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1.4:

a) $f(k)=\varepsilon(k+2)$

b) $f(k)=\varepsilon(k-3)$

c) $f(k)=\varepsilon(-k+2)$

d) $f(k)=(-1)^k\varepsilon(k)$

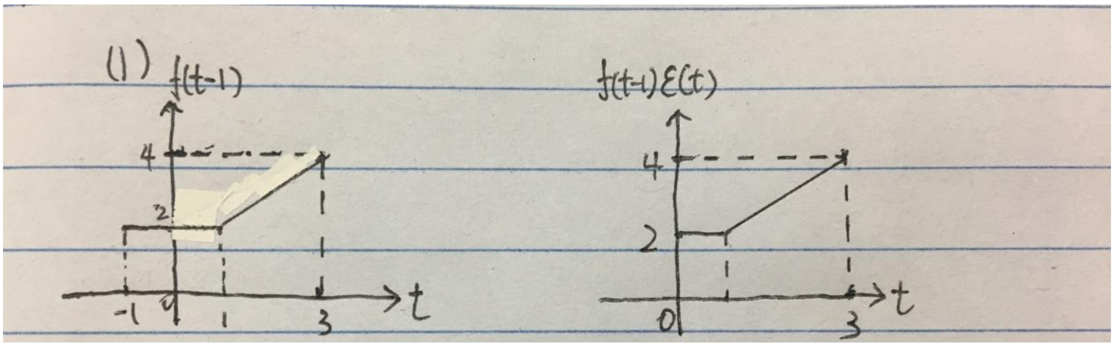
1.5:

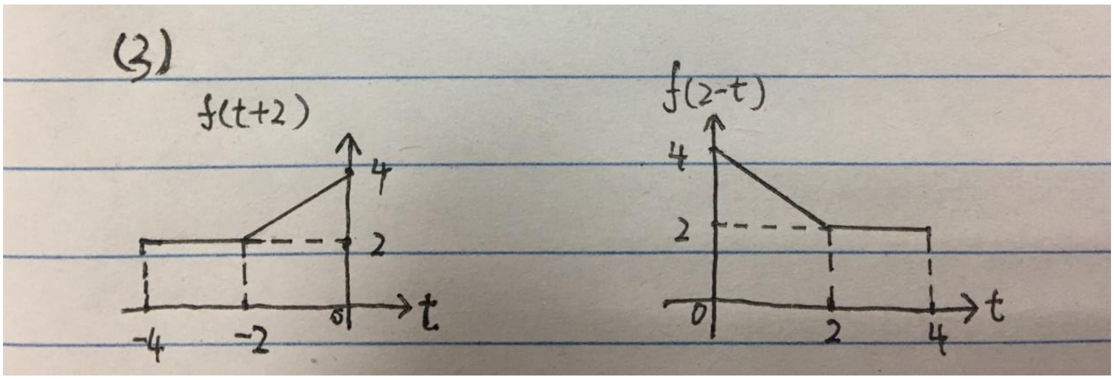
（1）序列为周期序列，T=0.3

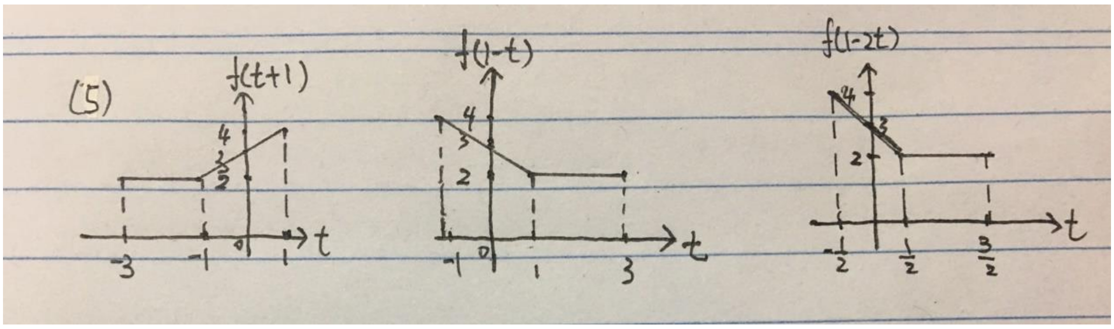
（2）对于 k=1，不存在周期 T 使$f_3(1)=f_3(1+mT)(m=0,\pm1,\pm2\ldots)$

