3.3. The given signal is

$$\begin{aligned} x(t) &= 2+\frac{1}{2}e^{j(2\pi/3)t}+\frac{1}{2}e^{-j(2\pi/3)t}-2je^{j(5\pi/3)t}+2je^{-j(5\pi/3)t} \\ &= 2+\frac{1}{2}e^{j2(2\pi/6)t}+\frac{1}{2}e^{-j2(2\pi/6)t}-2je^{j5(2\pi/6)t}+2je^{-j5(2\pi/6)t} \end{aligned}$$

From this, we may conclude that the fundamental frequency of $x(t)$ is $2\pi/6 = \pi/3$. The non-zero Fourier series coeffcients of $x(t)$ are:

$$a_0 = 2, \qquad a_2 = a_{-2} = \frac{1}{2}, \qquad a_5 = a_{-5}^* = -2j$$

3.21. Using the Fourier series synthesis eq. (3.38),

$$\begin{aligned} x(t) &= a_1 e^{j(2\pi/T)t}+a_{-1}e^{-j(2\pi/T)t}+a_5 e^{j5(2\pi/T)t}+a_{-5}e^{-j5(2\pi/T)t} \\ &= je^{j(2\pi/8)t}-je^{-j(2\pi/8)t}+2e^{j5(2\pi/8)t}+2e^{-j5(2\pi/8)t} \\ &= -2\sin(\frac{\pi}{4}t)+4\cos(\frac{5\pi}{4}t) \\ &= -2\cos(\frac{\pi}{4}t-\pi/2)+4\cos(\frac{5\pi}{4}t). \end{aligned}$$

3.22. (a) (i) $T=1$, $a_0=0$, $a_k=\frac{j(-1)^k}{k\pi}$, $k\neq 0$.

(ii) Here,

$$x(t)=\begin{cases} t+2, & -2<t<-1 \\ 1, & -1<t<1 \\ 2-t, & 1<t<2 \end{cases}$$

$T=6$, $a_0=1/2$, and

$$a_k=\begin{cases} 0, & k \text{ even} \\ \frac{6}{\pi^2k^2}\sin(\frac{\pi k}{2})\sin(\frac{\pi k}{6}), & k \text{ odd} \end{cases}$$

(iii) $T=3$, $a_0=1$, and

$$a_k=\frac{3j}{2\pi^2k^2}[e^{jk2\pi/3}\sin(k2\pi/3)+2e^{jk\pi/3}\sin(k\pi/3)], \qquad k\neq 0.$$

(iv) $T=2$, $a_0=-1/2$, $a_k=\frac{1}{2}-(-1)^k$, $k\neq 0$.

(v) $T=6$, $\omega_0=\pi/3$, and

$$a_k=\frac{\cos(2k\pi/3)-\cos(k\pi/3)}{jk\pi/3}.$$

Note that $a_0=0$ and $a_{k\ even}=0$.

(vi) $T=4$, $\omega_0=\pi/2$, $a_0=3/4$ and

$$a_k=\frac{e^{-jk\pi/2}\sin(k\pi/2)+e^{-jk\pi/4}\sin(k\pi/4)}{k\pi}, \qquad \forall k.$$

此处（f）答案明显错误，积分结果形式多样，请自行积分。

3.24. **(a)** We have

$$a_0=\frac{1}{2}\int_0^1 tdt+\frac{1}{2}\int_1^2(2-t)dt=1/2.$$

(b) The signal $g(t)=dx(t)/dt$ is as shown in Figure S3.24.

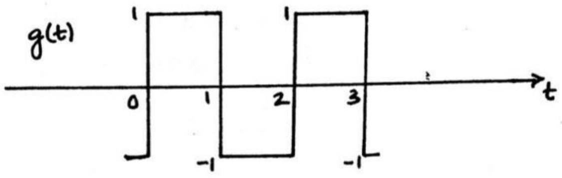

Figure S3.24

The FS coefficients b_k of $g(t)$ may be found as follows:

$$b_0=\frac{1}{2}\int_0^1 dt-\frac{1}{2}\int_1^2 dt=0$$

and

$$\begin{aligned} b_k &= \frac{1}{2}\int_0^1 e^{-j\pi kt}dt-\frac{1}{2}\int_1^2 e^{-j\pi kt}dt \\ &= \frac{1}{j\pi k}[1-e^{-j\pi k}]. \end{aligned}$$

(c) Note that

$$g(t)=\frac{dx(t)}{dt}\overset{FS}{\longleftrightarrow}b_k=jk\pi a_k.$$

Therefore,

$$a_k=\frac{1}{jk\pi}b_k=-\frac{1}{\pi^2k^2}\{1-e^{-j\pi k}\}.$$

3.25. **(a)** The nonzero FS coefficients of $x(t)$ are $a_1=a_{-1}=1/2$.

(b) The nonzero FS coefficients of $x(t)$ are $b_1=b_{-1}^*=1/2j$.

(c) Using the multiplication property, we know that

$$z(t)=x(t)y(t)\overset{FS}{\longleftrightarrow}c_k=\sum_{l=-\infty}^{\infty}a_lb_{k-l}.$$

Therefore,

$$c_k=a_k*b_k=\frac{1}{4j}\delta[k-2]-\frac{1}{4j}\delta[k+2].$$

This implies that the nonzero Fourier series coefficients of $z(t)$ are $c_2=c_{-2}^*=(1/4j)$.

(d) We have

$$z(t)=\sin(4t)\cos(4t)=\frac{1}{2}\sin(8t).$$

答案（d）有问题，这里应和（c）结论一样

Therefore, the nonzero Fourier series coefficients of $z(t)$ are $c_2=c_{-2}=(1/4j)$.