EE230: Lab-3
Circuits using OP-AMPS

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1 Overview of the experiment

1.1 Aim of the experiment

The im of the experiment is to study and simulate various opamp circuits in ngspice namely:

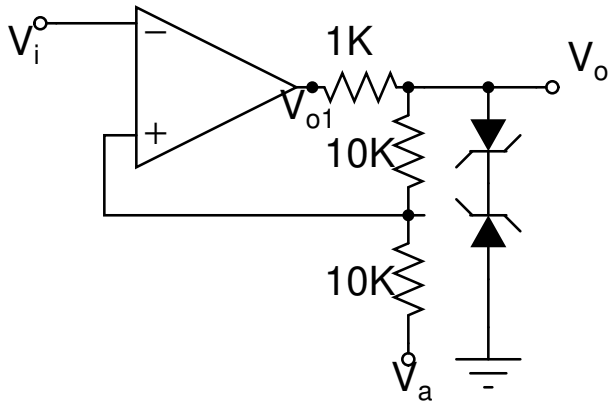
1. Schmidt Trigger
2. Astable Multivibrator
3. Monostable Multivibrator

1.2 Methods

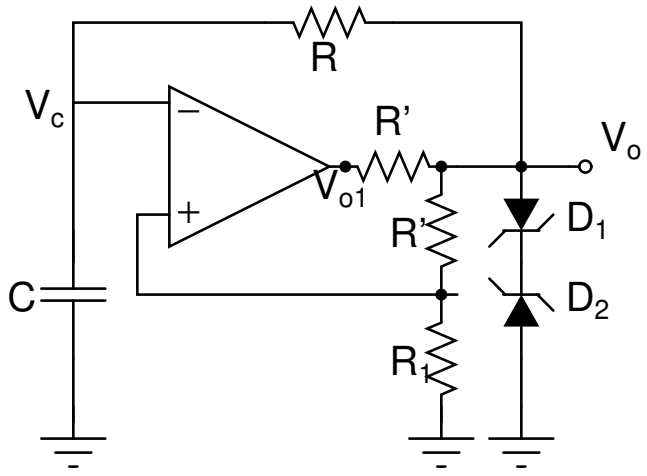
We start by analysing the circuits and then simulating in ngspice to check against theoretical expectations.

