

Notes for Signals and Systems

1.5 Symmetry-Based Classifications of Signals

A signal $x(t)$ is called an *even signal* if $x(-t) = x(t)$ for all t . If $x(-t) = -x(t)$, for all t , then $x(t)$ is called an *odd signal*.

The *even part* of a signal $x(t)$ is defined as

$$x_{ev}(t) = \frac{x(t) + x(-t)}{2}$$

and the *odd part* of $x(t)$ is

$$x_{od}(t) = \frac{x(t) - x(-t)}{2}$$

The even part of a signal is an even signal, since

$$x_{ev}(-t) = \frac{x(-t) + x(t)}{2} = x_{ev}(t)$$

and a similar calculation shows that the odd part of a signal is an odd signal. Also, for any signal $x(t)$ we can write a decomposition as

$$x(t) = x_{ev}(t) + x_{od}(t)$$

These concepts are most useful for real signals. For complex-valued signals, a symmetry concept that sometimes arises is *conjugate symmetry*, characterized by

$$x(t) = x^*(-t)$$

where superscript star denotes complex conjugate.