1 | Local Chapter Name

1.1 Simple TikZ and PGFplots Examples

This section demonstrates some simple TikZ and PGFplots examples, feel free to reference this code during the challenges at the end of this workshop :)

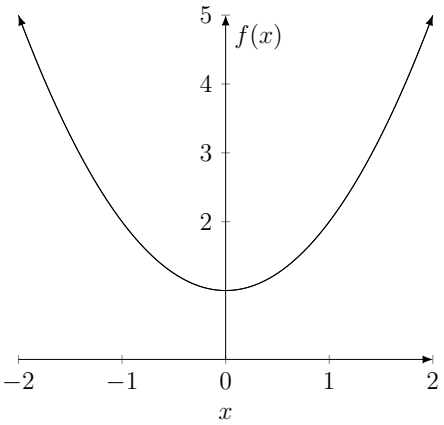

Figure 1.1: Plot of $f(x) = x^2 + 1$

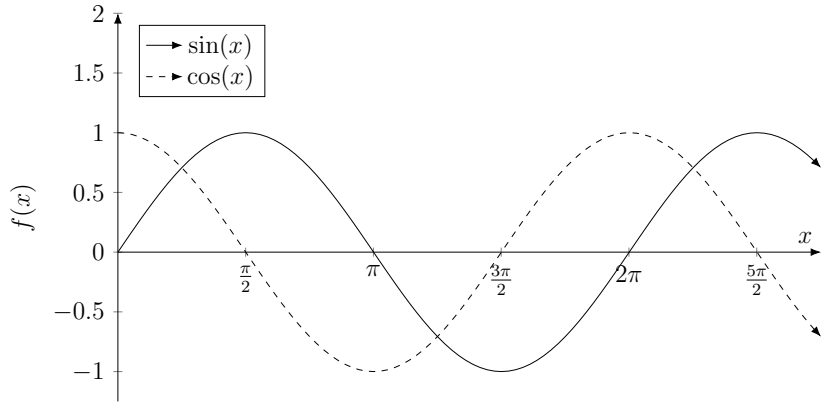

Figure 1.2: Sine and Cosine Functions

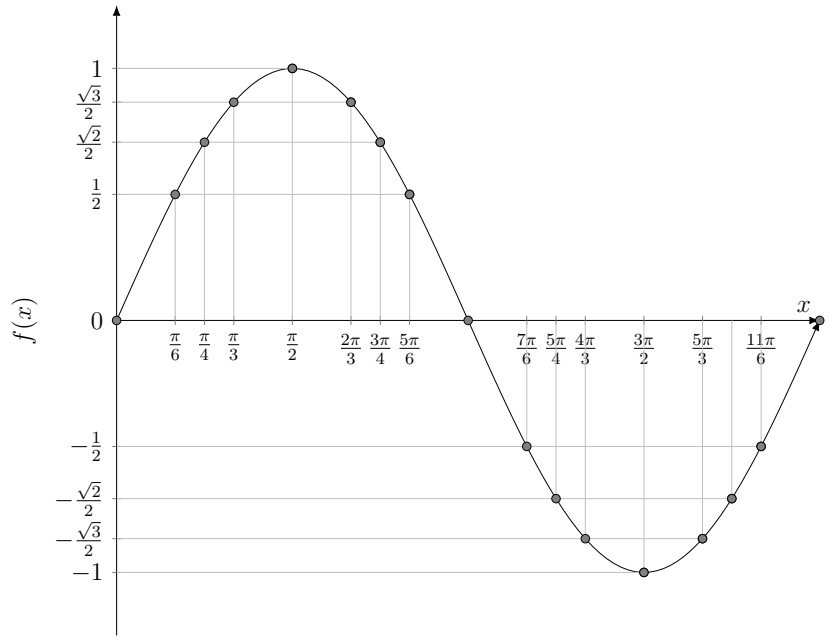

Figure 1.3: Sine Common Values