2 Design

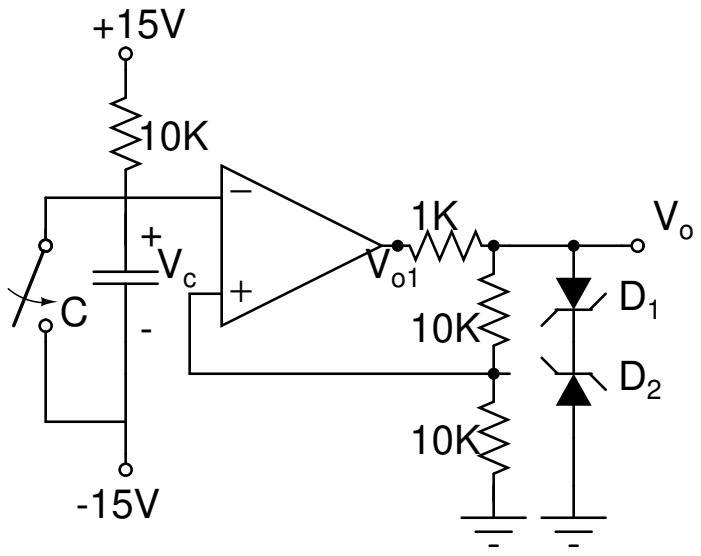
2.1 Schmidt Trigger



2.2 Astable Multivibrator



2.3 Monostable Multivibrator



3 Simulation results

3.1 Schimdt Trigger

3.1.1 Code snippet

```
Schmitt trigger
*Including the predefined op-amp subcircuit file
.include ua741.txt
.include zener_B.txt

.SUBCKT ZENER_12 1 2
D1 1 2 DF
DZ 3 1 DR
VZ 2 3 3.48
.MODEL DF D ( IS=27.5p RS=0.620 N=1.10 CJO=78.3p VJ=1.00 M
   =0.330
+ TT=50.1n)
.MODEL DR D ( IS=5.49f RS=50 N=1.77 )
.ENDS

*Connections as mentioned in subcircuit file
```

```
x1 2 9 3 4 5 UA741
R1 2 6 10K
R2 2 7 10K
R3 5 7 1K
xz1 8 7 ZENER_12
xz2 8 0 ZENER_12
vcc 3 0 dc 15v
vee 4 0 dc -15v

va 6 0 dc 3
vin 9 0 sin(0 6 1k 0 0)
.tran 0.001m 0.01
.control
run
plot v(7) vs v(9)
plot v(7) v(9)
*print v(9) v(7)
.endc
.end
```

3.1.2 Simulation results

3.2 Astable Multivibrator

3.2.1 Code snippet

```
Astable Multivibrator without diodes
*Including the predefined op-amp subcircuit file
.include ua741.txt
.include zener_B.txt

.SUBCKT ZENER_12 1 2
D1 1 2 DF
DZ 3 1 DR
VZ 2 3 3.48
.MODEL DF D ( IS=27.5p RS=0.620 N=1.10 CJO=78.3p VJ=1.00 M
   =0.330
+ TT=50.1n)
.MODEL DR D ( IS=5.49f RS=50 N=1.77 )
.ENDS

*Connections as mentioned in subcircuit file
x1 1 2 3 4 5 UA741
R1 1 0 30K
R2 1 5 35K
R4 5 2 50K
```

```
C1 2 0 0.01u
vcc 3 0 dc 15v
vee 4 0 dc -15v

.tran 0.01m 25m
.control
run
plot v(2) v(5)
*print v(5) v(2)
.endc
.end
```

