21BDS0340

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Electronics Lab

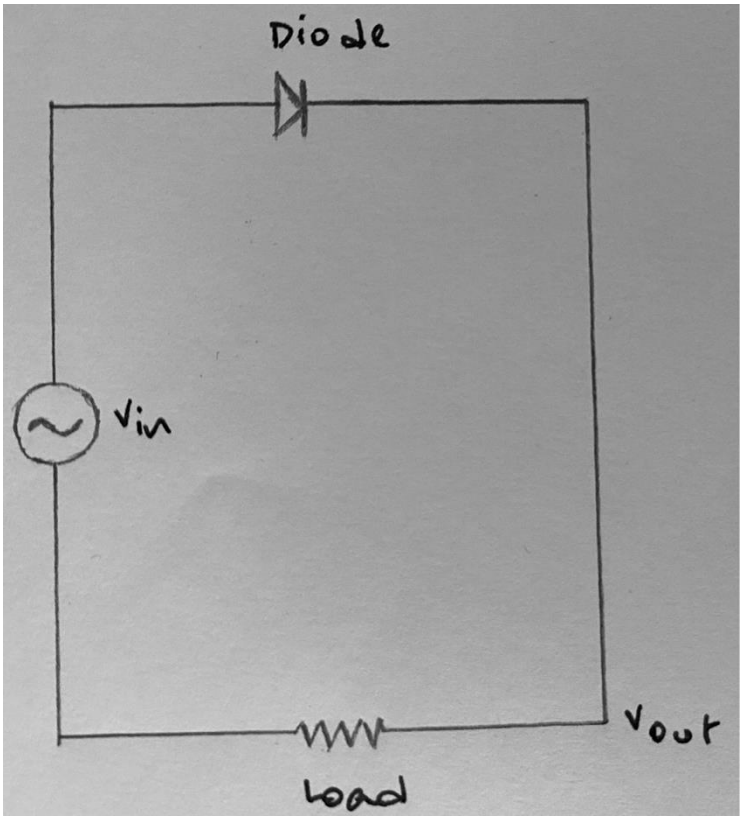
Task 2

Exercise No.: 1 Date: 10/03/22

Half wave and Full wave rectifier

