故系统的单位冲激响应为 $h(t)=g(t)=\frac{1}{2}e^{-t}\varepsilon(t)$

2-16

(1) $f_2(t)=\delta(t+2)+\delta(t-2)$

解：根据卷积的性质

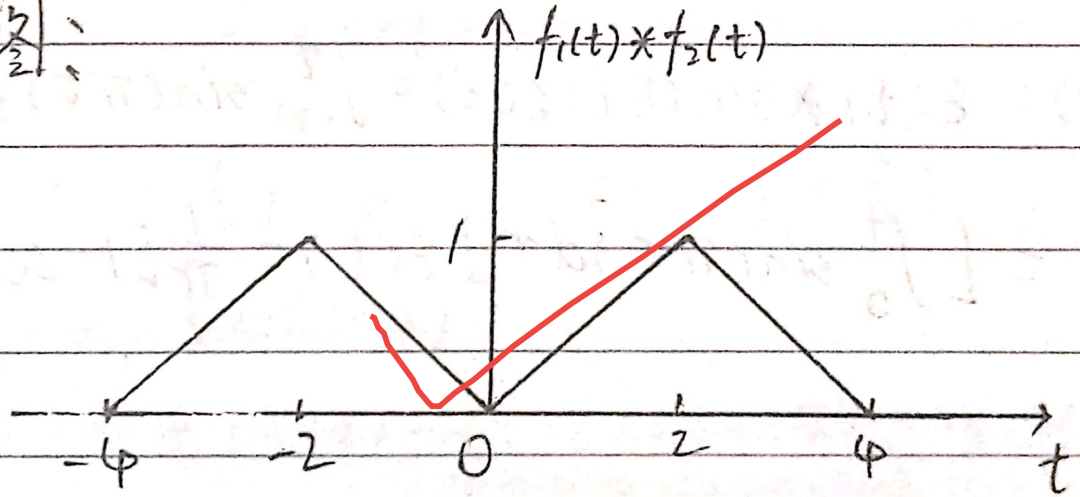
$$f_1(t)*f_2(t)=f_1(t)*\delta(t+2)+f_1(t)*\delta(t-2)$$

$$=f_1(t+2)*f_1(t-2)$$

$C u_c'(t)$

$=0$

波形如图：



源本

(3) $f_4(t)$

$f_{(4)}(t) = \delta(t) - \delta(t-2) - \delta(t-3) + \delta(t-4)$

根据卷积的性质，

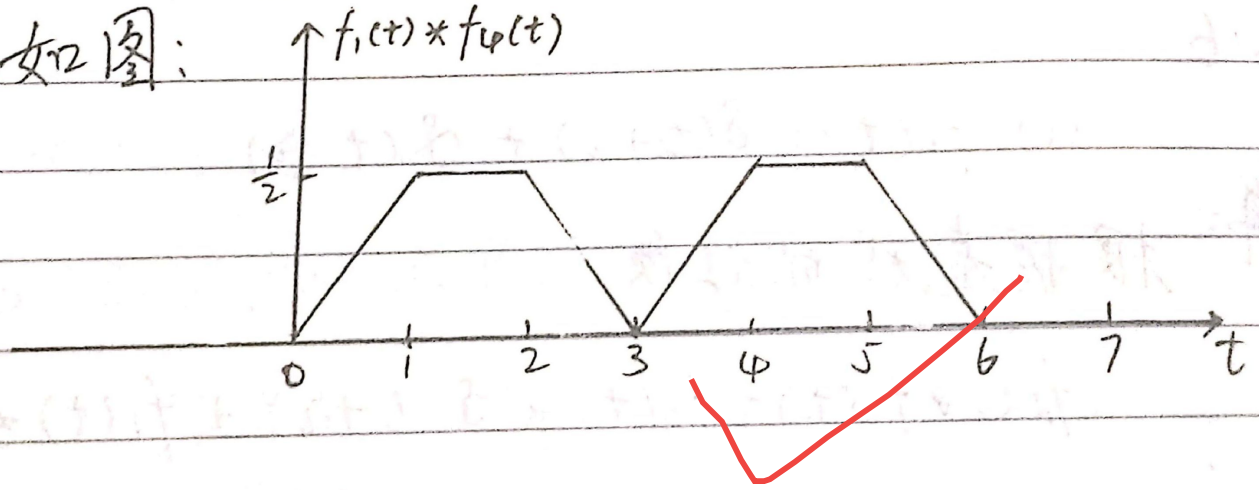
$f_1(t) \quad f_4(t) \quad f_1(t)$

$f_{(1)}(t) * f_{(4)}(t) = f_{(1)}(t) * \delta(t-2) - f_1(t) * \delta(t-3) +$

$f_1(t) * \delta(t-4)$

$= f_1(t-2) - f_1(t-3) + f_1(t-4)$

波形如图：



2-17 (7) 设 $f(t) = \varepsilon(t) * \sin(\pi t)\varepsilon(t)$，则

解：$f(t) = \varepsilon(t) * \sin(\pi t)\varepsilon(t) = \int_{-\infty}^{t} \sin(\pi\tau)\varepsilon(\tau)d\tau$

