Prelab Report

Group8: Muhan Li, Man Sun, Mingxiao An

I. Prelab#1

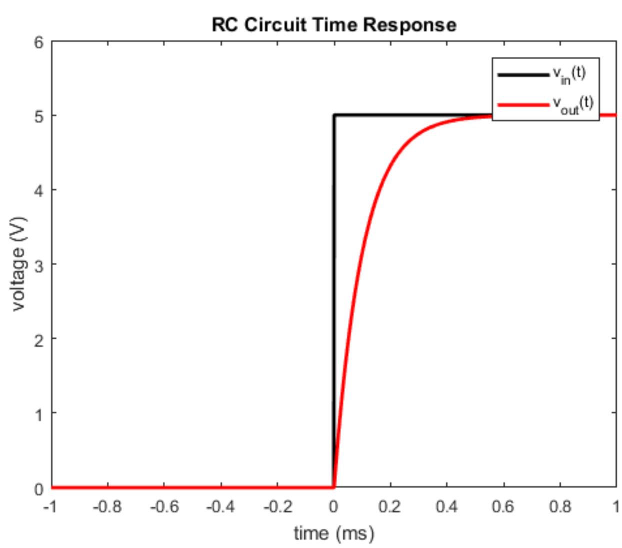
$$C\frac{\mathrm{d}v_{out}}{\mathrm{d}t} = I = \frac{v_{in} - v_{out}}{R} \tag{1}$$

$$v_{out} + RC\frac{\mathrm{d}v_{out}}{\mathrm{d}t} = v_{in} \tag{2}$$

II. Prelab#2

$$v_{out}(t) = -V_0 \mathrm{e}^{-\frac{t}{RC}} + V_0 \tag{3}$$

III. Prelab#3

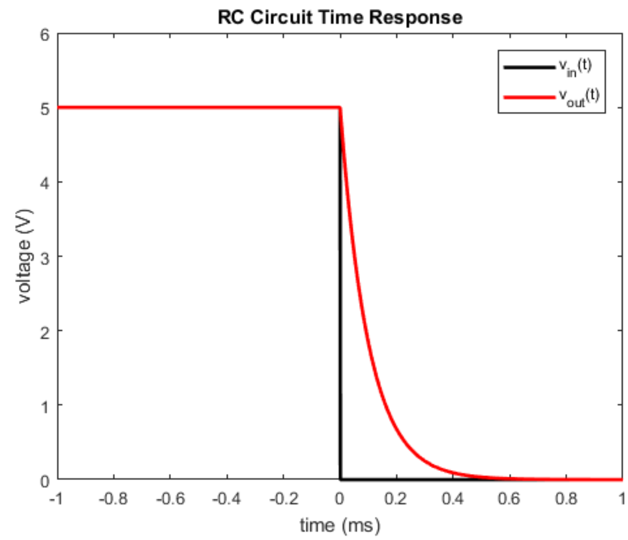


IV. Prelab#4

$$v_{out}(0) = V_0 \tag{4}$$

$$v_{out}(t) = V_0 \mathrm{e}^{-\frac{t}{RC}} \tag{5}$$

V. Prelab#5



VI. Prelab#6

a) Time Constant: $\tau = RC$

b) Rise Time:

10%-point: $\mathrm{e}^{-\frac{t}{RC}} = 0.9, t = 0.1RC$;
90%-point: $\mathrm{e}^{-\frac{t}{RC}} = 0.1, t = 2.3RC$;
rise time is $2.3RC - 0.1RC = 2.2RC$

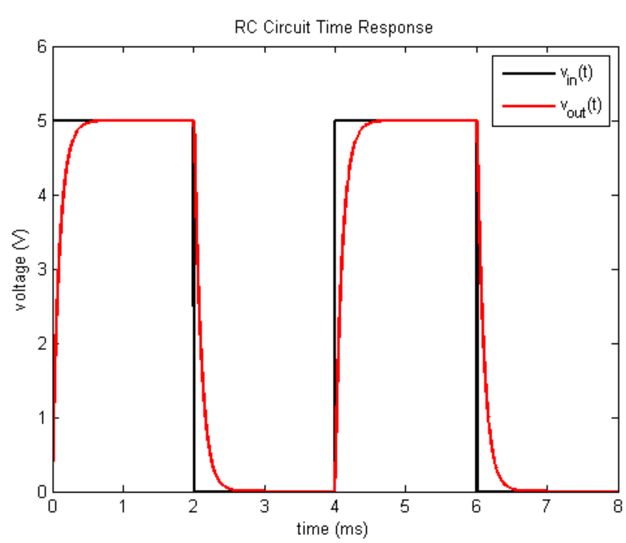
c) Fall Time:

90%-point: $\mathrm{e}^{-\frac{t}{RC}} = 0.9, t = 0.1RC$;
10%-point: $\mathrm{e}^{-\frac{t}{RC}} = 0.1, t = 2.3RC$;
fall time is $2.3RC - 0.1RC = 2.2RC$

d) Delay Time:

90%-point: $\mathrm{e}^{-\frac{t}{RC}} = 0.5, t = 0.69RC$;
delay time is $0.69RC$ for both R and C