3.3 Monostable Multivibrator

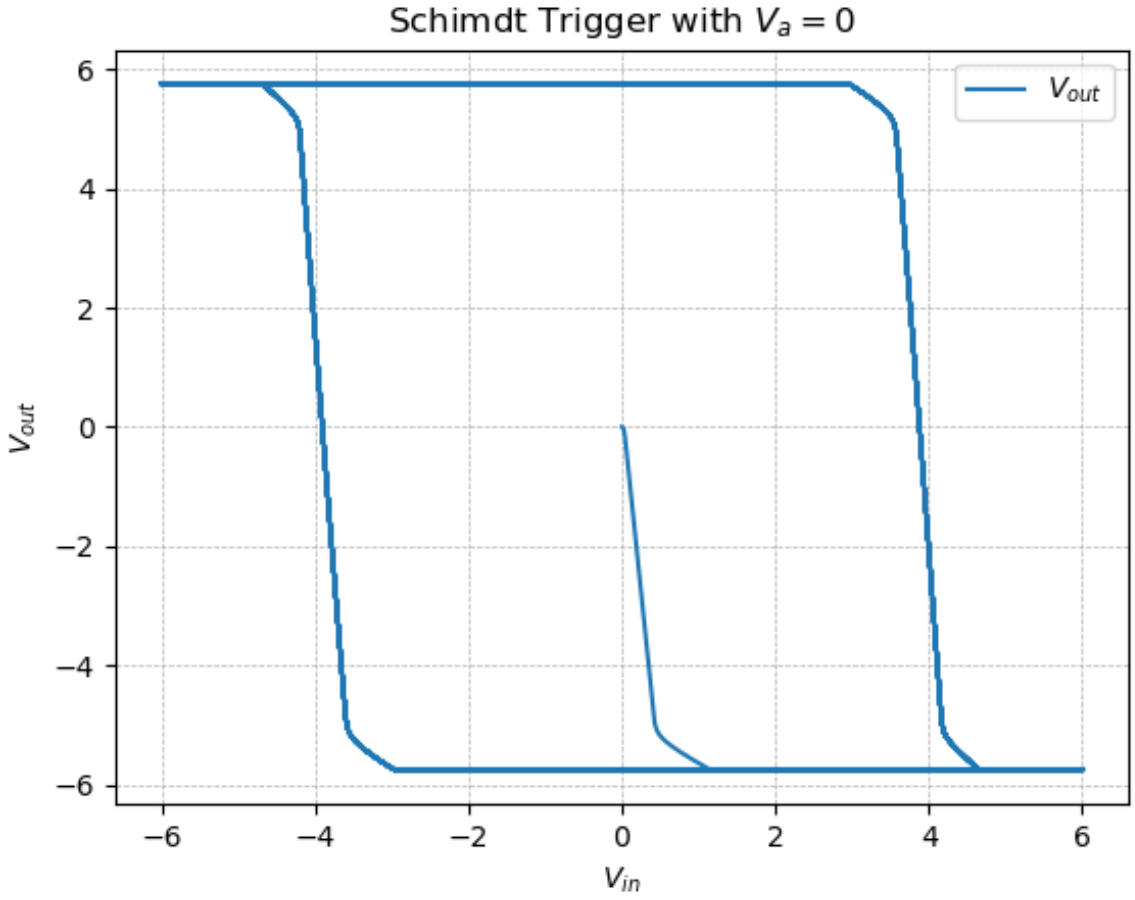
3.3.1 Code snippet

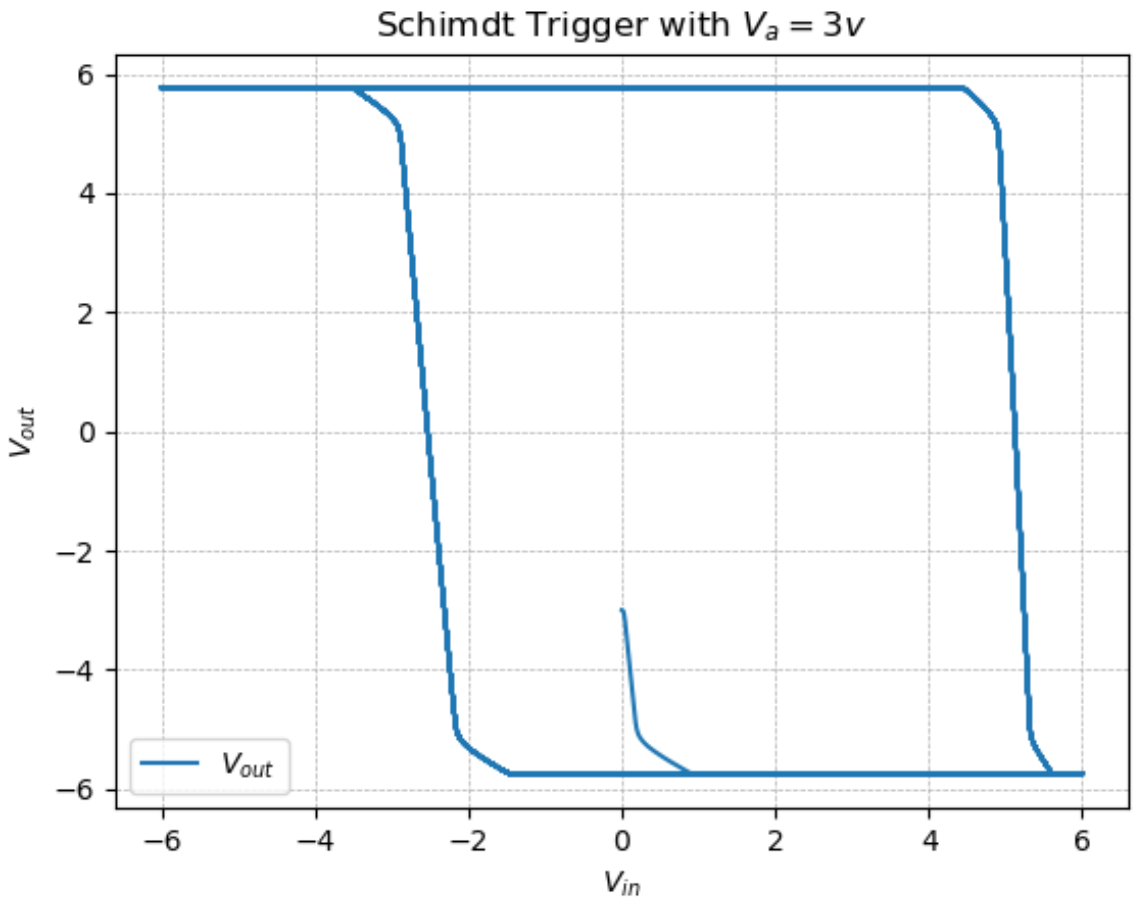
```
Monostable Multivibrator
*Including the predefined op-amp subcircuit file
.include ua741.txt
.include zener_B.txt

.SUBCKT ZENER_12 1 2
D1 1 2 DF
DZ 3 1 DR
VZ 2 3 3.48
.MODEL DF D ( IS=27.5p RS=0.620 N=1.10 CJO=78.3p VJ=1.00 M
   =0.330
+ TT=50.1n)
.MODEL DR D ( IS=5.49f RS=50 N=1.77 )
.ENDS

.SUBCKT button_sw 1 2 c
S1 1 2 c 0 b_sw1
* Initial value, pulsed value, delay time, rise time, fall
   time, pulse width *
V1 c 0 pulse(0 10 0.10 0.0 0.0 100u)
.model b_sw1 sw vt=1 vh=0.2 ron=1 roff=1000MEG
.ENDS button_sw

*Connections as mentioned in subcircuit file
x1 1 2 3 4 5 UA741
R1 1 0 10K
R2 1 6 10K
R3 6 5 1K
R4 2 8 10K
C1 2 9 10u
```