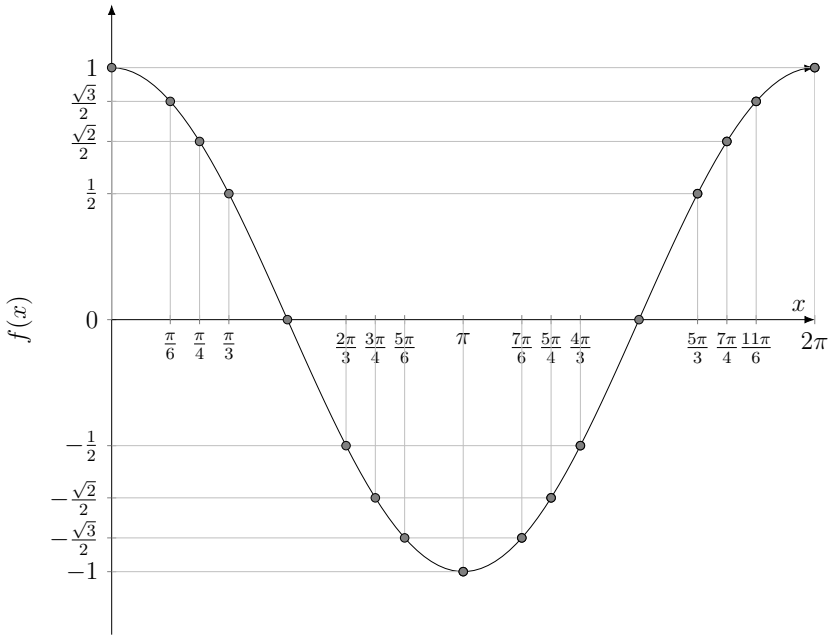

Figure 1.4: Cosine Common Values

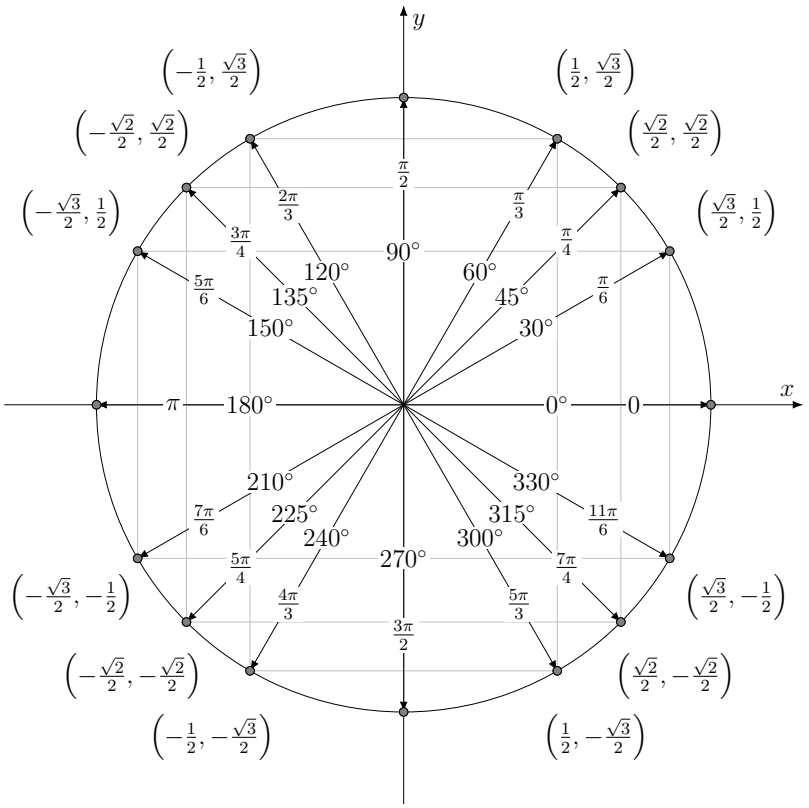

Figure 1.5: The Unit Circle

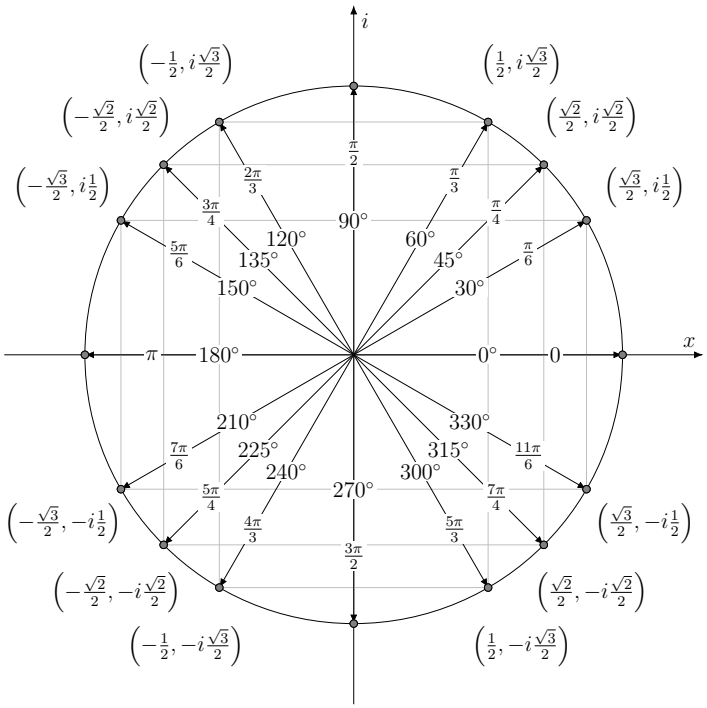

Figure 1.6: The Complex Unit Circle

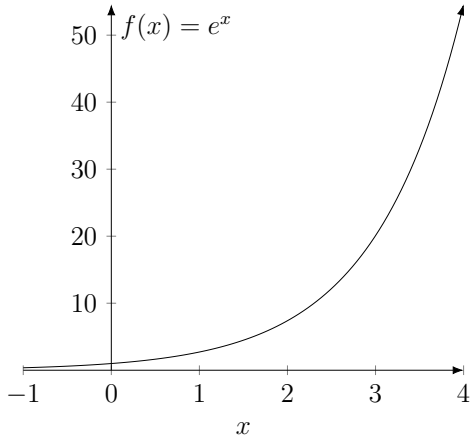

Figure 1.7: Exponential Growth

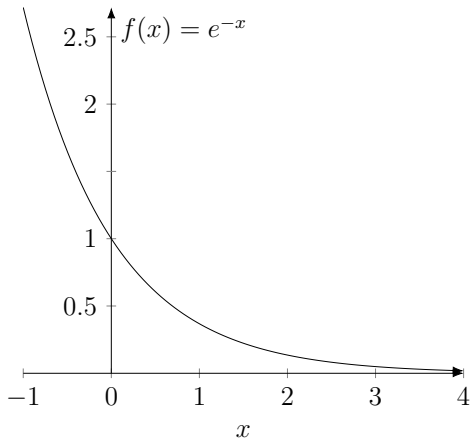

Figure 1.8: Exponential Decay

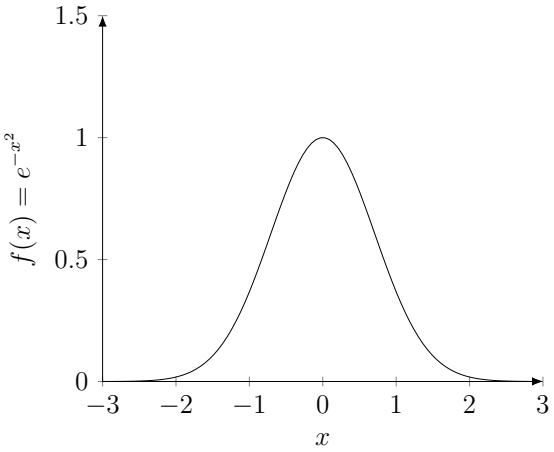

Figure 1.9: Pure Gaussian Function

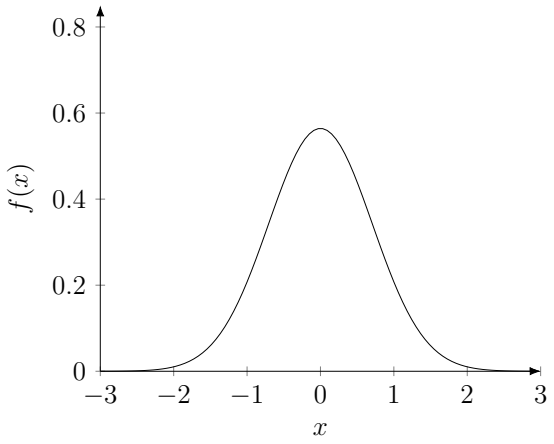

Figure 1.10: Normalized Gaussian Function

1.2 Envelope Detector Examples

Note: All figures for this section are found in Figures/Envelope_Detector

Realistic Circuit: Below is a simple "Envelope Detector" circuit, Figure "Envelope_Circuit_1". This circuit was simulated in PSpice, resulting in the plots below. These plots import from the tables in the "Data" folder for Circuit 1.