VII. Prelab#7



VIII. PRELAB#8

a) Figure 3.1.1: $\tau = RC$

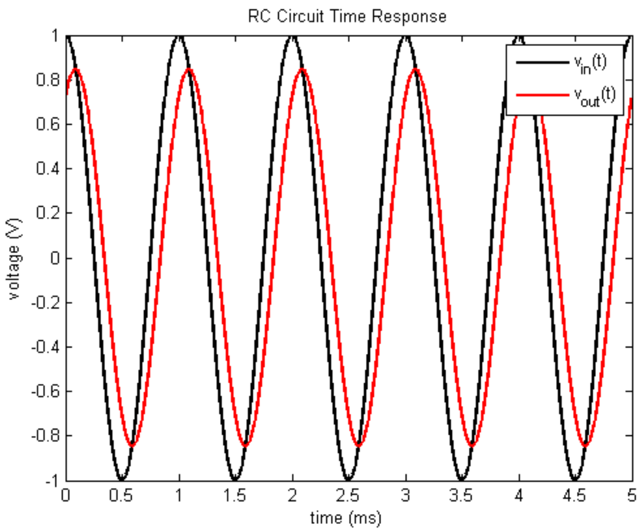
b) Figure 3.1.2: $\tau = R_1(C_1 + C_2) + R_2C_2 = 3RC$

c) Figure 3.1.3: $\tau = R_1(C_1+C_2+C_3)+R_2(C_2+C_3)+R_3C_3 = 6RC$

IX. PRELAB#9

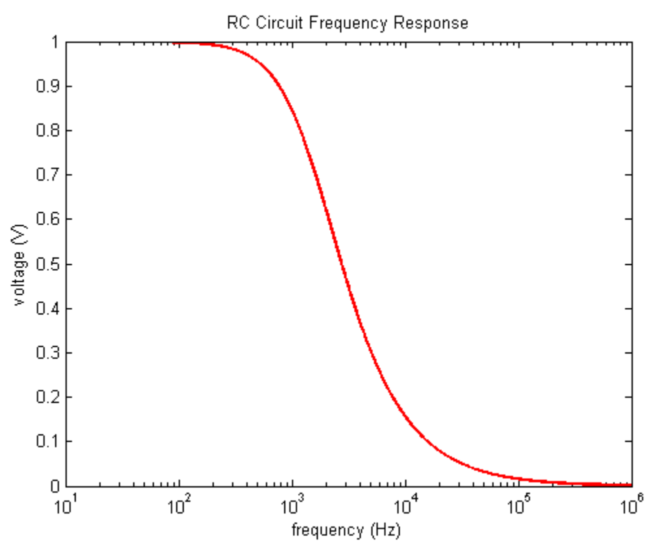
$$v_{out} + RC\frac{\mathrm{d}v_{out}}{\mathrm{d}t} = V_0 \cos \omega t \tag{6}$$

X. PRELAB#10



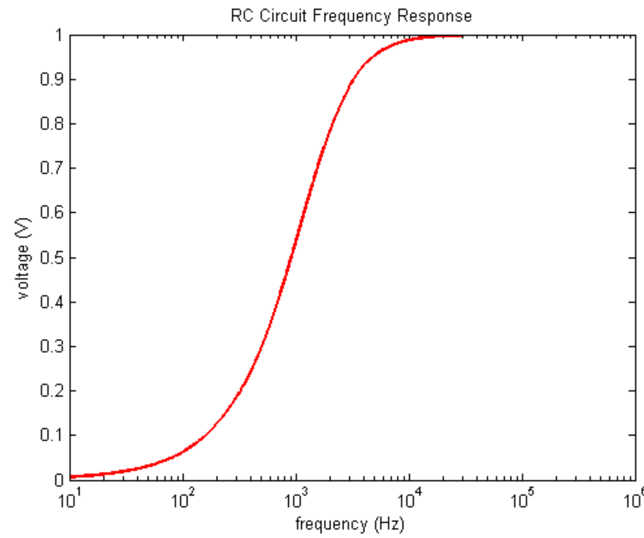
The output signal is a sinusoidal function.
The period $T = \frac{1}{f} = 1\text{ms}$
The magnitude $|v_{out}(t)| = \frac{v_0}{1+R^2C^2\omega^2} = 0.717$

XI. PRELAB#11



$|v_{out}(10\text{Hz})| = 0.999$
$|v_{out}(1\text{MHz})| = 1.59 \times 10^{-3}$
$f \to 0$, $|v_{out}(f)| \to V_0 = 1V$
$f \to \infty$, $|v_{out}(f)| \to 0V$

XII. PRELAB#12



$|v_{out}(1\text{Hz})| = 6.28 \times 10^{-4}$
$|v_{out}(1\text{MHz})| = 0.999$
$f \to 0$, $|v_{out}(f)| \to 0V$
$f \to \infty$, $|v_{out}(f)| \to V_0 = 1V$
Explaination: the capacitor behaves like a low-pass filter while the resistor behaves like a high-pass filter. Because the sum of two voltages of R and C is v_{in} as a constant, their behaviors are just the opposite.