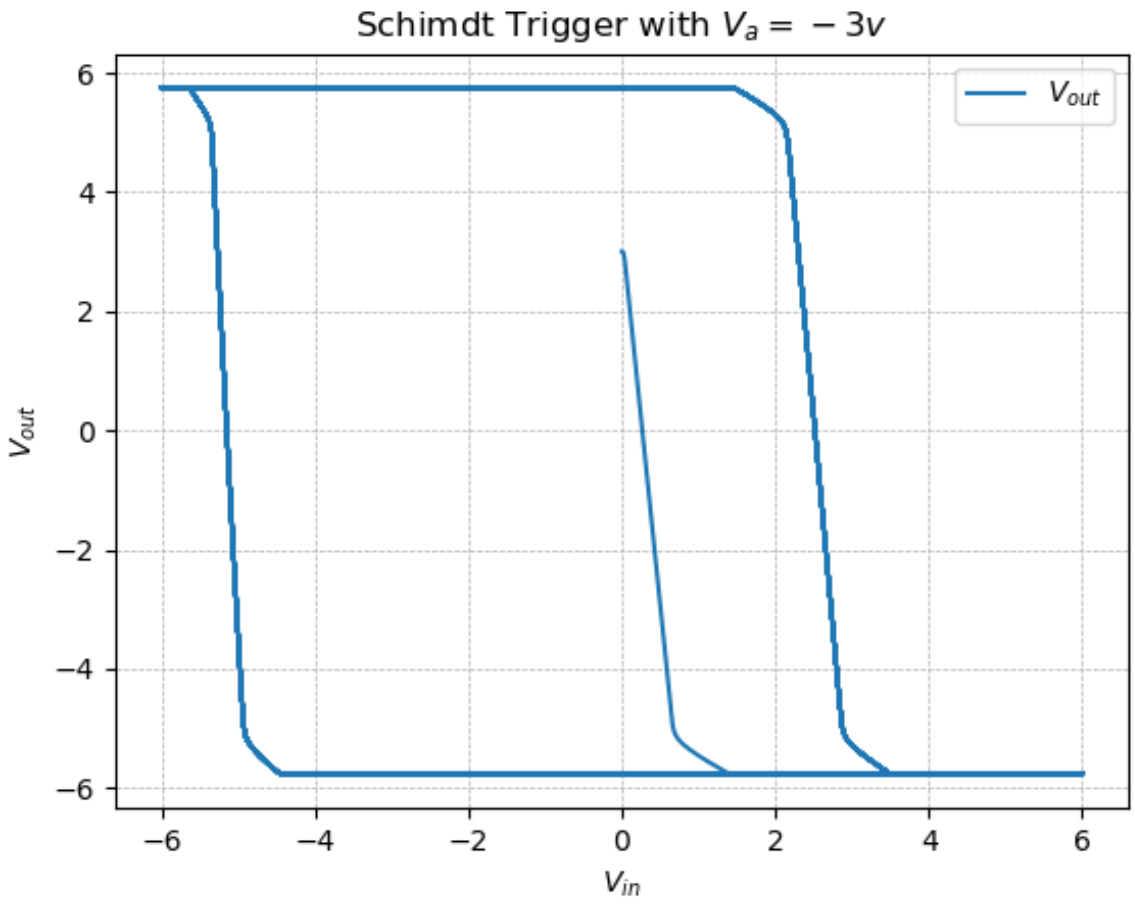
```
xz1 7 6 ZENER_12
xz2 7 0 ZENER_12
vcc 3 0 dc 15v
vee 4 0 dc -15v
vr 8 0 dc 15v
vc 9 0 -15v

xsw 2 9 10 button_sw

.tran 0.01m 1000m
.control
run
plot v(2) v(6) v(1) v(10)
*print v(6) v(2)
.endc
.end
```

