2u(t-1) + (t-3)^2u(t-3)$$

P2.7 (a) $y(t) = [1 - e^{-(t-1)}]u(t-1)$

(c) 비인과 시스템.

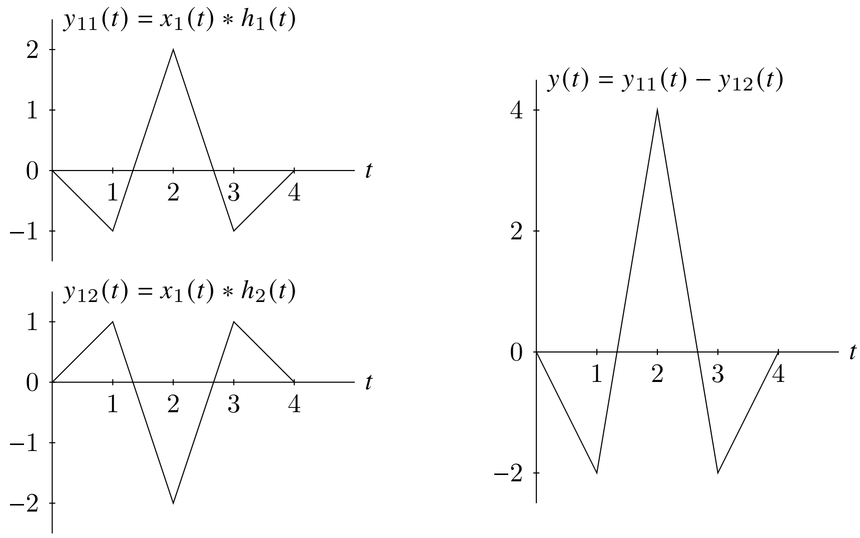
P2.8 $y_1(t) = 3[1 - e^{-2(t-2)}]u(t-2) + \sqrt{2}\cos(3t - \pi/6)$

P2.9 (a) 인과 안정 (b) 비인과 안정 (c) 인과 불안정
(d) 비인과 불안정 (e) 인과 불안정 (f) 인과 불안정

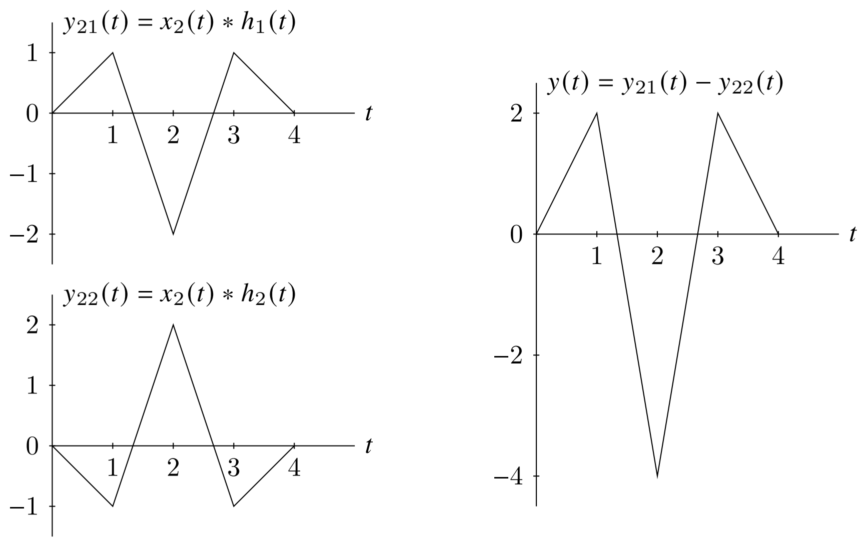
P2.10 (a) $h(t) = \delta(t-1) - \delta(t-3)$ (b) $y(t) = x(t-1) - x(t-3)$

P2.11 $h(t) = -e^{-t}[u(t) - u(t-2)] + [\delta(t) - e^{-2}\delta(t-2)]$

P2.12 (a)



(b)



(c) $y(2) > 0$ 이면 $x_1(t)$ 이 입력되었다고 판단하고, $y(2) < 0$ 이면 $x_2(t)$ 가 입력되었다고 판단한다.

P2.13 (a) $t < 0$ 이면 $y(t) = 0$ 이며, $t > 0$ 이면 $y(t) = e^t[1 - e^{-t}]$

(b) $t < 0$ 이면 $y(t) = 0$ 이며, $t > 0$ 이면 $y(t) = te^{-2t}$

(c) $t < 0$ 이면 $y(t) = 0$ 이며, $t > 0$ 이면 $y(t) = \frac{1}{p_2 - p_1}[e^{-p_1 t} - e^{-p_2 t}]$

