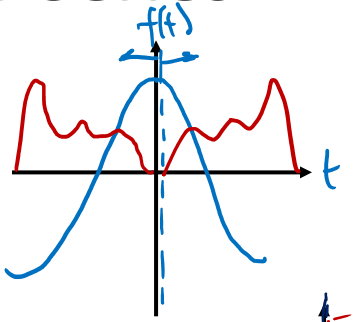
Symmetry in Fourier Series

Even functions

$f(t) = f(-t)$

Typo in the book in table 17.1

$b_n = 0$

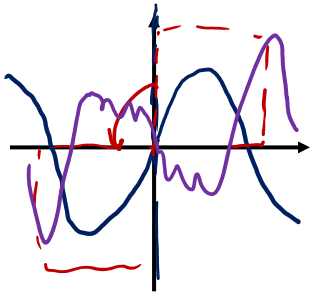


All apply with the DC component removed

Odd functions

$f(t) = -f(-t)$

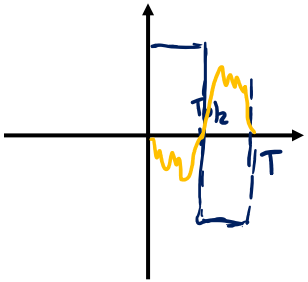
$a_n = 0$



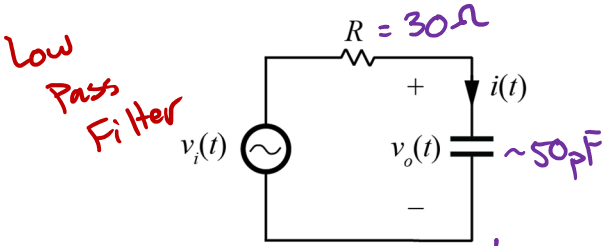
Half-wave symmetric functions

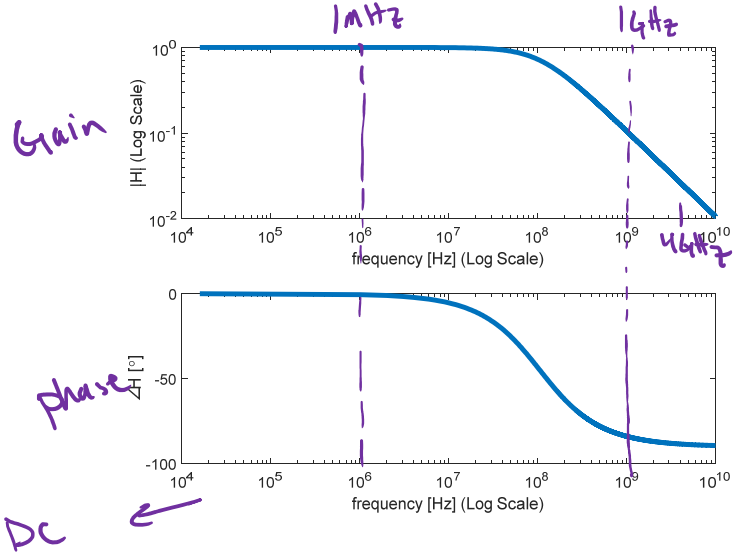
$f(t + \frac{T_0}{2}) = \pm f(t)$

