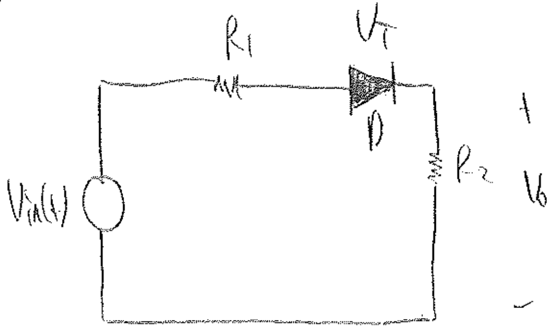
- Lab 2 -

③ ⓐ



$R_1 = R_2 = 10k\Omega$

$V_T \cong 0.7$ Volt (threshold voltage for the diode)

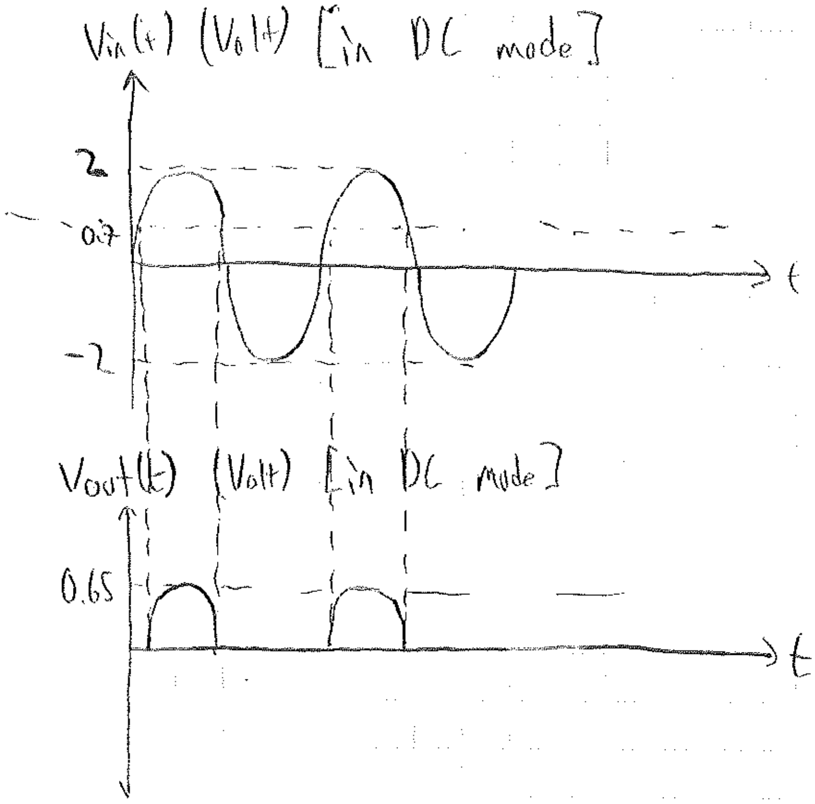
$V_{in} = 2\sin(2\pi f t)$ $f = 1000Hz$

if $V_{in}(t) > 0.7$ D is on

if $V_{in}(t) < 0.7$ D is off

$$V_{out}(t) = \frac{V_{in}(t) - 0.7}{10 + 10} \times 10 \quad \text{when } V_{in}(t) > 0.7$$

$$V_{out}(t) = 0 \quad \text{when } V_{in}(t) < 0.7$$



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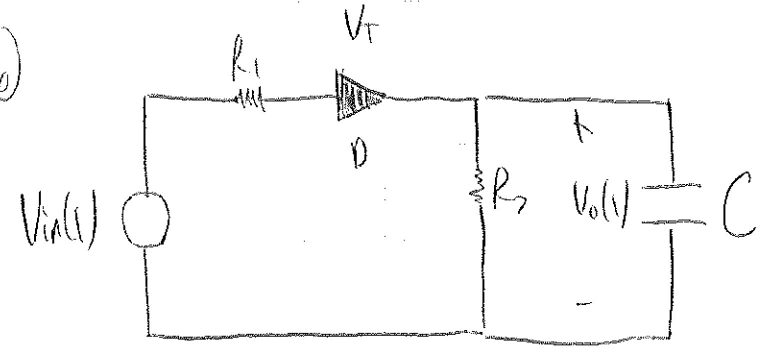


$V_{in}(t) = 2\sin(2\pi f t)$ $f = 10000\,Hz$

$R_1 = R_2 = 10k\Omega$

$C = 0.1\,\mu F$

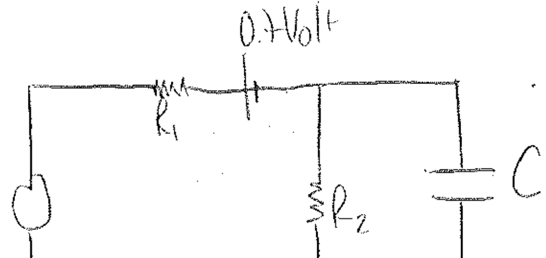
$V_T = 0.7$ Volt

This is a rectifier circuit, it is used to obtain approximately DC Voltage from AC input.