3.3.2 Simulation results

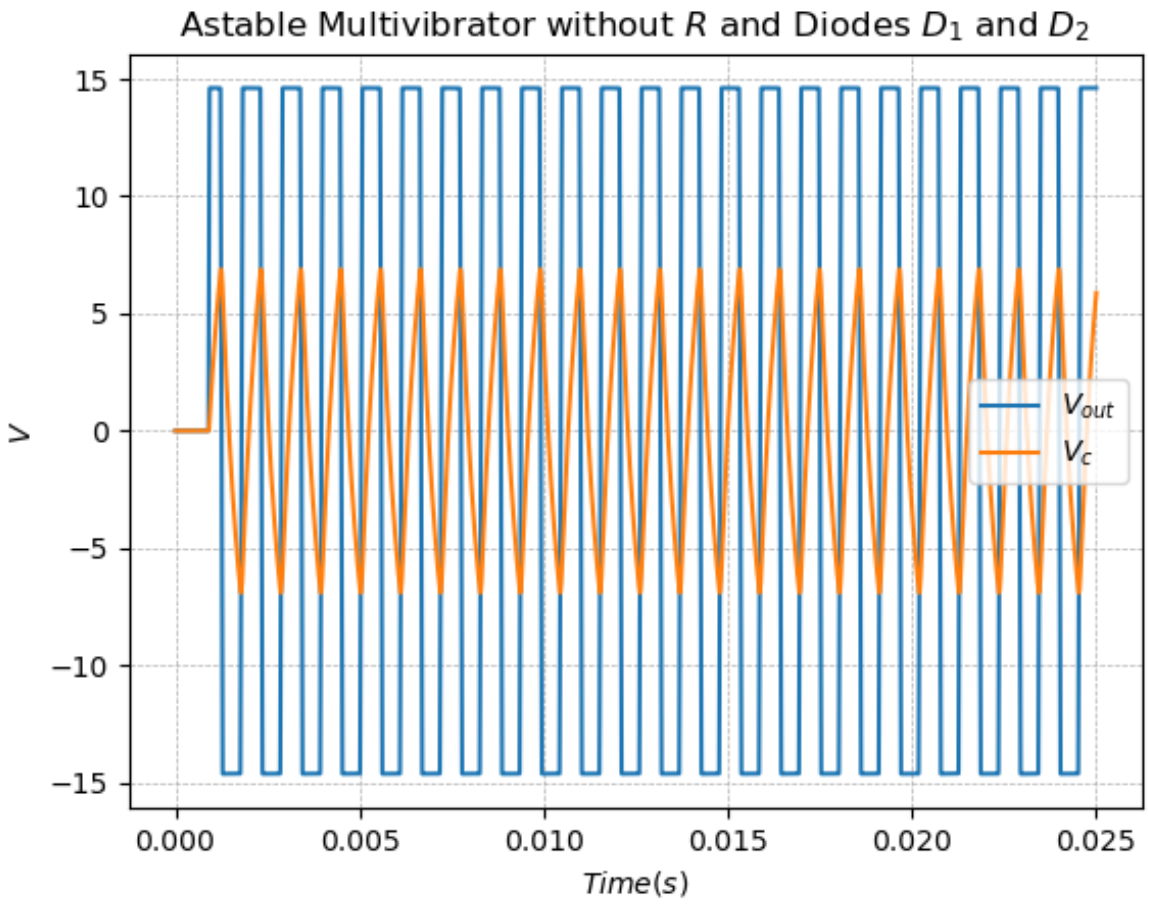
Schimdt Trigger

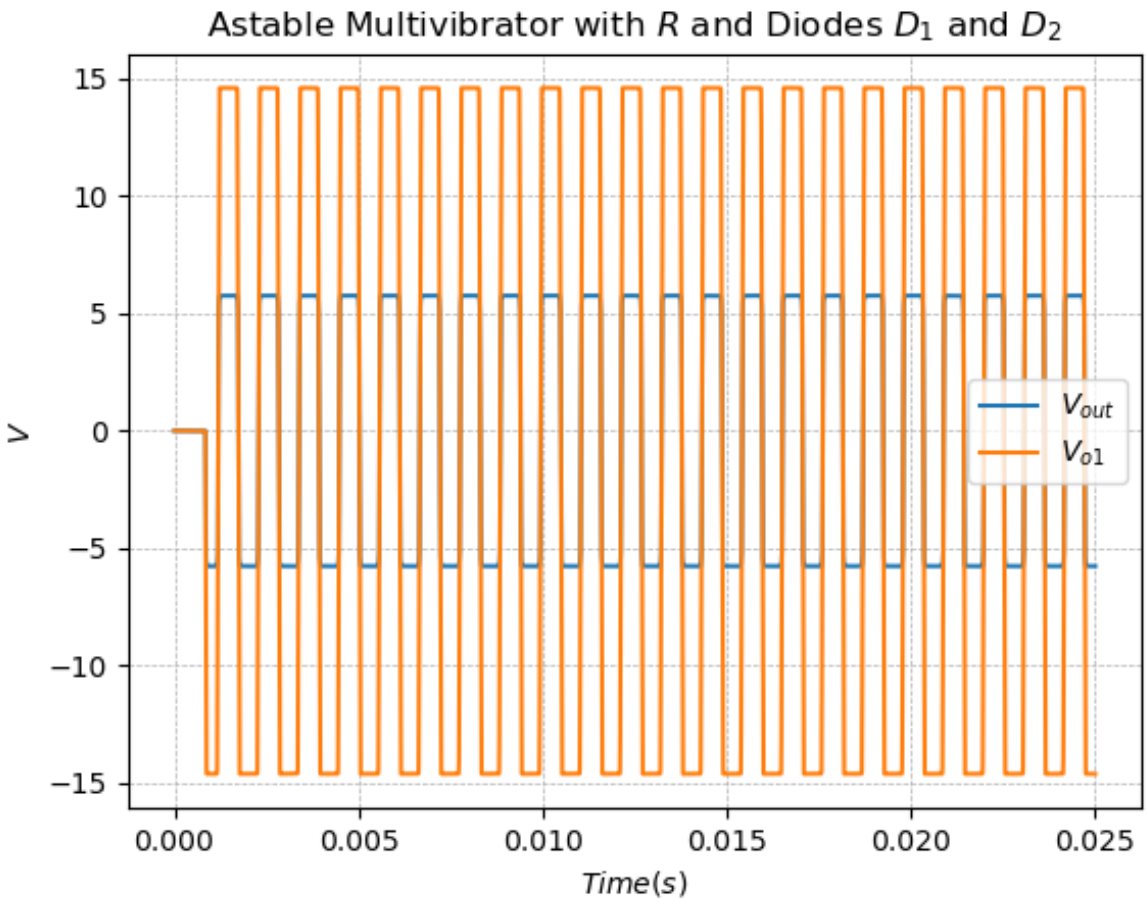

Schimdt Trigger with $V_a = 0$
V_{out}
V_{out}
V_{in}
6
4
2
0
−2
−4
−6
−6
−4
−2
0
2
4
6