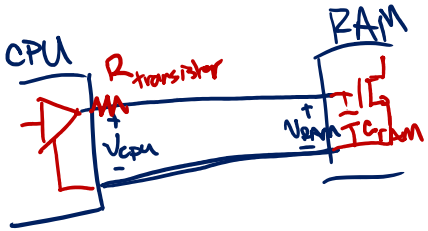
$a_n,\ b_n = 0$ for even n

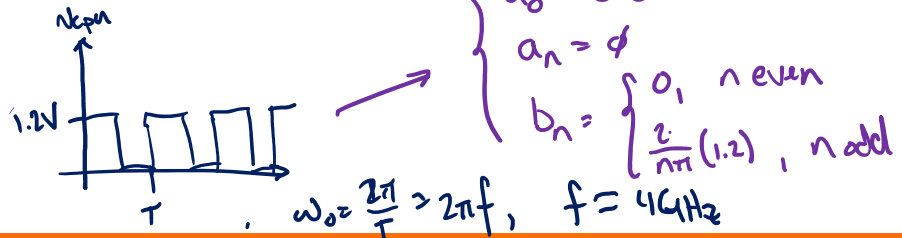


Application: Digital Communication

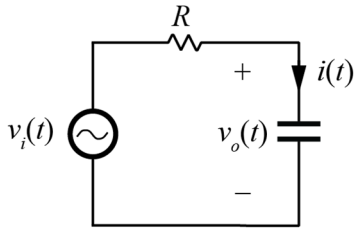


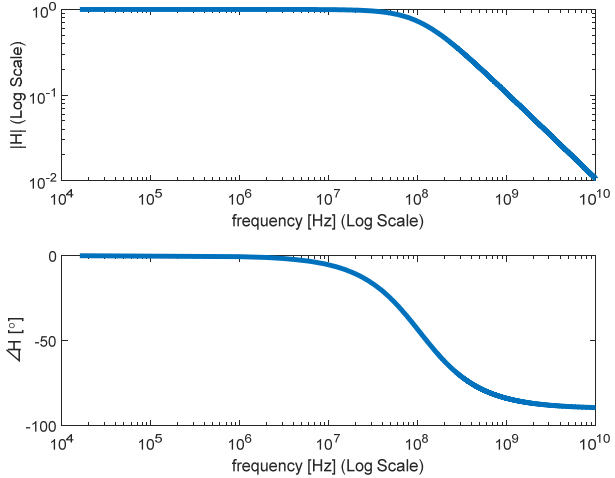




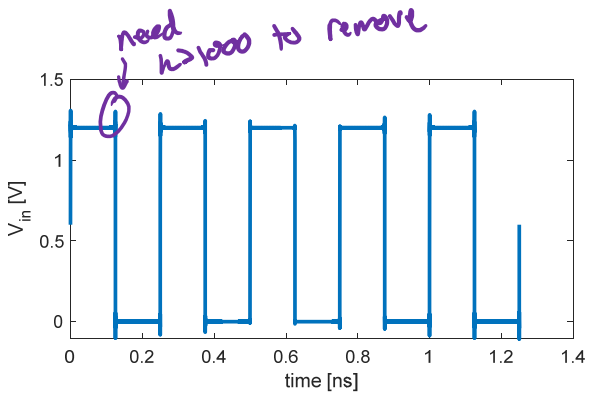


Application: Digital Communication





Applying Superposition



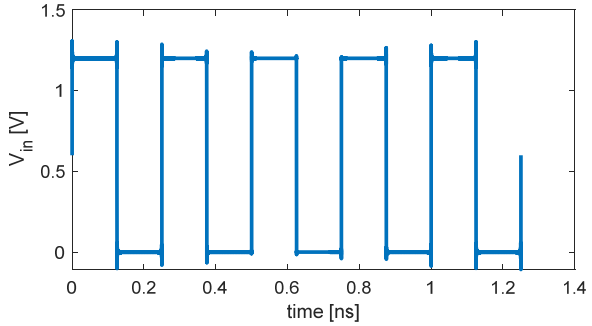
$v_i(t) = f(t) = a_0 + \sum_{k=1,3,5\ldots}^{\infty} b_k \sin(k\omega_0 t)$

