1. Consider the cascade interconnection of two LTI systems shown below:

\[ x[n] \xrightarrow{h_1[n]} h_1[n] \xrightarrow{h_2[n]} y[n] \]

The impulse response of system 1 is

\[ h_1[n] = u[n] - u[n-2] \]

The impulse response of system 2 is

\[ h_2[n] = \frac{1}{2} \delta[n] - \delta[n-1] + \delta[n-2] - \frac{1}{2} \delta[n-3] \]

Find the overall impulse response of the system; i.e., find \( y[n] \) when \( x[n] = \delta[n] \).
2. Consider the signal

\[ x(t) = 3 \cos(t) + 5 \sin(5t - \frac{\pi}{6}) - 2 \cos(8t - \frac{\pi}{3}) \]

(a) What is the period of \( x(t) \)

(b) What is the fundamental frequency of \( x(t) \)

(c) Write the exponential Fourier series for \( x(t) \).
3. Compute the Fourier transforms of the following signals. Note: You should not have to do any integrals.

(a) \[ x(t) = t e^{-2t} \cos(4t) u(t) \]

(b) \[ x(t) = \begin{cases} 
1 + \cos(\pi t) & |t| < 1 \\
0 & \text{otherwise}
\end{cases} \]
4. Below are some continuous-time signals. Answer the questions about the Fourier transforms of the signals. Be sure to explain your answers.

(a) 

\[ x(t) = \begin{cases} 
-2 & \text{for } -2 \leq t < -1 \\
1 & \text{for } -1 \leq t < 1 \\
 initial condition & \text{for } 1 \leq t \leq 2 
\end{cases} \]

i. Is \( X(\omega) \) real?

ii. Is \( X(\omega) \) imaginary?

iii. Is \( \int_{-\infty}^{\infty} X(\omega) \, d\omega \) equal to zero?

iv. Is \( X(\omega) \) periodic?

(b) \( x(t) = \delta(t - 2) \)

i. Is \( X(\omega) \) real?

ii. Is \( X(\omega) \) imaginary?

iii. Is \( \int_{-\infty}^{\infty} X(\omega) \, d\omega \) equal to zero?

iv. Is \( X(\omega) \) periodic?
(c)

i. Is $X(\omega)$ real?

ii. Is $X(\omega)$ imaginary?

iii. Is $\int_{-\infty}^{\infty} X(\omega) \, d\omega$ equal to zero?

iv. Is $X(\omega)$ periodic?