Schimdt Trigger with $V_a = 3v$
6
4
2
0
−2
−4
−6
V_{out}
−6
−4
−2
0
2
4
6
V_{in}
V_{out}

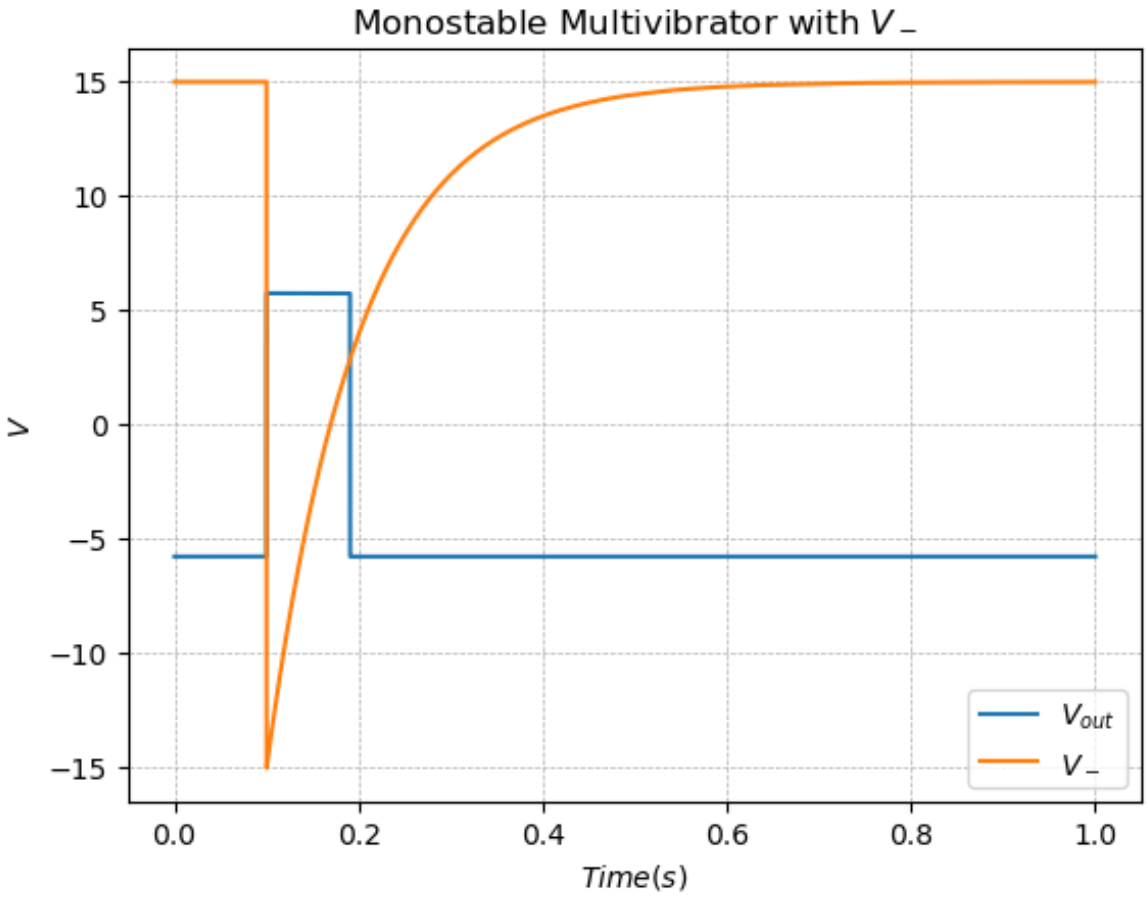


Astable Multivibrator


Astable Multivibrator without R and Diodes D_1 and D_2
15
10
5
0
−5
−10
−15
V
0.000
0.005
0.010
0.015
0.020
0.025
Time(s)
V_{out}
V_c



Monostable Multivibrator



4 Experiment completion status

All the sections were completed