

Answers

1. $g(x) = \text{autocorrelation of } f(x)$. Nonlinear (consider $2 f(x)$), Time-Variant (lose phase information).
2. $g(x) = f(-x)$. Linear, Time-Variant (shift input one way, output shifts the other way).
3. Linear, Time-Invariant. $H(s) = j2\pi s e^{-i2\pi s}$
4. Linear, Time-Invariant. $g(x) = f(x) * \text{comb}(x)$. $H(s) = \text{comb}(s)$.
5. Linear (all elements linear), Time-Variant (If input shifted, linear phase in s-domain that should result does not because of replication islands that are not filtered out. Also, interpolation filter does linear interpolation. So consider a slightly shifted version of the input. The piecewise linear output cannot be a shifted version of the original piecewise linear output. Note that if the interpolation filter is a sinc interpolator of appropriate bandwidth, the system is LTI).
6. Linear, Time-Invariant. $g(x) = f(x) * \text{step}(x)$. $H(s) = 1/2 \delta(s) - i/2\pi s$.