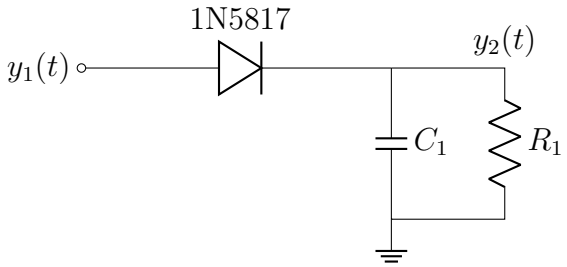

Figure 1.11: Ideal Envelope Detector Circuit

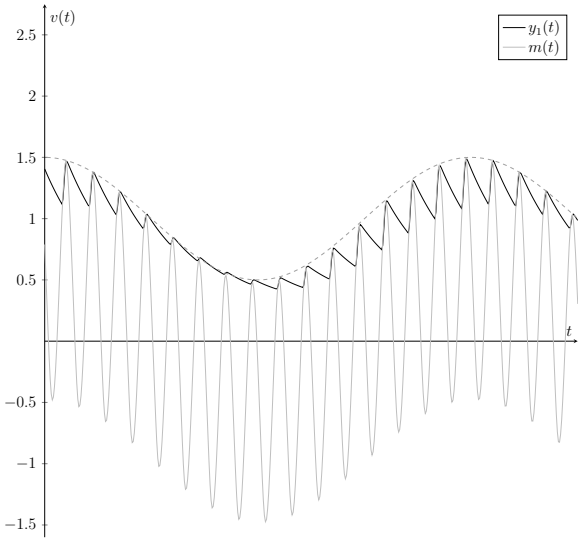

Figure 1.12: Ideal Circuit: $y_1(t)$ vs $y_2(t)$ with $V_F = 0$V

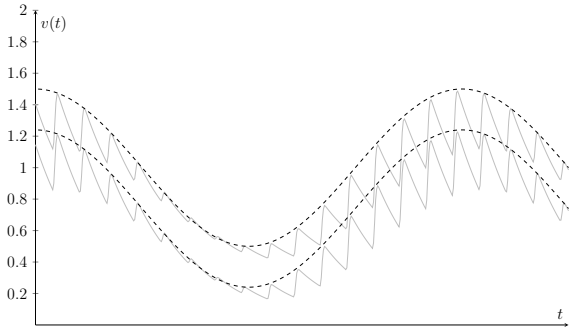

Figure 1.13: Ideal Circuit: Loss from Diode

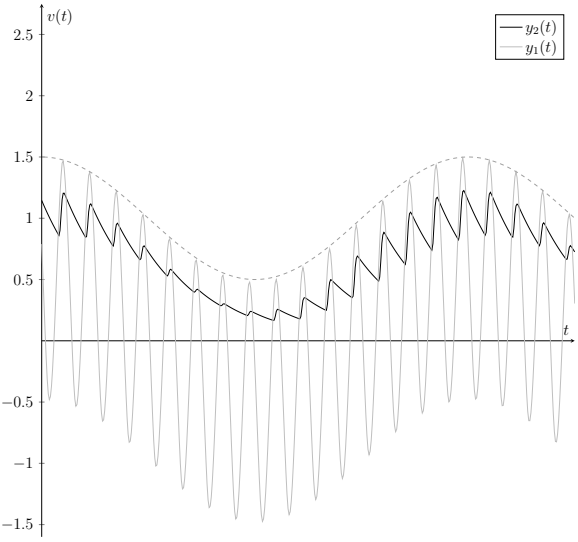

Figure 1.14: Ideal Circuit: $y_1(t)$ vs $y_2(t)$ with with $V_F = 0.26\text{V}$

Realistic Circuit: A more practical circuit is shown below in Figure **??**, and the same circuit with a 'UA741 Op-Amp Adder Circuit' added to the left is shown in Figure **??**. The adder circuit creates and AM signal with message $m(t)$ and carrier $c(t)$, and the circuit shown in Figure **??** approximately recovers $m(t)$. Circuit 3 was simulated in PSpice, and similarly with Circuit 1, the resulting plots are shown below. These examples pull from the other data file, exported from PSpice.