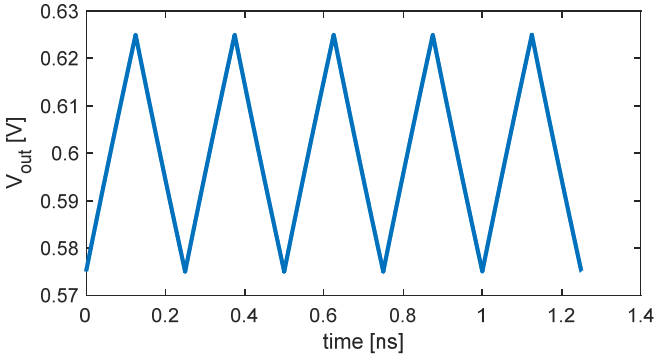
← first 1000 indices of summation

$H(j\omega) = \frac{1}{1 - j\omega RC}$

$v_o(t) = a_0 |H(j\omega \to 0)| + \sum_{k=1}^{\infty} |H(jk\omega_0)| b_k \sin(k\omega_0 t - \angle H(jk\omega_0))$

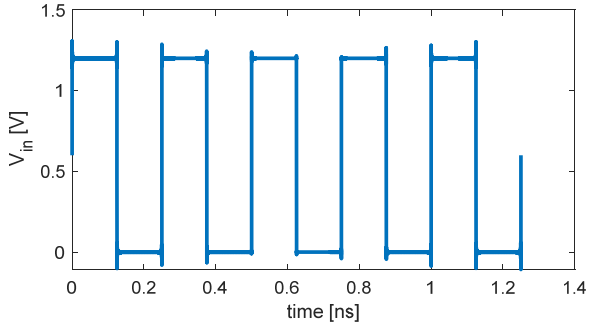
Calculated Output Voltage

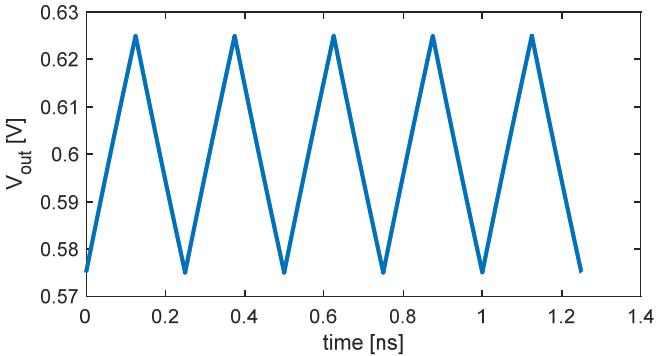


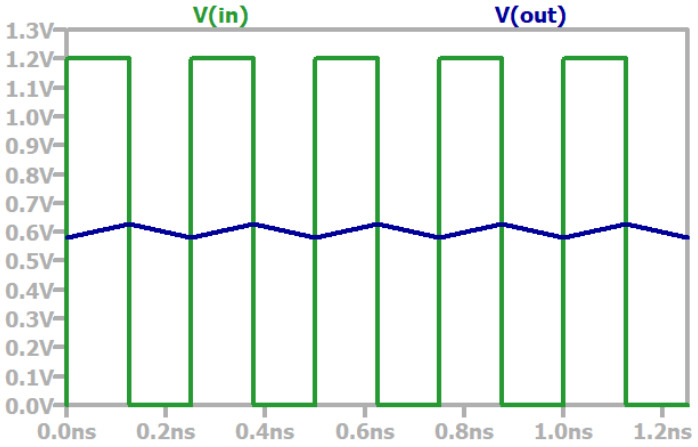


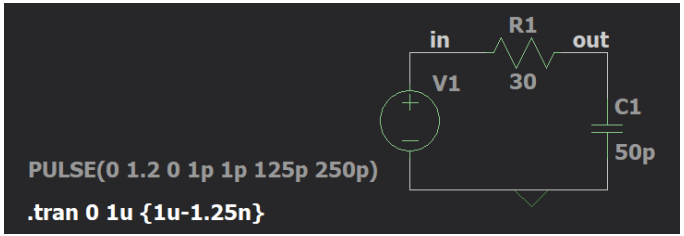
← Vout(t) (first 1000 terms)