Half Wave Rectifier

Circuit Diagram



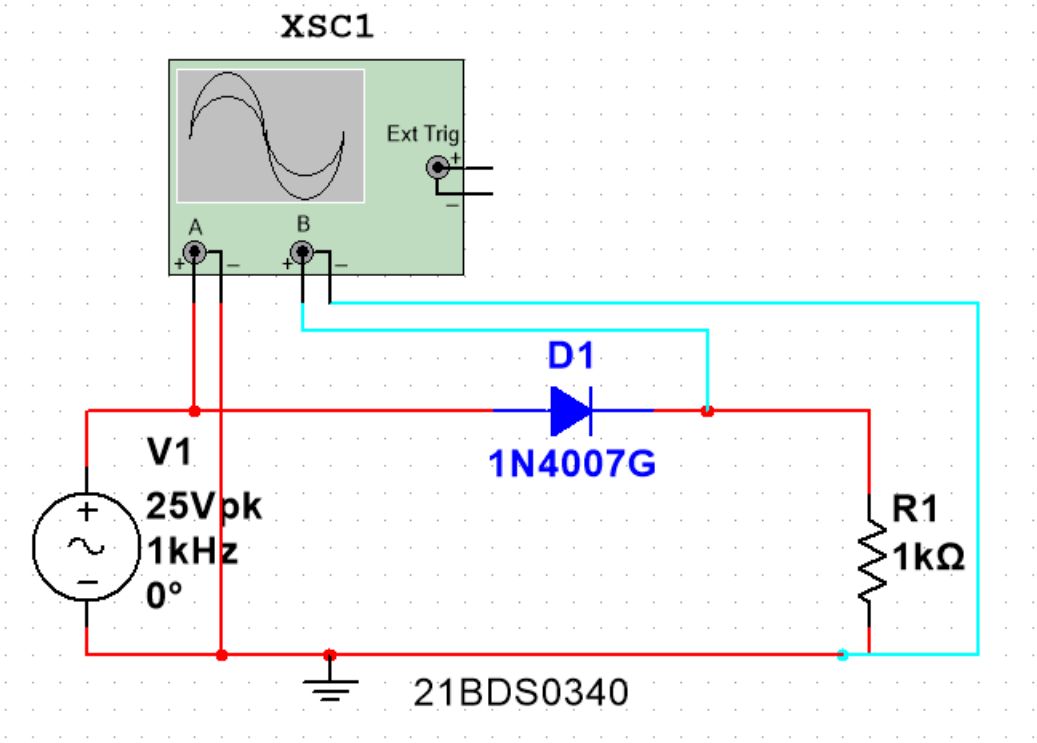
Components Required

Basic – Resistors

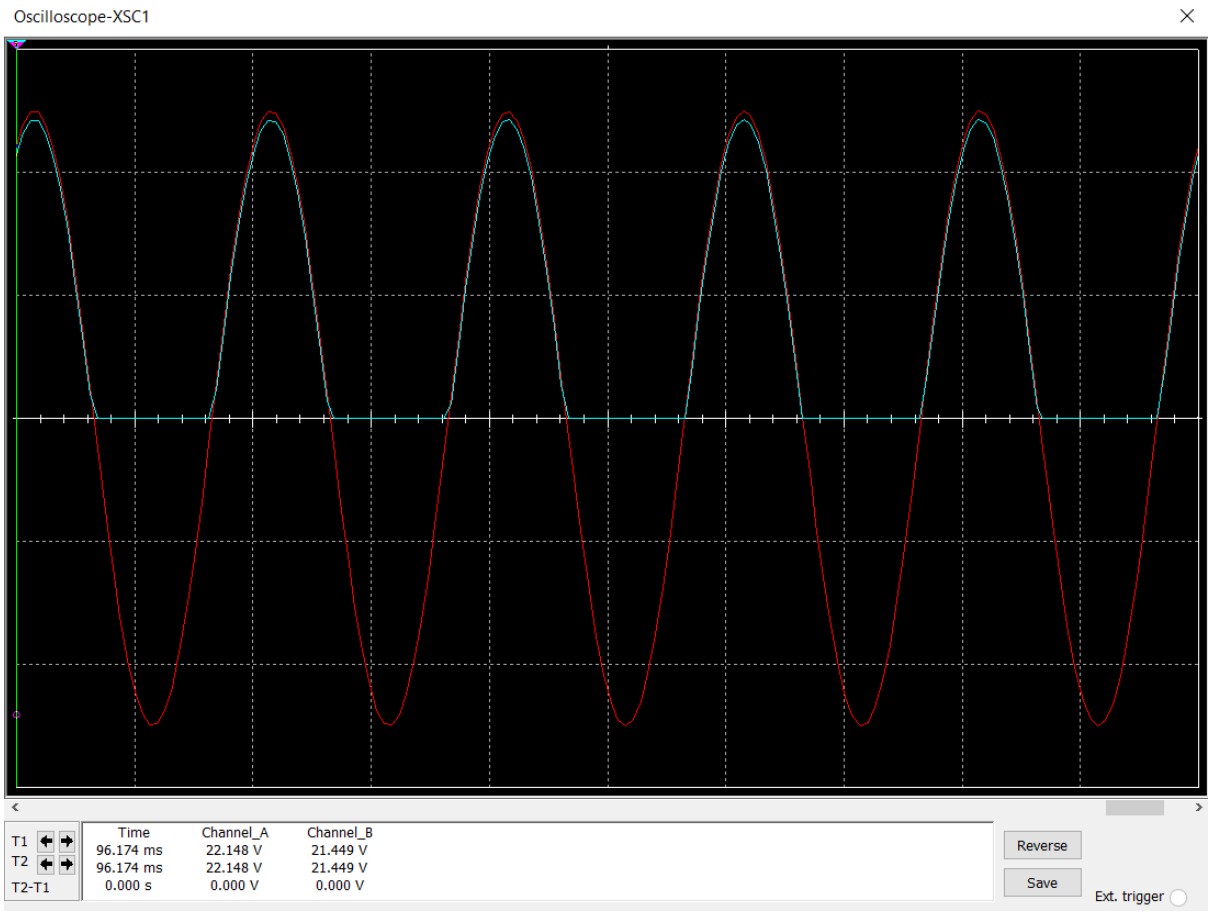
Sources – Power Sources – AC_Power, Ground

