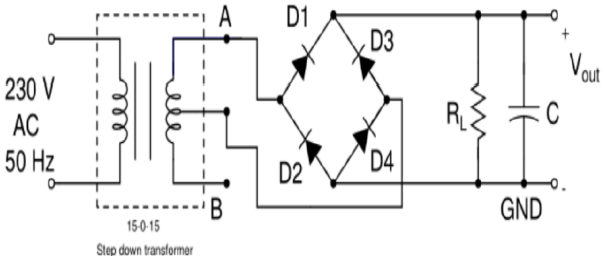
EE230 : Analog Circuits Lab

Mayur Ware | 19D070070, **Section 6**

Experiment 2: DC Power Supply

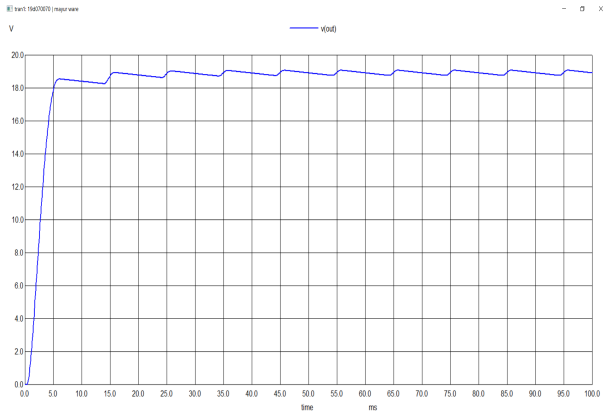
August 7, 2021

Unregulated Supply – without and with a Capacitive Filter

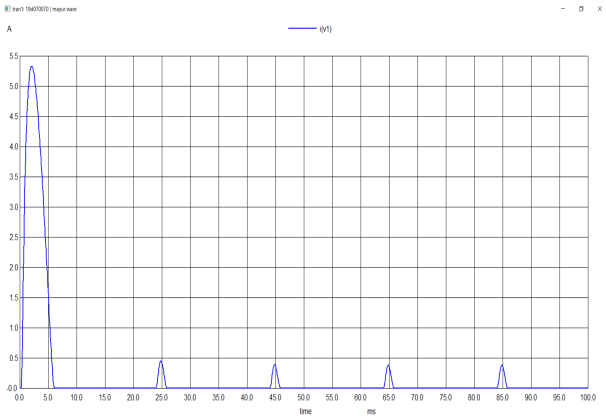



```
19D070070 | Mayur Ware
*Unregulated Supply      without a Capacitive Filter
*Importing the Diode Model
.include Diode_1N914.txt
D1 3 Out 1N914
D2 GND 1 1N914
D3 4 Out 1N914
D4 GND 2 1N914
RL Out GND 1k
*Reference Voltage Sources
V1 1 3 dc 0V
V2 2 4 dc 0V
*Input AC Source
*sin(offset amplitude frequency delay damping-factor)
V 1 2 sin(0 21.2132 50 0 0)
*Analysis
.tran 0.1m 100m
*Control Commands
.control
run
plot V(Out) i(V1) i(V2)
.endc
.end
```

Plots :



Output Voltage

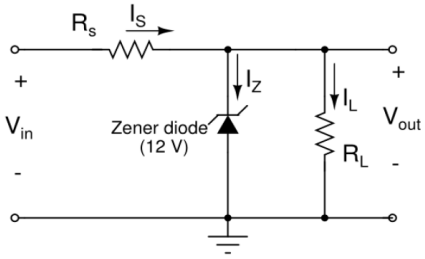


Current through Diode

Learnings :

High capacitance may result in lower ripple in Output voltage but it increases the first peak of the diode current which may damage the diode. Using high load resistance also helps to reduce ripple in output voltage.