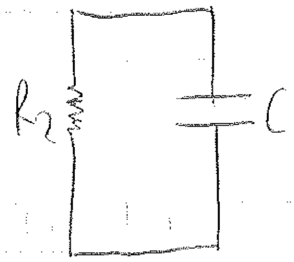
① When the $V_{in} > V_T$ diode is on and the capacitor voltage increases

② While the capacitor is decharged we have to compare the time constant of the R_2 C system with the period of the input. This happens when the diode is off

① When diode on



② When diode off



$T = \frac{1}{f} = \frac{1}{10000} = 10^{-4}$ second

(T → period of input)

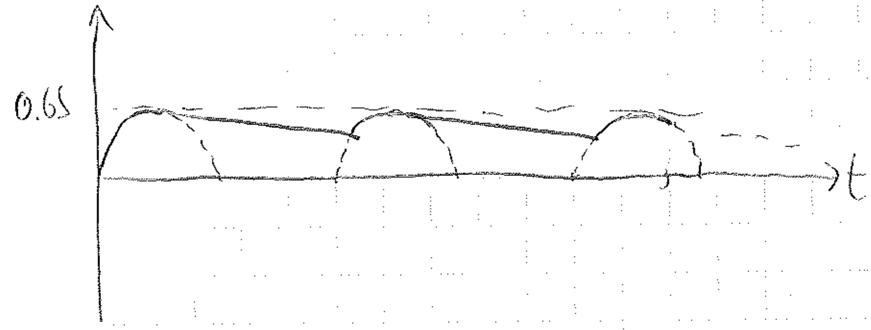
$\tau = R_2 C = 10 \times 10^3 \times 0.1 \times 10^{-6}$
$= 10000 \times 10^{-7}$
$= 10^{-3}$ second

(τ → time constant)

$T \gg \tau$

(hence capacitor discharges very slowly compared to the change in input waveform)

Vout(t) / Vo(t) in DC mode



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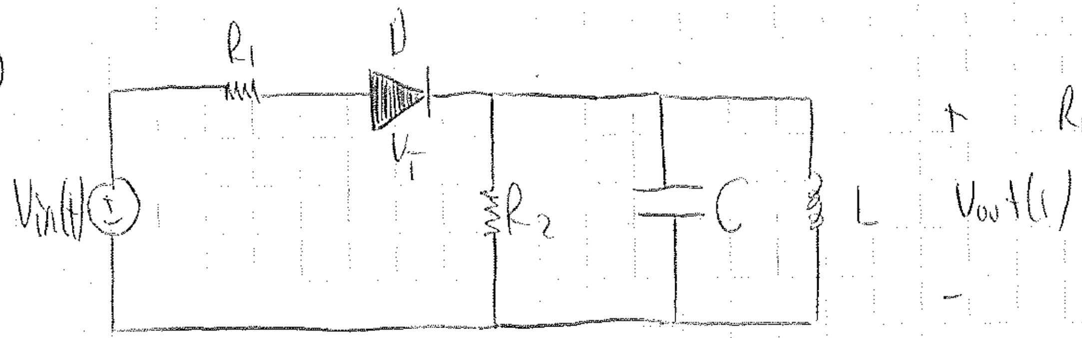


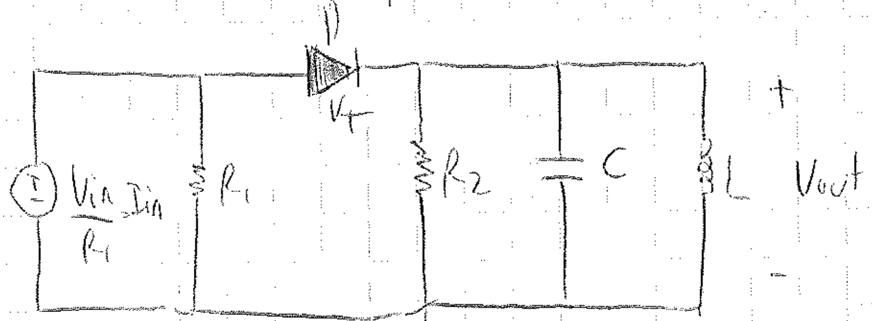
$R_1 = R_2 = 10k\Omega$

$C = 0{,}1\mu F$ $L = 0{,}1$ Henry

$V_{in}(t) = 2\sin(2\pi f t)$

$f = 10000 Hz$

use source transformation



$I_{in} X(s) \simeq V_{out}(s)$ [omitting the Voltage drop over D when diode is on]

↓

$\frac{V_{in}}{R_1} X(s) \simeq V_{out}(s)$ where $\frac{1}{X(s)} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{\frac{1}{sC}} + \frac{1}{sL}$

$\frac{V_{in}}{R_1} \frac{sLR_1R_2}{s^2LCR_1R_2 + s[LR_2 + LR_1] + R_1R_2} \simeq V_{out}(s)$ $V_{in}(s) \frac{sLR_2}{s^2LCR_1R_2 + s[LR_2 + LR_1] + R_1R_2} \simeq V_{out}(s)$

$$V_{in}(s) \times \frac{s\frac{1}{CR_1}}{s^2 + \left(\frac{R_1+R_2}{CR_1R_2}\right)s + \frac{1}{LC}} = V_{out}(s)$$

→ bandpass filter

maximum gain for bandpass filter is obtained when $w = w_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.1 \times 0.1 \times 10^{-6}}} = \frac{1}{\sqrt{10^{-8}}} = 10000 \frac{rad}{sec}$

However $V_{in}(t) = 2\sin(2\pi f t)$ with $f = 10000\,Hz$

$f_0 = \frac{w_0}{2\pi} = \frac{10000}{2\pi}$ Hertz $\quad f_0 \neq f$ [resonant frequency is not equal to input frequency]

* Hence if $V_{in}(t) = 2\sin(2\pi f t)$ where $f = 10000\,Hz$ the output will be composed of a very small portion of input signal, nearly no signal will be observed at the output