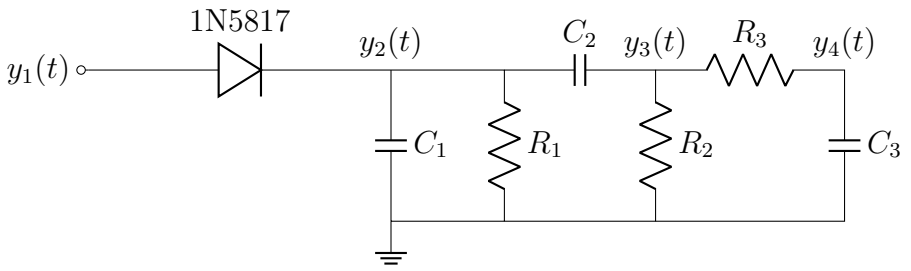

Figure 1.15: Practical Envelope Detector Circuit

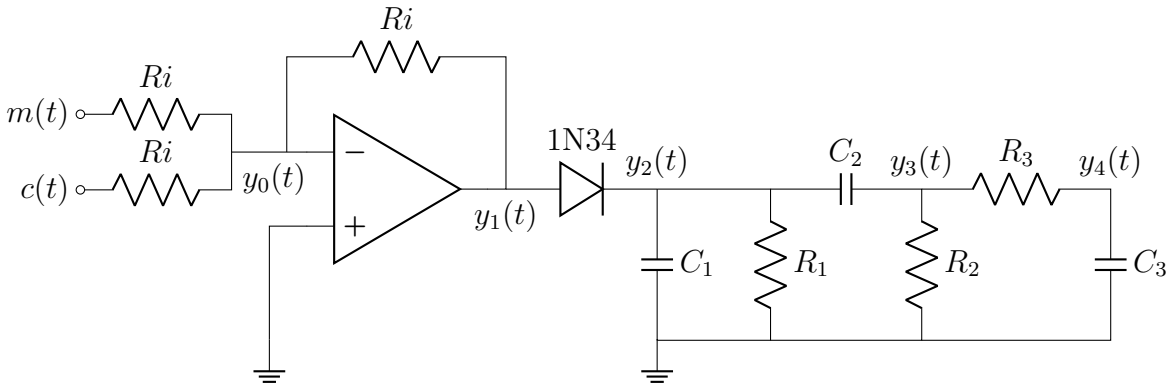

Figure 1.16: Complete Envelope Detector Circuit

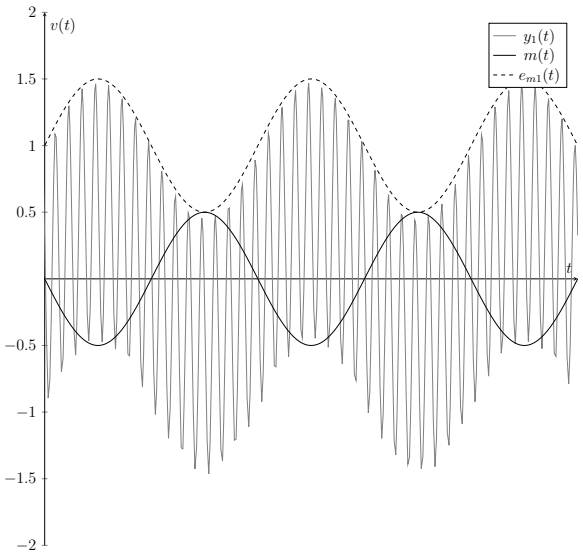

Figure 1.17: Envelope Detector: $y_0(t)$ vs $y_1(t)$

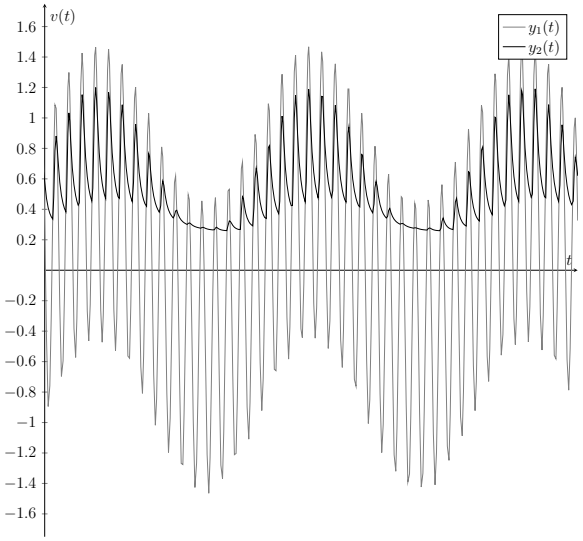

Figure 1.18: Envelope Detector: $y_1(t)$ vs $y_2(t)$

