Combined Operators

- If given \( x(at-b) \) and if \( a \) is negative we can follow either of the two following procedures:
  
  - Time-Shift \( x(t) \) by \( b \) to obtain \( x(t-b) \) and time scale the shifted signal \( x(t-b) \) by \( a \) to get \( x(at-b) \)
  
  - Time-scale \( x(t) \) by \( a \) to obtain \( x(a \cdot (t-b/a)) \) and shift \( x(at) \) by \( b/a \) to obtain \( x(a(t-b/a)) = x(at-b) \)
Periodic Signals

- A periodic continuous –time signal has the property
  \[ x(t) = x(t+T) \]
  - It is unchanged by the time shift of \( T \) and it is said that \( x(t) \) is periodic with a period \( T \)
  - Fundamental Period of \( x(t) \): smallest positive value of \( T \) for which
    \[ x(t) = x(t+T) \]

- Discrete-time periodic signals are defined similarly as
  \[ x[n] = x[n+N] \]
Even and Odd Signals

- A signal $x(t)$ or $x[n]$ is referred to as an Even signal if it is equal to its time-reversed counterpart.
  
  $$x(-t) = x(t) \text{ or } x[-n] = x[n]$$

- A Signal is called an Odd signal if
  
  $$x(-t) = -x(t) \text{ or } x[-n] = -x[n]$$
Even and Odd Signals

- Any signal can be broken down into a sum of two signals, even and odd:

\[ Ev\{x(t)\} = \frac{1}{2}[x(t) + x(-t)] \]

\[ Od\{x(t)\} = \frac{1}{2}[x(t) - x(-t)] \]