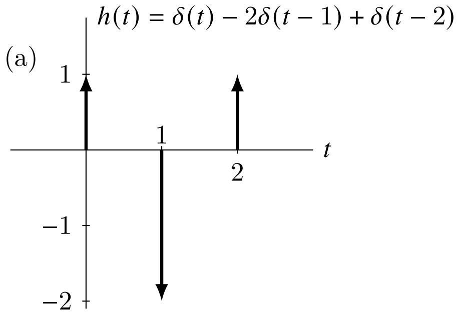
P2.14 (a) $e^{-t}u(t) + e^{-(t-1)}u(t-1) + e^{-(t-2)}u(t-2) + e^{-(t-3)}u(t-3)$

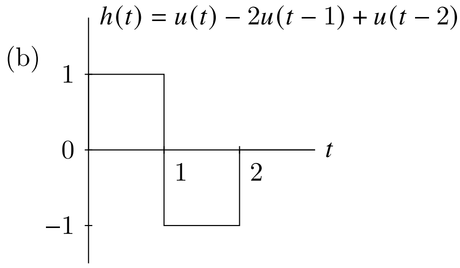
(b) $e^{-2t}u(t-1)$

(c) $\delta(t-2) + 2e^{-2(t-2)}\cos(2\pi t)u(t-2)$

(d) $\delta(t) + 2\delta(t-1) + 3\delta(t-2) + 6\delta(t-3)$

P2.15





P2.16 (a) $$y(t) = \frac{1}{3}e^{-t} - \frac{1}{2}e^{-2t} + \frac{1}{6}e^{-4t}, \quad t > 0$$

(b) $$x_1(t) = \frac{d}{dt}x(t) + 5x(t)$$

$$\longmapsto \quad y_1(t) = \frac{d}{dt}y(t) + 5y(t) = \frac{4}{3}e^{-t} - \frac{3}{2}e^{-2t} + \frac{1}{6}e^{-4t}, \quad t > 0$$

P2.17 (a) $$h(t) = e^{-t}[1 - e^{-t}]u(t)$$

(b) $$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t)$$

P2.18 (a) $$h_1(t) = \frac{\delta(t)}{dt} + \delta(t), \qquad h_2(t) = e^{-t}[1 - e^{-t}]u(t)$$

(b) $$h(t) = e^{-2t}u(t)$$

(c) $$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = \frac{dx(t)}{dt} + x(t)$$

P2.19 (a) $h_1(t) = \dfrac{d\delta(t)}{dt} + \delta(t)$

$$h_2(t) = \int_0^t e^{-\tau} e^{-2(t-\tau)} d\tau = e^{-t}[1 - e^{-t}]u(t)$$

(b) $h(t) = [-e^{-t} + 2e^{-2t}]u(t) + [e^{-t} - e^{-2t}]u(t) = e^{-2t}u(t)$

(c) $\dfrac{d^2y(t)}{dt^2} + 3\dfrac{dy(t)}{dt} + 2y(t) = \dfrac{dx(t)}{dt} + x(t)$

P2.20 (a)

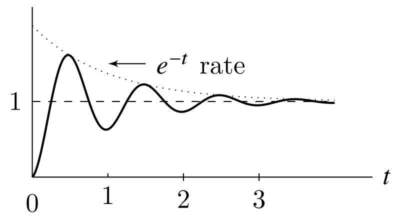
- 과제동은 $a_1^2 - 36 > 0 \quad \Longrightarrow \quad |a_1| > 6$
- 임계제동은 $a_1^2 - 36 = 0 \quad \Longrightarrow \quad a_1 = \pm 6$
- 부족제동은 $a_1^2 - 36 < 0 \quad \Longrightarrow \quad |a_1| < 6$

(b) $y_{step}(t) = \dfrac{1}{9} - \dfrac{1}{9}e^{-3t} - \dfrac{1}{3}te^{-3t}, \quad t > 0$

(c) $h(t) = \dfrac{dy_{step}(t)}{dt} = te^{-3t}, \quad t > 0$

P2.21 (a) 특성식의 근은 $s_{1,2} = -1 \pm j2\pi$. 허근을 가지므로 부족제동에 해당한다.

(b) $e^{-\sigma t}\cos(\omega_0 t) = e^{-t}\cos(2\pi t)$ 의 꼴로 감소하면서 진동한다.



P2.22 (a) $y(t) = 2e^{-t}[1 - \cos(t)]u(t)$

(b) $y_{step}(t) = \dfrac{1}{2}u(t) - \dfrac{\sqrt{2}}{2}e^{-t}\cos(t - \pi/4)u(t)$

(c) $h(t) = \dfrac{dy_{step}(t)}{dt} = -(1-j)c_3 e^{-(1-j)t} - (1+j)c_4 e^{-(1+j)t}, \quad t > 0$

BIBO 안정하다.

P2.23 (a) $y(t) = e^{-t} - \dfrac{1}{2}e^{-2t} - \dfrac{1}{2}e^{-3t}, \quad t > 0$

(b) $y_{step}(t) = \underbrace{e^{-2t} - 2e^{-t}}_{y_{tr}(t)} + \underbrace{1}_{y_{ss}(t)}, \quad t > 0$