Simulate – Instruments – Oscilloscope

Simulated Circuit Diagram



Simulation Output



Calculations

RMS voltage $V_{rms} = \frac{V_m}{2} = \frac{24.253\ V}{2}$

$= 12.126\ V$

DC / Average voltage $V_{dc} = \frac{V_m}{\pi} = 7.72\ V$

Ripple factor $r = \left(\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1\right)^{1/2} = 1.21$

Efficiency $\eta = \frac{P_{DC}}{P_{AC}} = \frac{V_{DC}^2}{V_{AC}^2} = \frac{V_{DC}^2}{V_{rms}^2} = \frac{4}{\pi^2} = 40.6\%$

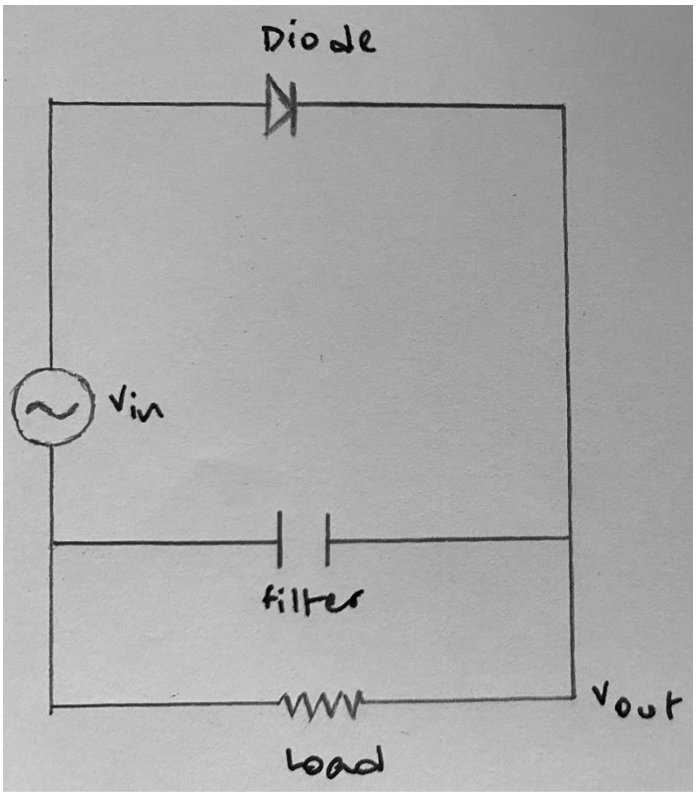
Form factor $F.F = \frac{V_{rms}}{V_{dc}} = \frac{\pi}{2} = 1.57$

Peak factor $P.F = \frac{V_m}{V_{rms}} = 2$

S. No.	Parameter	Value
1	Peak voltage (V_m)	25.25 V
2	RMS voltage (V_{rms})	12.13 V
3	DC voltage (V_{dc})	7.72 V
4	Ripple factor (r)	1.21
5	Efficiency (η)	40.6%
6	Form Factor (F.F.)	1.57
7	Peak Factor (P.F.)	2

Half Wave Rectifier (With Smoothing Capacitor)