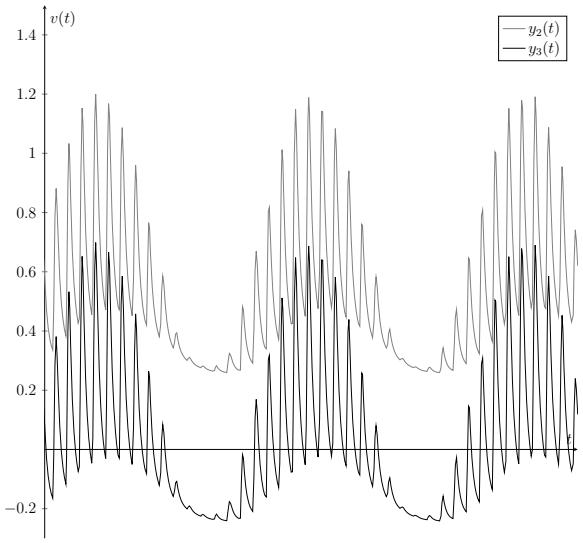

Figure 1.19: Envelope Detector: $y_2(t)$ vs $y_3(t)$

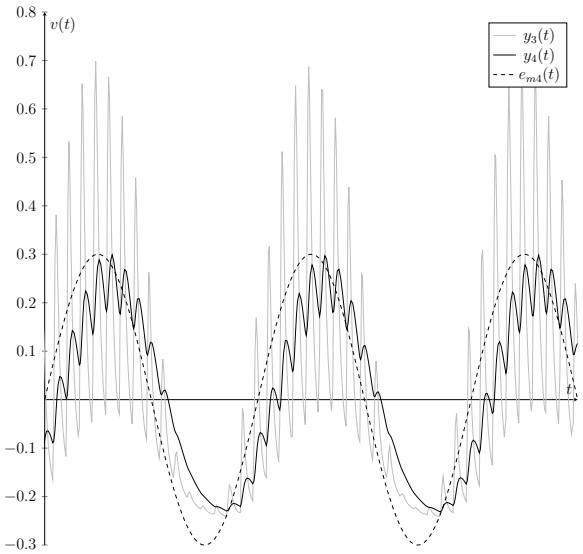

Figure 1.20: Envelope Detector: $y_3(t)$ vs $y_4(t)$

1.3 Low-Pass Filter Response Harmonic Reconstruction

Below a simple RC-Low-Pass Filter circuit is shown, along with it's input $v_i(t)$. The math needed to exactly construct its output is dealt with in the figure file(s).