DC Power Supply with Zener Diode Regulator

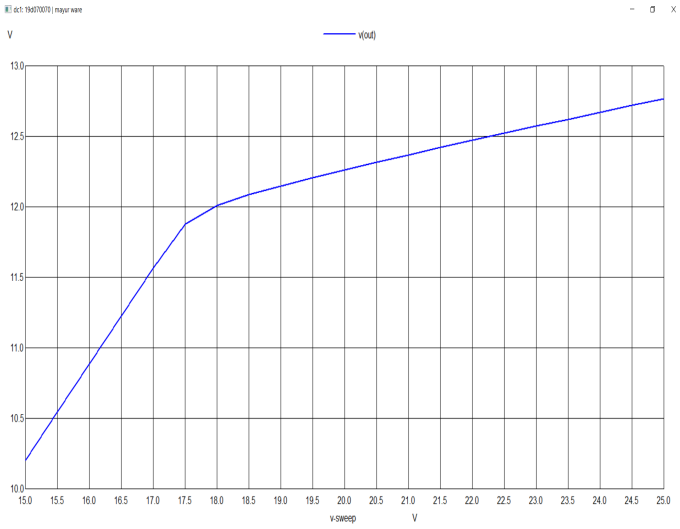



```
19D070070 | Mayur Ware
*Zener Regulator - Analysis
*Importing the Zener Model
.SUBCKT ZENER_12 1 2
D1 1 2 DF
DZ 3 1 DR
VZ 2 3 10.8
.MODEL DF D ( IS=27.5p RS=0.620 N=1.10 CJO=78.3p VJ=1.00 M=0.330 TT=50.1n )
.MODEL DR D ( IS=5.49f RS=50 N=1.77 )
.ENDS

*Netlist
Rs In 1 470
Rl 4 GND 705
X1 GND 3 ZENER_12
*Voltage Sources
Vin In GND dc 20V
V1 1 Out dc 0V
V2 Out 3 dc 0V
V3 Out 4 dc 0V

*Control Commands
.dc Vin 15 25 0.5
.control
run
set color0 = white
set xbrushwidth = 2
print V(Out) i(V1)  i(V2) i(V3)
.endc
.end
```

Plots :

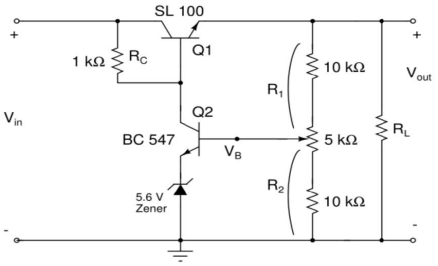


Index	v-sweep	v(out)	i(v1)	i(v2)	
0	1.500000e+01	1.020408e+01	1.020408e-02	3.710267e-11	1.020408e-02
1	1.550000e+01	1.054422e+01	1.054422e-02	3.778295e-11	1.054422e-02
2	1.600000e+01	1.088435e+01	1.088435e-02	3.849787e-11	1.088435e-02
3	1.650000e+01	1.122449e+01	1.122449e-02	9.754691e-11	1.122449e-02
4	1.700000e+01	1.156459e+01	1.156469e-02	9.838411e-08	1.156459e-02
5	1.750000e+01	1.187787e+01	1.196197e-02	8.409802e-05	1.187787e-02
6	1.800000e+01	1.200973e+01	1.274526e-02	7.355326e-04	1.200973e-02
7	1.850000e+01	1.208601e+01	1.364678e-02	1.560762e-03	1.208601e-02
8	1.900000e+01	1.214904e+01	1.457651e-02	2.427471e-03	1.214904e-02
9	1.950000e+01	1.220753e+01	1.551589e-02	3.308364e-03	1.220753e-02
10	2.000000e+01	1.226282e+01	1.646208e-02	4.199255e-03	1.226282e-02
11	2.050000e+01	1.231638e+01	1.741195e-02	5.095567e-03	1.231638e-02
12	2.100000e+01	1.236880e+01	1.836426e-02	5.995462e-03	1.236880e-02
13	2.150000e+01	1.242034e+01	1.931842e-02	6.898083e-03	1.242034e-02
14	2.200000e+01	1.247121e+01	2.027401e-02	7.802798e-03	1.247121e-02
15	2.250000e+01	1.252156e+01	2.123072e-02	8.709161e-03	1.252156e-02
16	2.300000e+01	1.257148e+01	2.218833e-02	9.616852e-03	1.257148e-02
17	2.350000e+01	1.262105e+01	2.314669e-02	1.052564e-02	1.262105e-02
18	2.400000e+01	1.267033e+01	2.410567e-02	1.143534e-02	1.267033e-02
19	2.450000e+01	1.271937e+01	2.506518e-02	1.234582e-02	1.271937e-02
20	2.500000e+01	1.276818e+01	2.602514e-02	1.325696e-02	1.276818e-02

Learnings :

Output voltage in this case depends on input voltage as well as the load resistance. Load resistance value must be greater than a calculated minimum value to get the correct outputs.

