Experiment - 2

DC Power Supply

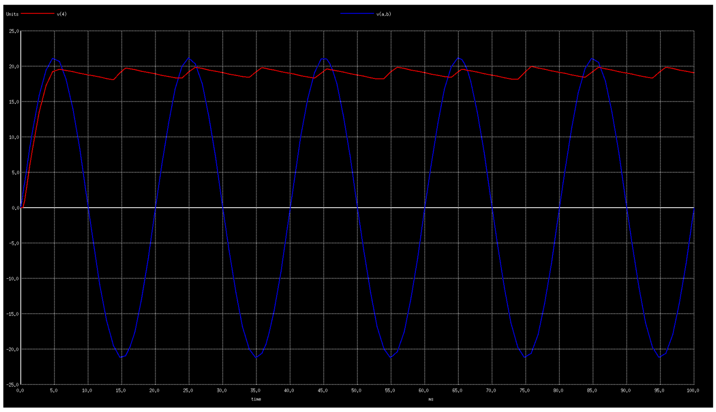
Report by Prasann Viswanathan - 190070047

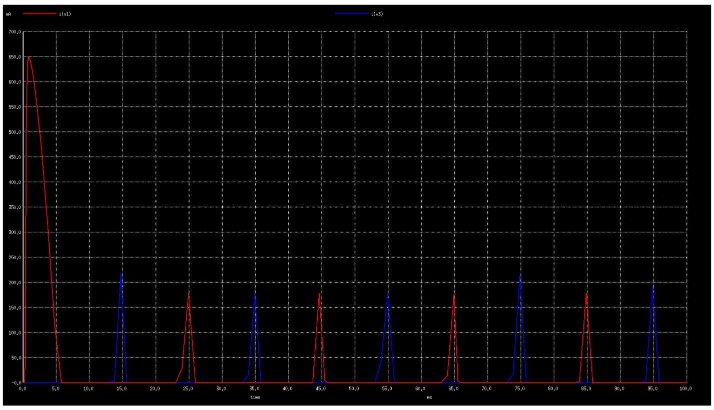
1. Unregulated power supply with Capacitive Filter

a. ngspice code:

```
Prasann Viswanathan 190070047 unregulated DC supply

.MODEL 1N914 D (IS=6.2229E-9 N=1.9224 RS=0.33636 IKF=42.843E-3 CJO=764.38E-15
                + M=0.1001 VJ=0.99900 BV=1000 IBV=1 TT=2.8854E-9)

vin a b sin(0 21.213 50 0 0)
d1 a 1 1N914
v1 1 4 0
d2 0 a 1N914
d3 b 3 1N914
v3 3 4 0
d4 0 b 1N914
r1 0 4 1k
c1 0 4 100u

.tran 0.001 0.1
.control
run

plot v(4) v(a,b)
plot i(v1) i(v3)

.endc
.end
```

b. Results





c. Learning outcomes

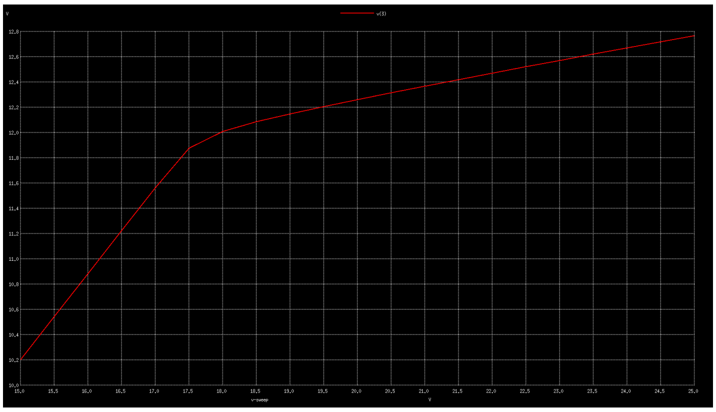
We see from the different plots by varying the values of the load resistance and capacitance that while increasing the capacitance value reduces the ripple in the output voltage, it progressively requires higher charging currents to flow through the diode bridge in the transient state, which could go beyond the rated current for the bridge and in turn damage it

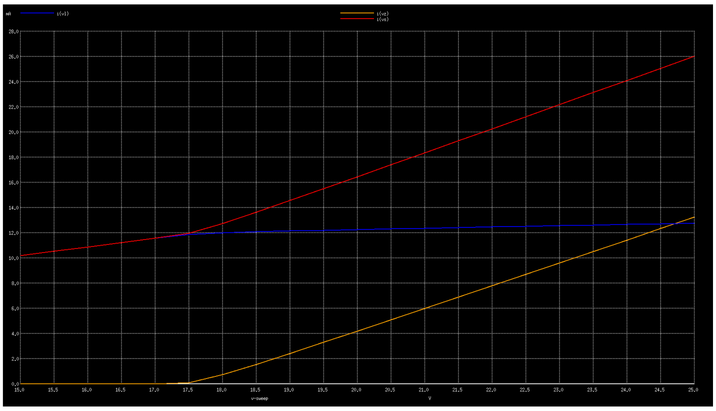
Regulated power supply with Zener Regulator

d. ngspice code:

```
Prasann Viswanathan 190070047 Regulated Zener

.SUBCKT ZENER_12 1 2
D1 1 2 DF
DZ 3 1 DR
VZ 2 3 10.8
.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

v_in 1 0
rs 1 2 470
vs 2 3 0
rl 3 4 1k
vl 4 0 0
x1 5 3 ZENER_12
vz 5 0 0

*analysis commands
.dc v_in 15 25 0.5
.control
run

*display commands
plot v(3)
plot i(vs) i(vl) i(vz)

.endc
.end
```

e. Results





f. Learning outcomes

For a Zener regulator to function properly in the reverse biased mode, we see that we need to provide some minimum input voltage (17V in this case) below which the output voltage won’t be regulated at the desired value. This is given theoretically by ensuring the Vth drop across the Zener is maintained to be > Vz, either by increasing Vin or adjusting the relative ratios of Rl and Rs.

