## Exercise 6.25

**L Answer.**

A LTI system with input $x$, output $y$, and impulse response $h$ is characterized by the equation

$$y(t) = x * h(t).$$

take FT

In the Fourier domain, the preceding equation is equivalent to

$$Y(\omega) = X(\omega)H(\omega).$$

$H(\omega) = 0$ for all $|\omega| > B$

Since the system bandwidth is $B$ (i.e., $H(\omega) = 0$ for all $|\omega| > B$), we have

$$Y(\omega) = \begin{cases} X(\omega)H(\omega) & |\omega| \leq B \\ 0 & \text{otherwise.} \end{cases}$$

consider case $|\omega| > B$

In other words, the output spectrum $Y$ is guaranteed to satisfy

$$Y(\omega) = 0 \quad \text{for } |\omega| > B.$$

Thus, if the input spectrum $X$ contains information at frequencies in the range $[-B, B]$, this information will be completely eliminated in the output spectrum $Y$ and, therefore, irrecoverably lost. For this reason, it is not possible to (reliably) transmit, over a communication channel with bandwidth $B$, a signal $x$ with bandwidth greater than $B$.

 