DC Power Supply with a BJT Series Regulator

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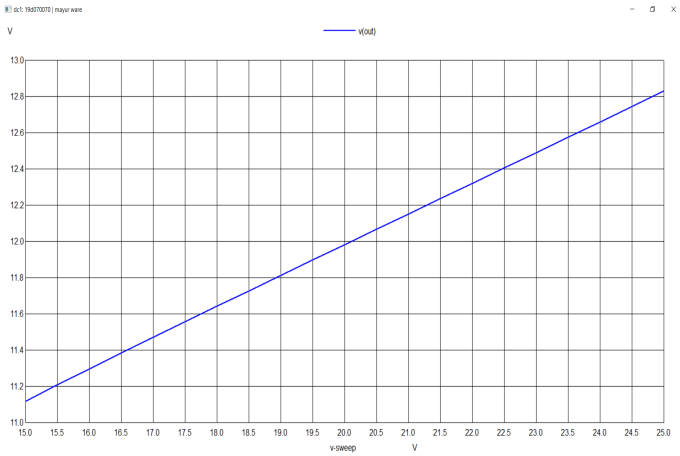
*BJT Series Regulator - Analysis
*Importing the SL100 and BC547
.model bc547a NPN IS=10f BF=200 ISE=10.3f IKF=50m NE=1.3
+ BR=9.5 VAF=80 IKR=12m ISC=47p NC=2 VAR=10 RB=280 RE=1 RC=40
+ tr=0.3u tf=0.5n cje=12p vje=0.48 mje=0.5 cjc=6p vjc=0.7 mjc=0.33 kf=2f
.model SL100 NPN IS=100f BF=80 ISE=10.3f IKF=50m 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

*Netlist
Rc In 1 1k
Rl Out GND 1k
X1 GND 3 ZENER_5.6
R1 Out 2 11k
R2 2 GND 14k
*Voltage Sources
Vin In GND dc 20V
*BJTs
Q1 In 1 Out SL100
Q2 1 2 3 bc547a

*Control Commands
.dc Vin 15 25 0.5
.control
run
set xbrushwidth = 2
plot V(Out) V(1) V(2) V(3)
.endc
.end
```

Plots :



Index	v-sweep	v(out)	v(1)	v(2)	v(3)
0	1.500000e+01	1.111796e+01	1.181267e+01	6.083515e+00	5.388992e+00
1	1.550000e+01	1.120860e+01	1.190357e+01	6.115294e+00	5.415784e+00
2	1.600000e+01	1.129634e+01	1.199155e+01	6.145089e+00	5.441359e+00
3	1.650000e+01	1.138379e+01	1.207924e+01	6.174618e+00	5.466764e+00
4	1.700000e+01	1.147051e+01	1.216618e+01	6.203560e+00	5.491805e+00
5	1.750000e+01	1.155662e+01	1.225252e+01	6.231980e+00	5.516520e+00
6	1.800000e+01	1.164227e+01	1.233840e+01	6.259960e+00	5.540959e+00
7	1.850000e+01	1.172758e+01	1.242392e+01	6.287562e+00	5.565158e+00
8	1.900000e+01	1.181262e+01	1.250917e+01	6.314833e+00	5.589148e+00
9	1.950000e+01	1.189747e+01	1.259424e+01	6.341816e+00	5.612952e+00
10	2.000000e+01	1.198219e+01	1.267916e+01	6.368541e+00	5.636592e+00
11	2.050000e+01	1.206683e+01	1.276401e+01	6.395038e+00	5.660083e+00
12	2.100000e+01	1.215142e+01	1.284881e+01	6.421329e+00	5.683440e+00
13	2.150000e+01	1.223601e+01	1.293360e+01	6.447434e+00	5.706675e+00
14	2.200000e+01	1.232062e+01	1.301842e+01	6.473371e+00	5.729797e+00
15	2.250000e+01	1.240528e+01	1.310328e+01	6.499153e+00	5.752817e+00
16	2.300000e+01	1.249001e+01	1.318821e+01	6.524794e+00	5.775742e+00
17	2.350000e+01	1.257483e+01	1.327323e+01	6.550304e+00	5.798579e+00
18	2.400000e+01	1.265975e+01	1.335835e+01	6.575695e+00	5.821333e+00
19	2.450000e+01	1.274479e+01	1.344360e+01	6.600974e+00	5.844010e+00
20	2.500000e+01	1.282996e+01	1.352897e+01	6.626149e+00	5.866615e+00

Learning :

DC Power Supply with a BJT Series Regulator is a negative feedback circuit which is more stable than the Zener Regulator. This Regulator gives the most stable output.