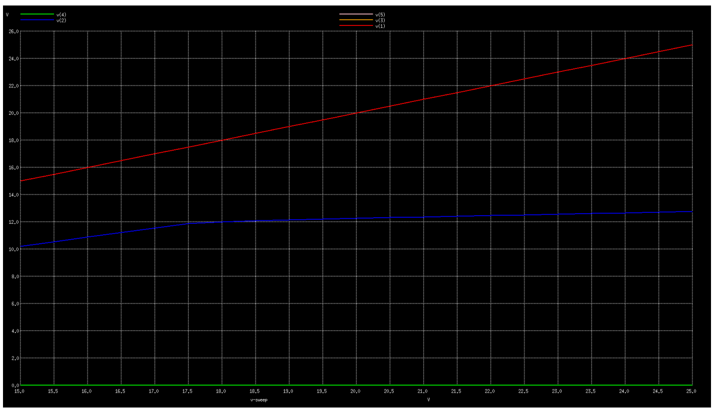
Care must also be taken not to let Iz exceed as the regulator can support currents only upto some limit.

2. Regulated power supply with BJT Series regulator

a. ngspice code:

```
Prasann Viswanathan 190070047 regulated BJT series

.include zener_B.txt

.model bc547a NPN IS=10f BF=200 ISE=10.3f IKF=50m NE=1.3
+ BR=9.5 VAF=80 IKR=12m ISC=47p NC=2 VAR=10 RB=280 RE=1 RC=40
+ tr=0.3u tf=0.5n cje=12p vje=0.48 mje=0.5 cjc=6p vjc=0.7 mjc=0.33 kf=2f

.model SL100 NPN IS=100f BF=80 ISE=10.3f IKF=50m NE=1.3
+ BR=9.5 VAF=80 IKR=12m ISC=47p NC=2 VAR=10 RB=100 RE=1 RC=10
+ tr=0.3u tf=0.5n cje=12p vje=0.48 mje=0.5 cjc=6p vjc=0.7 mjc=0.33 kf=2f

v_in 1 0
q1 3 4 5 bc547a
q2 1 3 2 SL100
rc 1 3 1k
r1 2 4 10.2k
r2 4 0 14.8k
rl 2 0 1k
x1 0 5 DI_1N4734A

*analysis command
.dc Vin 15 25 0.5
.control
run

*display commands
print v(1) v(2) v(3) v(4) v(5)
plot v(1) v(2) v(3) v(4) v(5)

.endc
.end
```

b. Results



Index	v-sweep	v(1)	v(2)	v(3)
0	1.500000e+01	1.500000e+01	1.020408e+01	1.020408e+01
1	1.550000e+01	1.550000e+01	1.054422e+01	1.054422e+01
2	1.600000e+01	1.600000e+01	1.088435e+01	1.088435e+01
3	1.650000e+01	1.650000e+01	1.122449e+01	1.122449e+01
4	1.700000e+01	1.700000e+01	1.156459e+01	1.156459e+01
5	1.750000e+01	1.750000e+01	1.187786e+01	1.187786e+01
6	1.800000e+01	1.800000e+01	1.200970e+01	1.200970e+01
7	1.850000e+01	1.850000e+01	1.208599e+01	1.208599e+01
8	1.900000e+01	1.900000e+01	1.214901e+01	1.214901e+01
9	1.950000e+01	1.950000e+01	1.220750e+01	1.220750e+01
10	2.000000e+01	2.000000e+01	1.226279e+01	1.226279e+01
11	2.050000e+01	2.050000e+01	1.231635e+01	1.231635e+01
12	2.100000e+01	2.100000e+01	1.236877e+01	1.236877e+01
13	2.150000e+01	2.150000e+01	1.242031e+01	1.242031e+01
14	2.200000e+01	2.200000e+01	1.247118e+01	1.247118e+01
15	2.250000e+01	2.250000e+01	1.252153e+01	1.252153e+01
16	2.300000e+01	2.300000e+01	1.257145e+01	1.257145e+01
17	2.350000e+01	2.350000e+01	1.262102e+01	1.262102e+01
18	2.400000e+01	2.400000e+01	1.267030e+01	1.267030e+01
19	2.450000e+01	2.450000e+01	1.271933e+01	1.271933e+01
20	2.500000e+01	2.500000e+01	1.276815e+01	1.276815e+01

c. Learning outcomes

In case of the BJT regulator, we see that unlike a Zener diode based regulator, it functions satisfactorily for a broader range of input voltages as well as load currents and is thus a much better choice than the Zener Regulator.