1. Determine the Fourier Transform of the following signals. (solve 7/11 at least 2 discrete)
   i. \( x(t) = \frac{1}{1+t^2} \)
   ii. \( x(t) = \sum_{k=-\infty}^{\infty} \Pi(t-2k) \)
   iii. \( x(t) = t \ast \text{sinc}(t) \)
   iv. \( x(t) = \left[ \Pi\left(\frac{t}{2}\right) + \Pi(t) \right] \ast \Pi(t) \)
   v. \( x(t) = x(t) \) as shown below:

   ![Graph of a signal](image)

   vi. \( x(t) = e^{-a^2 t^2} \)
   vii. \( x(t) = e^{3|t|} \sin(2t) \)
   viii. \( x[n] = \left(\frac{1}{2}\right)^{|n|} u[-n-2] \)
   ix. \( x[n] = (2)^2 \sin\left(\frac{\pi}{4} n\right) u[-n] \)
   x. \( x[n] = (n-1) \left(\frac{1}{3}\right)^{|n|} \)
   xi. \( x[n] = \left(\frac{\sin\left(\frac{\pi n}{5}\right)}{\pi n}\right) \cos\left(\frac{n\pi}{7}\right) \)

2. Find the inverse Fourier Transform of the below functions. (solve 3/5 at least 1 discrete)
   i. \( X(jw) = \cos(w) \)
   ii. \( X(jw) = \frac{4j}{w} \sin^2(3w) \)
   iii. \( X(jw) = \frac{5(jw)+7}{(jw+4)((jw)^2+jw+1)} \)
   iv. \( X(e^{jw}) = \cos^2(w) + \sin^2(3w) \)
   v. \( X(e^{jw}) = \frac{(1-\frac{1}{2}e^{jw})}{1-\frac{1}{4}e^{jw}-\frac{1}{8}e^{-jw}} \)
3. Let \( x(t) \) have the Fourier Transform \( X(jw) \), and let \( p(t) \) be periodic with fundamental frequency \( w_0 \) and Fourier series representation

\[
p(t) = \sum_{n=-\infty}^{+\infty} a_n e^{jnwt}
\]

Determine expression for the Fourier Transform of \( y(t) = x(t)p(t) \).

4. By using Fourier Transform properties, evaluate the following integrals. (solve 1/2)
   i. \( \int_{-\infty}^{+\infty} \text{sinc}^2(t)dt \)
   ii. \( \int_{0}^{+\infty} e^{-at}\cos(\beta t) dt \)

5. Consider a system with an impulse response \( h(t) \). What would be the output of this system to the input signal \( x(t) \)?

\[
x(t) = \cos(2\pi t) + \sin(6\pi t) \quad h(t) = \frac{\sin(4\pi t)\cos(8\pi t)}{\pi t}
\]

6. Suppose \( H(e^{jw}) \) is a band-pass filter, where on \([-\pi, \pi]\)

\[
H(e^{jw}) = \begin{cases} 
1, & \frac{\pi}{4} \leq |w| \leq \frac{3\pi}{4} \\
0, & \text{otherwise}
\end{cases}
\]

Suppose the following inputs, determine the output of the above filter. (solve 2/3)
   i. \( x[n] = (-1)^n \)
   ii. \( x[n] = 2 + \cos\left(\frac{5\pi n}{8} - \frac{\pi}{8}\right) \)
   iii. \( \sum_{k=-\infty}^{+\infty} \left(\frac{1}{2}\right)^{n-4k} u[n - 4k] \)

7. Let \( x[n] \) be a signal with Fourier Transform \( X(e^{jw}) \), we are given the following information:
   i. \( x[n] > 0 \)
   ii. \( x[n] = 0 \quad n > 0 \)
   iii. \( \frac{1}{2\pi} \int_{-\pi}^{+\pi} |X(e^{jw})|^2 \, dw = 3 \)
   iv. \( \text{Im}[X(e^{jw})] = \sin(w) - \sin(2w) \)

Find closed-form expression for \( x[n] \).