1. Using the definition of the Fourier integral, determine the Fourier Transform of the following signals

(a) \( x(t) = \begin{cases} 1 - t^2 & -1 < t < 1 \\ 0 & \text{else} \end{cases} \)

(b) \( x(t) = \begin{cases} \cos(\frac{\pi}{2} t) & -1 < t < 1 \\ 0 & \text{else} \end{cases} \)

(c) \( x(t) = e^{-t^2} \)

(d) \( x(t) = e^{-t^2} \)

2. Using the definition of the Fourier integral, determine the Inverse Fourier Transform of the following frequency spectra

(a) \( X(\omega) = e^{-\omega^2} \)

(b) \( X(\omega) = 1 + j\omega \)

3. Using Table 7.1 and 7.2 determine the Fourier Transform of the following signals

(a) \( x_a(t) = 2 + 2 \cos(2\pi t) \)

(b) \( x(t) = \frac{1}{2} x_a(2t - 1) \)

4. Using Table 7.1 and 7.2 determine the Inverse Fourier Transform of the following frequency spectra

(a) \( X(\omega) = \frac{1 + j\omega}{5 - \omega^2 + j2\omega} \) (Hint: Row 16)
(b) \( X(\omega) = u(\omega) \)

5. For both the low-pass and high-pass circuit below, where \( R = 2 \) and \( C = \frac{1}{2} \)

(a) Determine the frequency response

(b) Determine the frequency spectra of the output signal due to a pulse input defined as

\[
x(t) = \frac{1}{\tau} \Pi \left[ \frac{t}{\tau} \right]
\]

Note: \( \Pi \) is the gate function, also known as the rect function.

(c) Compare the previous result as \( \tau \to 0 \) to the Fourier Transform of the impulse response, specifically how are they similar or different and why?