Circuit Diagram



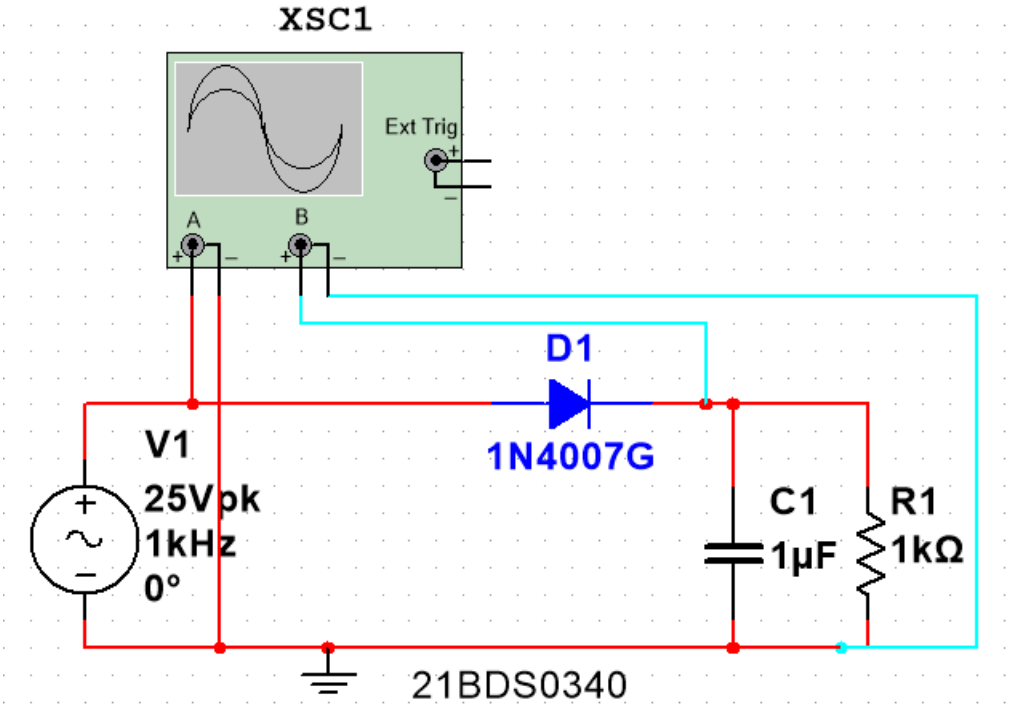
Components Required

Basic – Resistors, Capacitors

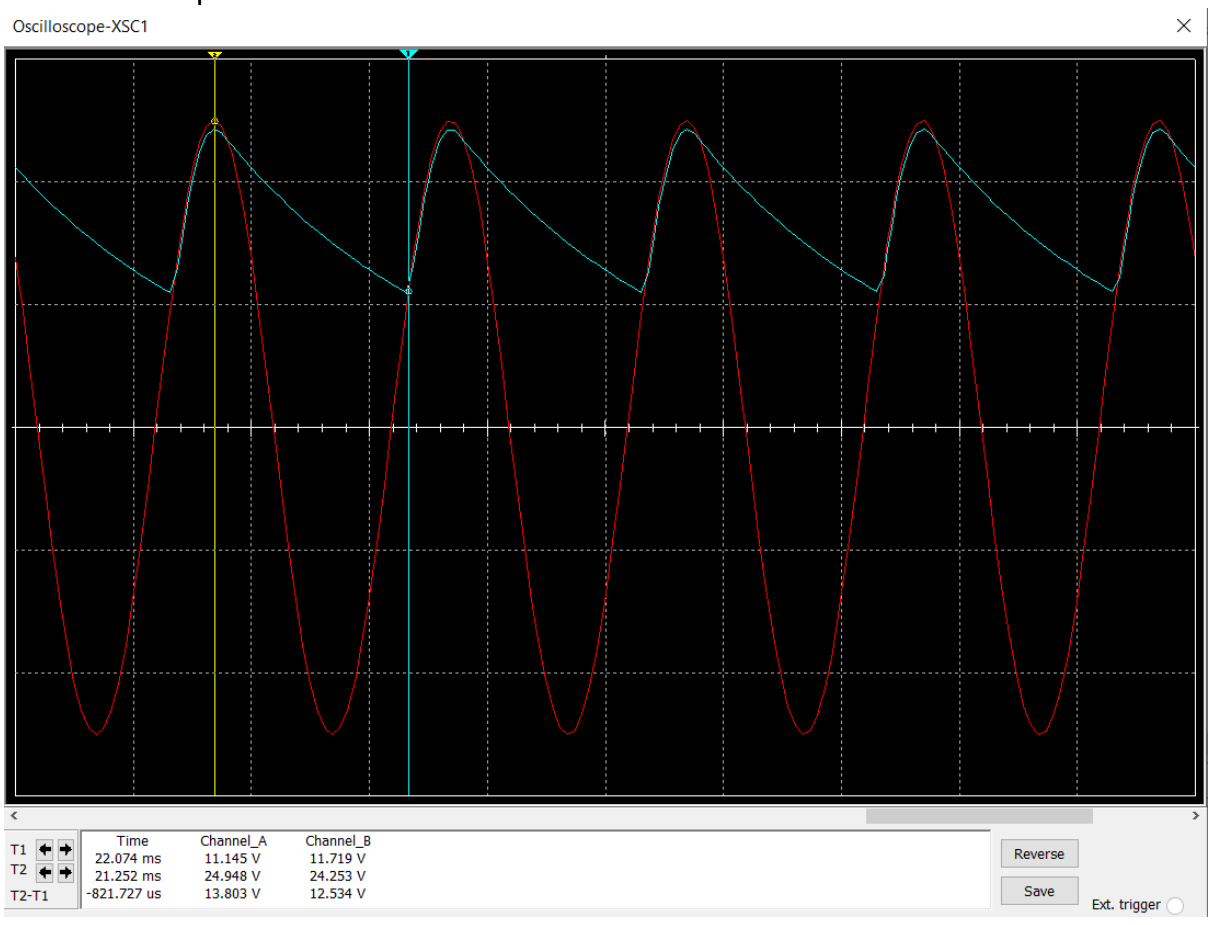
Sources – Power Sources – AC_Power, Ground