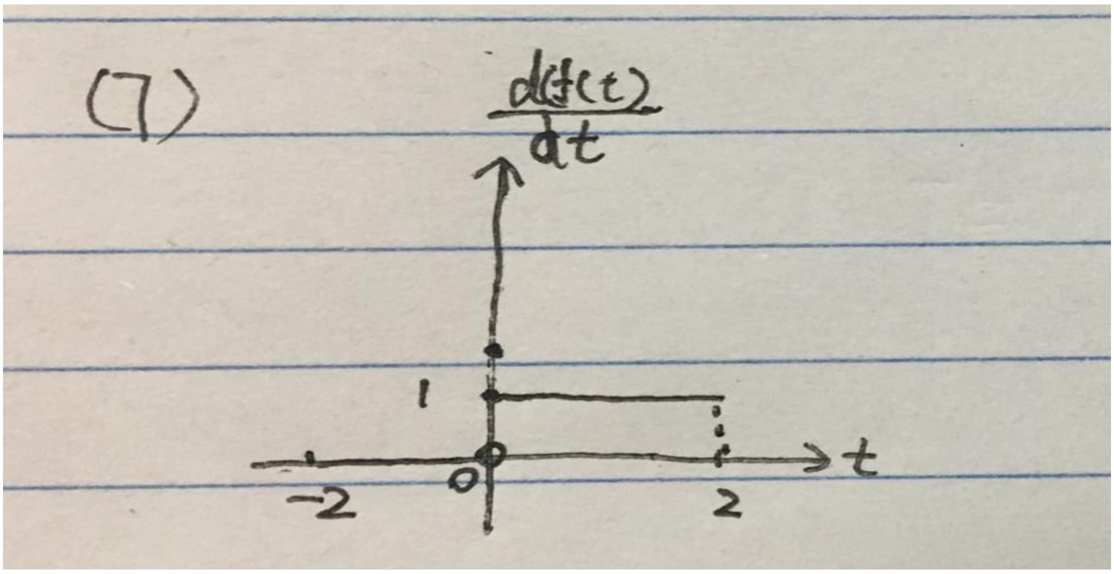
（3）$cos\,t$周期$T_1=2\pi$，$sin(\pi t)$周期$T_2=2$，$\frac{T_1}{T_2}=\pi$不为有理数，故 f5 不具有周期性

1.6:









1.10:

(1)

$$\frac{d^2}{dt^2}[\cos t+\sin 2t]\varepsilon(t) = \frac{d}{dt}\{[-\mathrm{sint}+2\cos(2\mathrm{t})]\varepsilon(\mathrm{t})+[\cos t+\sin 2t]\sigma(t)\}$$

$$=\frac{d}{dt}\{[-\mathrm{sint}+2\cos(2\mathrm{t})]\varepsilon(\mathrm{t})+\sigma(t)\}$$

$$=[-\cos t-4\sin(2t)]\varepsilon(t)+[-\mathrm{sint}+2\cos(2\mathrm{t})]\sigma(t)+\sigma^2(t)$$

$$=[-\cos t-4\sin(2t)]\varepsilon(t)+2\sigma(t)+\sigma^2(t)$$

(2)

$$(1+t)\frac{d}{dt}[e^{-t}\delta(t)]=(1+\mathrm{t})*[-e^{-t}\delta(t)+e^{-t}\delta'(t)]$$

$$=(1+\mathrm{t})*[-\delta(t)+\delta(t)+\delta'(t))]$$

$$=(1+t)*\delta'(t)=\delta'(t)+\delta(t)$$

Tips: $\begin{cases} e^{-at}\delta'(t)=\delta'(t)+a\delta(t) \\ t\delta'(t)=-\delta(t) \end{cases}$

(3)

令$f(t)=\frac{sin(\pi t)}{t}$，则$\int_{-\infty}^{\infty}\frac{sin(\pi t)}{t}\delta(t)\,dt=\int_{-\infty}^{\infty}f(t)\delta(t)\,dt=\mathrm{f}(0)=1$

(4)

$$\int_{-\infty}^{\infty}e^{-2t}\left[\delta(t)+\delta'^{(t)}\right]dt=\int_{-\infty}^{\infty}e^{-2t}\delta'^{(t)}\,dt+\int_{-\infty}^{\infty}e^{-2t}\delta(t)\,dt=2+1=3$$

(5)

$$\int_{-\infty}^{\infty}[t^2+sin\left(\frac{\pi}{4}t\right)\delta(t+2)]\,dt=[t^2+\sin\left(\frac{\pi}{4}t\right)]\Big|_{t=-2}=3$$

(7)

$$\int_{-\infty}^{\infty}(t^3+2t^2-2t+1)\delta'^{(t-1)}\,dt=[t^3+2t^2-2t+1]'|_{t=1}=5$$

1.23:

（1）

$$\begin{cases} y_{zs}(t)=\int_0^t \sin x f(x)\,dx \\ y_{zi}(t)=e^{-t}x(0) \end{cases}$$ 故$y(t)=y_{zi}(t)+y_{zs}(t)$满足可分解性

同时，

$e^{-t}[x_1(0)+x_2(0)]=e^{-t}x_1(0)+e^{-t}x_2(0)$，满足零输入线性

$\int_0^t \sin x[f_1(x)+f_2(x)]\,dx=\int_0^t \sin x f_1(x)dx+\int_0^t \sin x\, f_2(x)dx$，满足零状态线性　故系统为线性的

（3）

$$\begin{cases} y_{zs}(t)=\sin[x(0)*t] \\ y_{zi}(t)=\int_0^t f(x)\,dx \end{cases}$$ 故$y(t)=y_{zi}(t)+y_{zs}(t)$满足可分解性

但，$sin\big[\big(x_1(0)+x_2(0)\big)*t\big]\neq\sin[x_1(0)*t]+\sin[x_2(0)*t]$不满足零输入特性，故为非线性系统