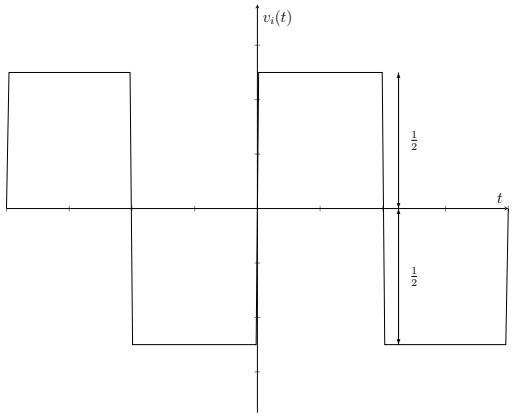

Figure 1.21: Input Signal $v_i(t)$

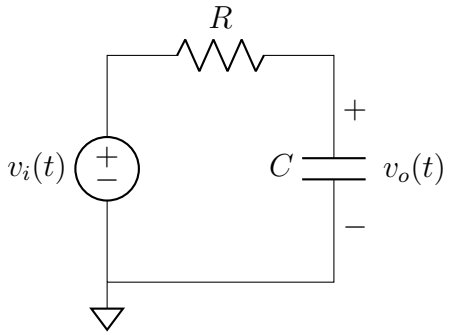

Figure 1.22: Time Domain Low-Pass Filter Circuit

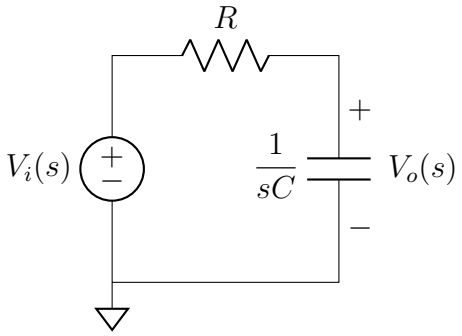

Figure 1.23: Laplace Domain Low-Pass Filter Circuit

The reconstruction plot takes a while to render, it has been commented out! Feel free to add it back in, and change the parameters. It will appear below :)

1.4 Self Guided Challenges

Using the example figures from the last three sections as a guide, feel free to attempt to replicate these figures. These (like the example figures) are all from my homework, and as such I know for a fact they are all doable using the same methods as before. For the last example you may need to consult the CircuitTikZ documentation.

Challenge 1: The provided image is an example of sampling a sinusoidal signal with a sampling period 1/T. The sampling function $p(t)$ has a duty cycle $d = 0.25$ and a height $h = 1$. Make the amplitude and frequency of the sinusoidal function parameterized so they can be changed if needed.

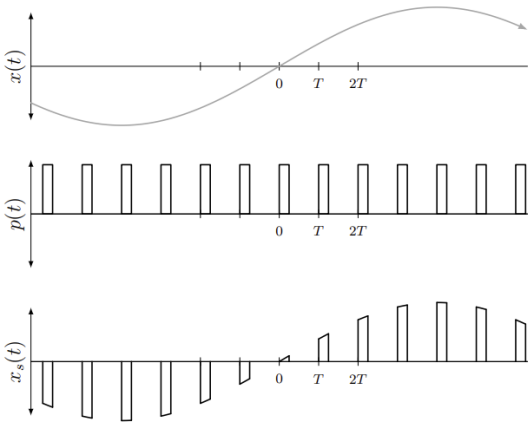

Figure 1.24: Challenge Prompt 1

Figure 1.25: Replication of Prompt 1

Challenge 2: The provided image is a circuit I took from one of my Communication Systems lab reports. It can take a sampled circuit like the one above, and render a DSB-SC AM signal from it. Replicate this schematic below.

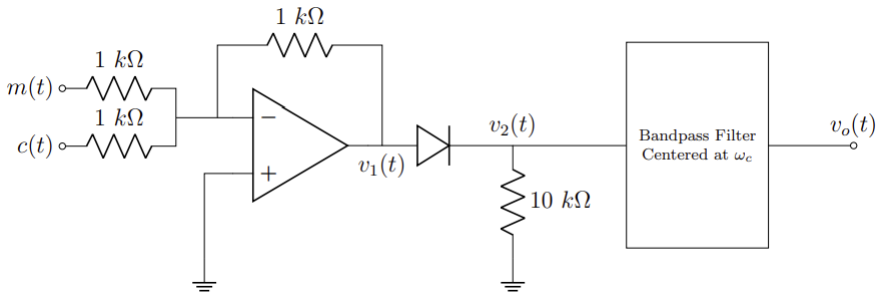

Figure 1.26: Challenge Prompt

Figure 1.27: Replication of Prompt 2

Challenge 3: The provided image comes from a homework problem assigned in the elective class 1Intro to Photonics'. The provided image in the assignment was rather low resolution like the one given, so I replicated it in LaTeXfor my submission (because why not?). Replicate this figure below:

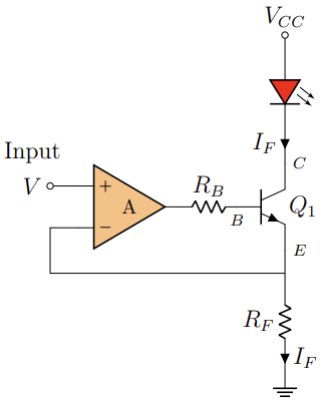

Figure 1.28: Challenge Prompt 3

Figure 1.29: Replication of Prompt 3