Simulate – Instruments – Oscilloscope

Simulated Circuit Diagram



Simulation Output



Calculations

$$V_{r,rms} = \frac{V_{rpp}}{2\sqrt{3}} = \frac{12.534}{2\sqrt{3}}$$

$$= 3.62 \text{ V}$$

$$\text{DC voltage } V_{dc} = V_m - \frac{V_{rpp}}{2}$$

$$= 17.99 \text{ V}$$

$$\text{Ripple Factor } r = \frac{V_{r,rms}}{V_{dc}}$$

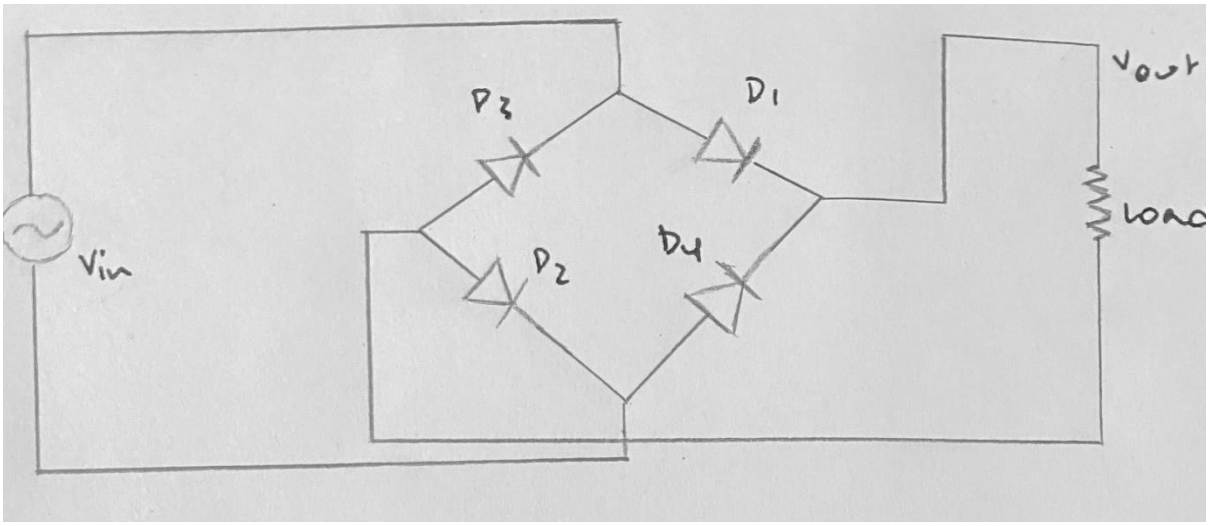