（5）

$$\begin{cases} y_{zs}(k)=kx(0) \\ y_{zi}(k)=\sum_{j=0}^{k} f(j) \end{cases}$$ 故$y(t)=y_{zi}(t)+y_{zs}(t)$满足可分解性

且，

$k[x_1(0)+x_2(0)]=kx_1(0)+kx_2(0)$满足零输入线性

$\sum_{j=0}^{k}[f_1(j)+f_2(j)]=\sum_{j=0}^{k} f_1(j)+\sum_{j=0}^{k} f_2(j)$满足零状态线性

故为线性系统

1.25:

（3）

$af_1(t)\,cos(2\pi t)+bf_2(t)\,cos(2\pi t)=af_1(t)\,cos(2\pi t)+bf_2(t)\,cos(2\pi t)$系统满足齐次性与可加性

$y_{zs}(t-t_d)\neq f(t-t_1)\,cos(2\pi t)$ 时变

t<0，$f(t)=0$，$y_{zs}(t)=f(t)\,cos(2\pi t)=0$　因果

$|f(t)|<\infty$，$|y_{zs}(t)|=|f(t)\,cos(2\pi t)|<\infty$　稳定

故为线性时变因果稳定系统

1.32

由 LT1 系统为线性时不变因果稳定系统

故$y_{(t)}=\varepsilon(t)-\varepsilon(t-1)-\varepsilon(t-2)+\varepsilon(t-3)=f(t)-f(t-1)-f(t-2)+f(t-3)$

2.14

根据$h(t)$定义有：

$h'(t)+2h(t)=\sigma'(t)-\sigma(t)$

$h'(0_-)=h(0_-)=0$

先求出$h'(0_+)$，令：

$h'(t)=a\sigma'(t)+b\sigma(t)+r_1(t)$

$h(t)=a\sigma(t)+r_2(t)$

故$\begin{cases} a=1 \\ b=-2 \end{cases}$，对$h'(t)$从 0-到 0+求积分

$$h(0_+)-h(0_-)=b$$

故$h(0_+)=b=-2$

当 t>0 时有$h'^{(t)}+2h(t)=0$，微分方程的特征根为-2

故系统的冲激响应为：$h(t)=C_1e^{-2t}$

带入初始条件$h(0_+)=-2$，得出$C_1=-2$

$$故冲激响应为：\mathrm{h}(t)=\sigma(t)-2e^{-2t}$$

阶跃响应为冲击响应的积分：$g(t)=\int_{-\infty}^{t}h(\tau)\,d\tau=\varepsilon(t)-2e^{-2t}$

2.17

(1)

$$y_{zs}(t)=\int_{-\infty}^{\infty}f_1(\tau)f_2(t-\tau)\,d\tau=\int_{-\infty}^{\infty}\tau\varepsilon(t)\varepsilon(t-\tau)\,d\tau=\int_0^t\tau\,d\tau=\frac{1}{2}\tau^2$$

(3)

$$y_{zs}(t)=\int_{-\infty}^{\infty}f_1(\tau)f_2(t-\tau)\,d\tau=\int_{-\infty}^{\infty}e^{-2\tau}\varepsilon(\tau)e^{-2(t-\tau)}\varepsilon(t-\tau)\,d\tau$$

$$=\int_{-\infty}^{\infty}e^{-2t}\varepsilon(\tau)\varepsilon(t-\tau)\,d\tau=\int_0^t e^{-2t}\,d\tau=te^{-2t}$$

(5)

$$y_{zs}(t)=\int_{-\infty}^{\infty}f_1(t-\tau)f_2(\tau)\,d\tau=\int_{-\infty}^{\infty}(t-\tau)\varepsilon(t-\tau)e^{-2\tau}\varepsilon(\tau)\,d\tau$$

$$=\int_0^t te^{-2\tau}\,d\tau-\int_0^t\tau e^{-2\tau}\,d\tau=-\frac{1}{2}te^{-2t}+-\frac{1}{2}te^{-2t}+\frac{1}{4}e^{-2t}=\frac{1}{4}e^{-2t}$$

(7)

$$y_{zs}(t)=\int_{-\infty}^{\infty}f_1(t-\tau)f_2(\tau)\,d\tau=\int_{-\infty}^{\infty}\sin(\pi\tau)\,\varepsilon(\tau)\,[\varepsilon(t-\tau)-\varepsilon(\tau)]d\tau$$

$$=\int_0^t\sin(\pi\tau)\,d\tau-\int_0^{t-4}\sin(\pi\tau)\,d\tau=\frac{1}{\pi}[\cos(\pi t)-\cos[\pi(t-4)]]$$

(9)

$$y_{zs}(t)=\int_{-\infty}^{\infty}f_1(\tau)f_2(t-\tau)\,d\tau=\int_{-\infty}^{\infty}\tau\varepsilon(\tau-1)\varepsilon(t-\tau+3)\,d\tau$$

$$=\int_1^{t+3}\tau\,d\tau=\frac{1}{2}t^2+3t+4$$