$= \left[\int_0^t \sin(\pi\tau)d\tau\right]\varepsilon(t) = \frac{1}{\pi}[1-\cos(\pi t)]\varepsilon(t)$

$$f_1(t)*f_2(t)=[\varepsilon(t)-\varepsilon(t-4)]*\sin(\pi t)\varepsilon(t)$$

$$=\varepsilon(t)**\sin(\pi t)\varepsilon(t)-\varepsilon(t-4)*\sin(\pi t)\varepsilon(t)$$

$$=f(t)-f(t-4)$$

故 $f_1(t)*f_2(t)=f(t)-f(t-4)$

$$=\frac{1}{\pi}[1-\cos(\pi t)]\varepsilon(t)-\frac{1}{\pi}[1-\cos\pi(t-4)]\varepsilon(t-4)$$

$$=\frac{1}{\pi}[1-\cos(\pi t)][\varepsilon(t)-\varepsilon(t-4)]$$

2.18 由各波形图可得 $h(t)=\varepsilon(t)-\varepsilon(t-2)$

解: $f_1(t)=\varepsilon(t-2)-\varepsilon(t-3)$

$$f_2(t)=\frac{1}{2}t[\varepsilon(t)-\varepsilon(t-2)]$$

$$=\frac{1}{2}t\varepsilon(t)-\frac{1}{2}(t-2)\varepsilon(t-2)-\varepsilon(t-2)$$

$$f_3(t)=\frac{1}{2}t[\varepsilon(t)-\varepsilon(t-2)]+[2-\frac{1}{2}t][\varepsilon(t-2)-\varepsilon(t-4)]$$

$$=\frac{1}{2}t\varepsilon(t)-(t-2)\varepsilon(t-2)+\frac{1}{2}(t-4)\varepsilon(t-4)$$

源本

(1) 当输入为单位阶跃函数时，系统零状态响应为：

$$y_{zs1}(t) = h(t) * \varepsilon(t) = [\varepsilon(t) - \varepsilon(t-2)] * \varepsilon(t)$$

$$= t\varepsilon(t) - (t-2)\varepsilon(t-2)$$

(2) 当输入为 $f_1(t)$ 时，该系统的零状态响应为：

$$y_{zs2}(t) = h(t) * f_1(t) = [\varepsilon(t) - \varepsilon(t-2)] * [\varepsilon(t-2) - \varepsilon(t-2)]$$

$$= y_{zs1}(t-2) - y_{zs1}(t-2)$$

$$= (t-2)\varepsilon(t-2) - (t-3)\varepsilon(t-3) - (t-4)\varepsilon(t-4) + (t-5)\varepsilon(t-5)$$

2.26 解：由加法器可得：$x'(t) = f(t) - x(t)$

即 $x'(t) + x(t) = f(t)$

由加法器得，$y(t) = 2x'(t) - x(t)$

源本

等式两边取微分得：$y'(t)=2x''(t)-x'(t)$

两式相加得 $y'(t)+y(t)=2x''(t)+2x'(t)-[x'(t)-x(t)]$

$=2f'(t)-f(t)$

设 $h_1(t)$ 满足 $h_1'(t)+h_1(t)=\delta(t)$，$h_1(0+)=1$

则有：$h_1(t)=e^{-t}\varepsilon(t)$

故系统的冲激响应为：$h(t)=2h_1'(t)-h_1(t)$

$=2\delta(t)-3e^{-t}\varepsilon(t)$

2.30 令 $f(t)=\delta(t)$，则加法器两个输入分别为

解：$h_{11}(t)=y_1(t)=f(t)*h_1(t)=\delta(t)*\varepsilon(t)=\varepsilon(t)$

$h_{12}(t)=y_2(t)=f(t)*h_2(t)*h_1(t)*h_3(t)$

$=\delta(t)*\delta(t-1)*\varepsilon(t)*[-\delta(t)]=-\varepsilon(t-1)$

故复合系统的冲激响应为：$h(t)=h_{11}(t)+h_{12}(t)$

$=\varepsilon(t)-\varepsilon(t-1)$ 源本