$$= 0.201$$

$$\text{Also } r = \frac{1}{2\sqrt{3} f R_L C}$$

S. NO.	Parameter	Value
1	RMS voltage $V_{r,rms}$	3.62 V
2	DC voltage V_{dc}	17.99 V
3	Ripple factor r	0.201

Full Wave Rectifier

Circuit Diagram



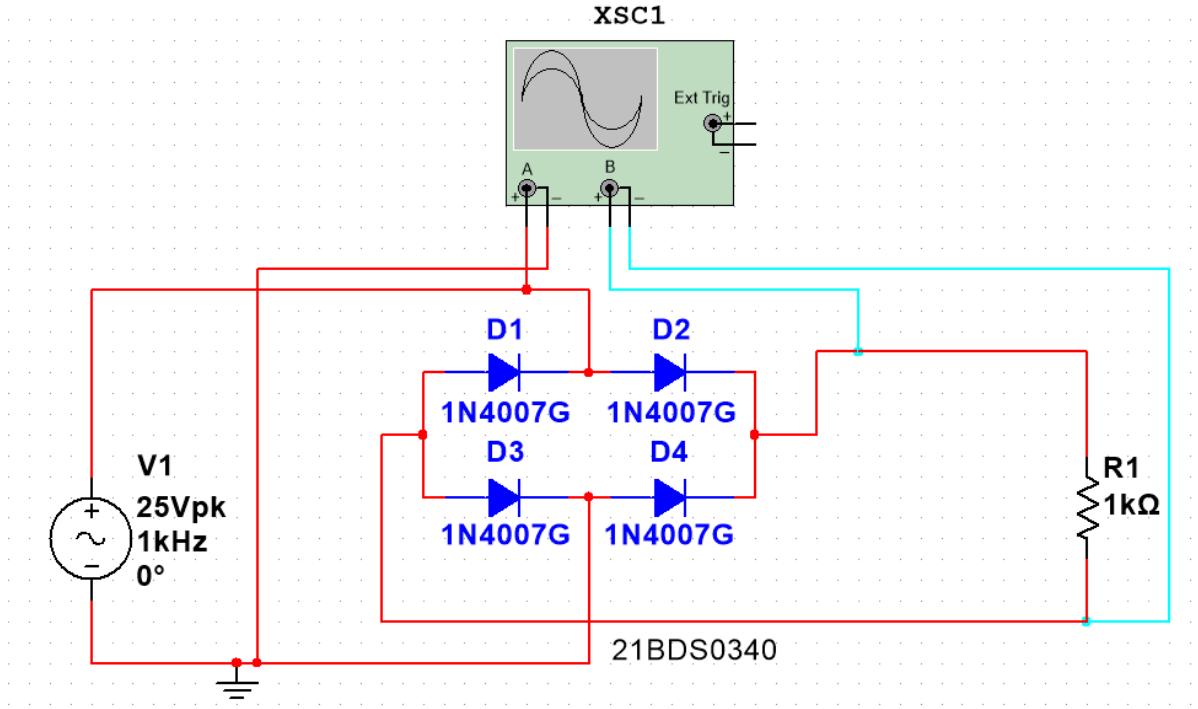
Components Required

Basic – Resistors

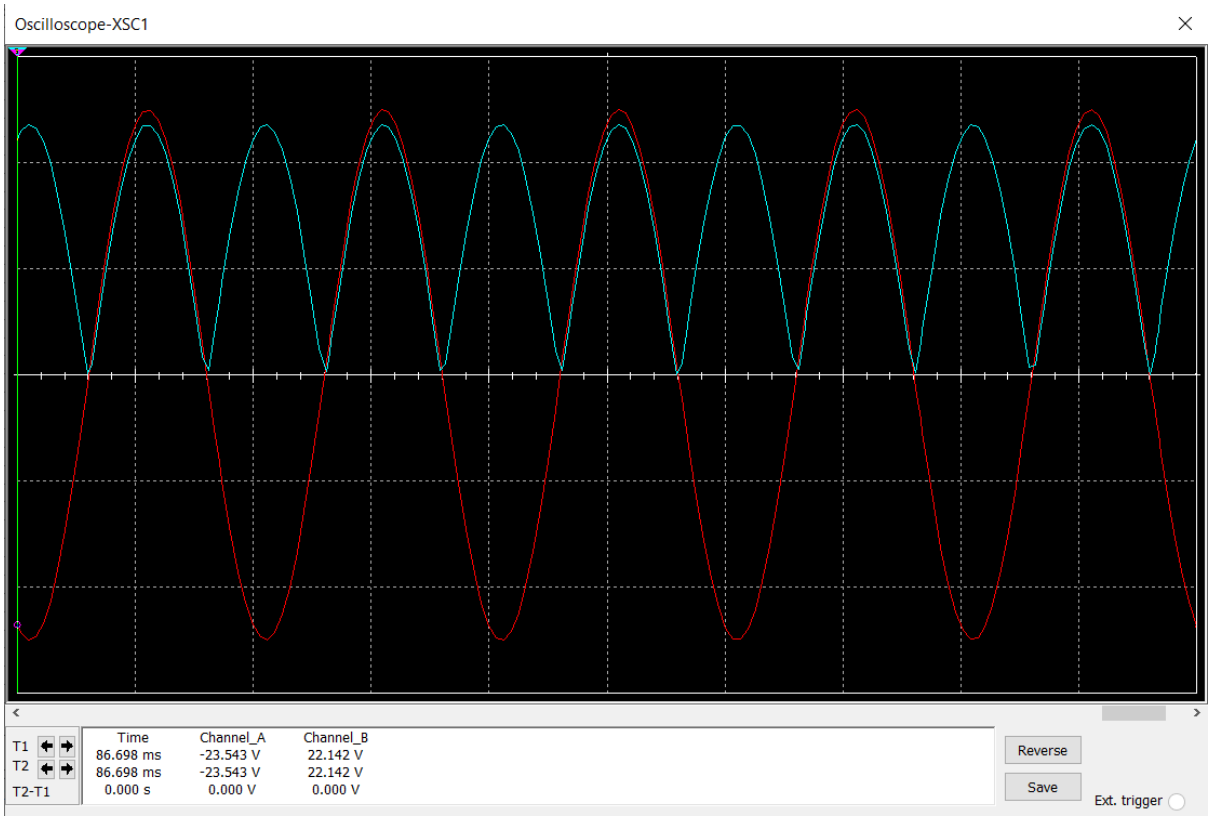
Sources – Power Sources – AC_Power, Ground