Simulation Verification

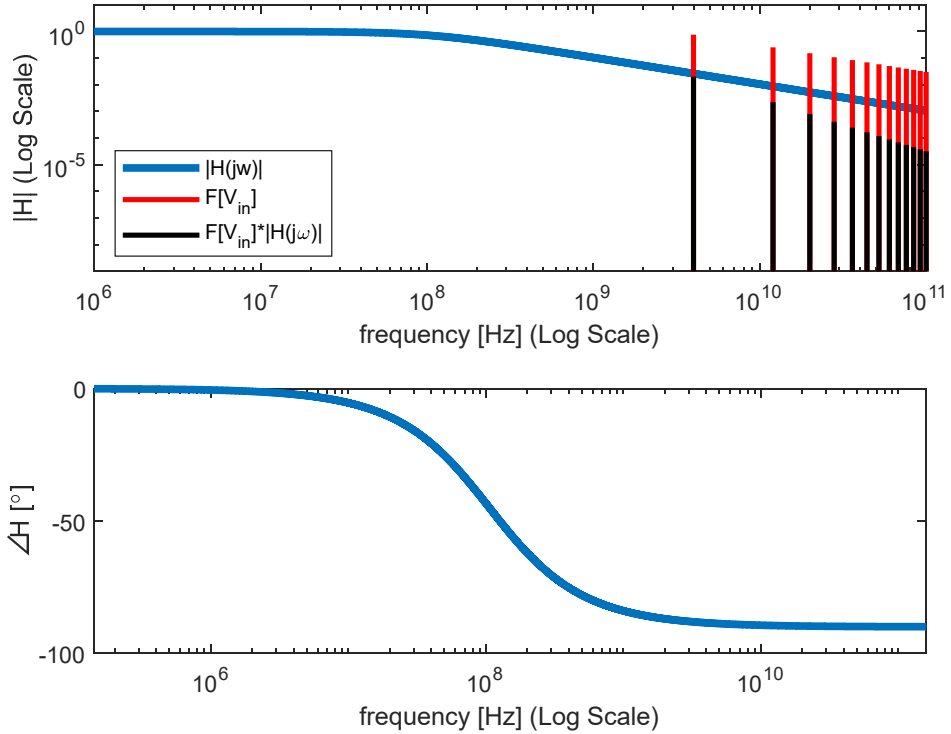


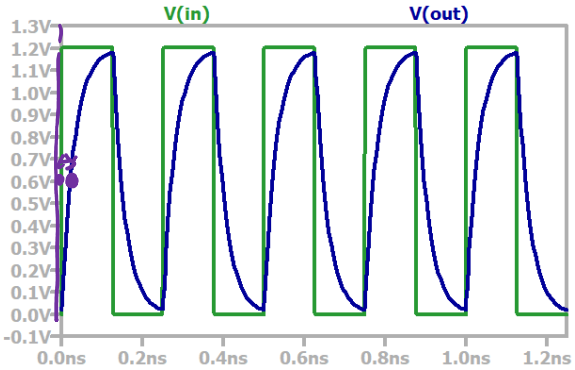


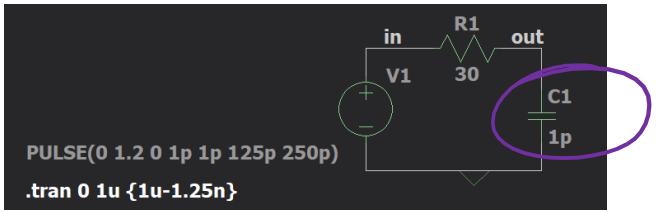




Frequency Domain Interpretation




V(in)
V(out)
1.3V
1.2V
1.1V
1.0V
0.9V
0.8V
0.7V
0.6V
0.5V
0.4V
0.3V
0.2V
0.1V
0.0V
-0.1V
0.0ns
0.2ns
0.4ns
0.6ns
0.8ns
1.0ns
1.2ns


in
R1
out
V1
30
C1
1p
PULSE(0 1.2 0 1p 1p 125p 250p)
.tran 0 1u {1u-1.25n}