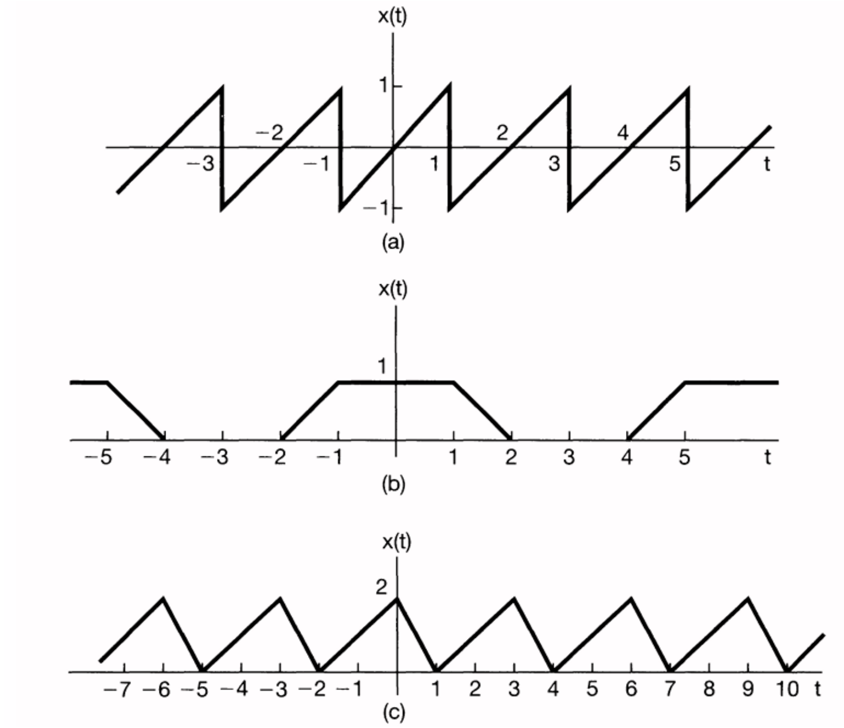
Tutorial 3 Questions

1. For the continuous-time periodic signal,
   $x(t) = 2 + \cos\left(\frac{2\pi}{3}t\right) + 4\sin\left(\frac{5\pi}{3}t\right)$, determine the fundamental frequency w_0 and the Fourier series coefficients a_k.

2. A continuous-time periodic signal x(t) is real valued and has a fundamental period T = 8. The nonzero Fourier series coefficients for x(t) are specified as $a_1 = a_{-1}^* = j$, $a_5 = a_{-5} = 2$. Express x(t) in the form
   $x(t) = \sum_{k=0}^{\infty} A_k \cos(w_k t + \emptyset_k)$

3. Determine the Fourier series representations for the following signals



4. Find the Fourier series representation of x(t) which is periodic with period 2, and $x(t) = e^{-t}$ for $-1 < t < 1$.

5. Find the Fourier series coefficients for the continuous time periodic signal with fundamental frequency $\Omega_0 = \pi$.

$$x(t) = \begin{cases} 1.5, & 0 \leq t < 1 \\ -1.5, & 1 \leq t < 2 \end{cases}$$

6. Consider the following continuous-time signals with a fundamental period of T = ½.

$$x(t) = \cos(4\pi t)$$
$$y(t) = \sin(4\pi t)$$

   a) calculate FS coefficient of x(t), y(t).
   b) calculate the FS Coefficient of z(t), where z(t) = x(t)*y(t)

7. Let x(t) be a periodic signal with fundamental period T and Fourier series coefficients a_k. Derive the Fourier series coefficients of each of the following signal in terms of a_k

$$\frac{d^2x(t)}{dt^2}$$

8. Calculate the Fourier transform of
   a) $e^{-2(t-1)}u(t-1)$
   b) $e^{-2|t-1|}$
   c) $\delta(t+1)+\delta(t-1)$
   d) $te^{-2t}u(t)$

9. Given that x(t) has the Fourier transform X(jw), express the Fourier transforms of the signals listed below in terms of X(jw). (Use properties)

   a) $x_1(t) = x(1 - t) + x(-1 - t)$
   b) $x_2(t) = x(3t - 6)$
   c) $x_3(t) = \frac{d^2(x-1)}{dt^2}$

10. Use the Fourier transform synthesis to determine the inverse Fourier transforms of:

   (a) $X_1(j\omega) = 2\pi\,\delta(\omega) + \pi\,\delta(\omega - 4\pi) + \pi\,\delta(\omega + 4\pi)$

   (b) $X_2(j\omega) = \begin{cases} 2, & 0 \le \omega \le 2 \\ -2, & -2 \le \omega < 0 \\ 0, & |\omega| > 2 \end{cases}$