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The input signal to the LTI system is given as $x(t)$, with FS coefficients a_k. The impulse response of the LTI system is $H(w)$.

In frequency domain, the FS coefficients of the input signal are represented as impulses with an amplitude a_k. Now by the properties of convolution, the output signals has F.S coefficients $a_k(H(kw_0))$.

The periodicity of the output signal is independent of the nature of both $x(t)$ and $h(t)$. Cases where both $x(t)$ and $h(t)$ being nonperiodic and $y(t)$ (the output signal) being periodic also exist.