Simulate – Instruments – Oscilloscope

Simulated Circuit Diagram



Simulation Output



Calculations

RMS voltage $V_{rms} = \frac{V_m}{\sqrt{2}}$

$= 16.62\ V$

DC/Average voltage $V_{dc} = \frac{2V_m}{\pi}$

$= 14.97\ V$

Ripple Factor $r = \left(\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1\right)^{1/2}$

$= 0.482$

Efficiency $\eta = \frac{4}{\pi^2} = 81.2\%$

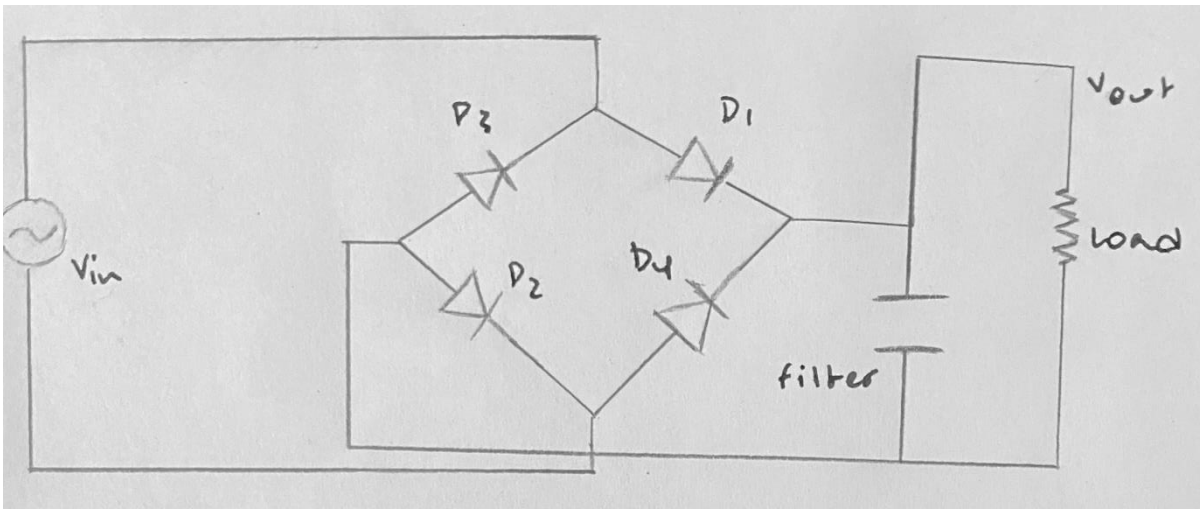
Form Factor $= \frac{V_{rms}}{V_{dc}} = \frac{\pi}{2\sqrt{2}} = 1.11$

Peak Factor $= \frac{V_m}{V_{rms}} = \sqrt{2}$

S. No.	Parameter	Value
1	V_m	23.51 V
2	RMS voltage V_{rms}	16.62 V
3	DC voltage V_{dc}	14.97 V
4	Ripple Factor r	0.482
5	Efficiency η	81.2%
6	Form Factor	1.11
7	Peak Factor	$\sqrt{2}$

Full Wave Rectifier (With Smoothing Capacitor)

Circuit Diagram



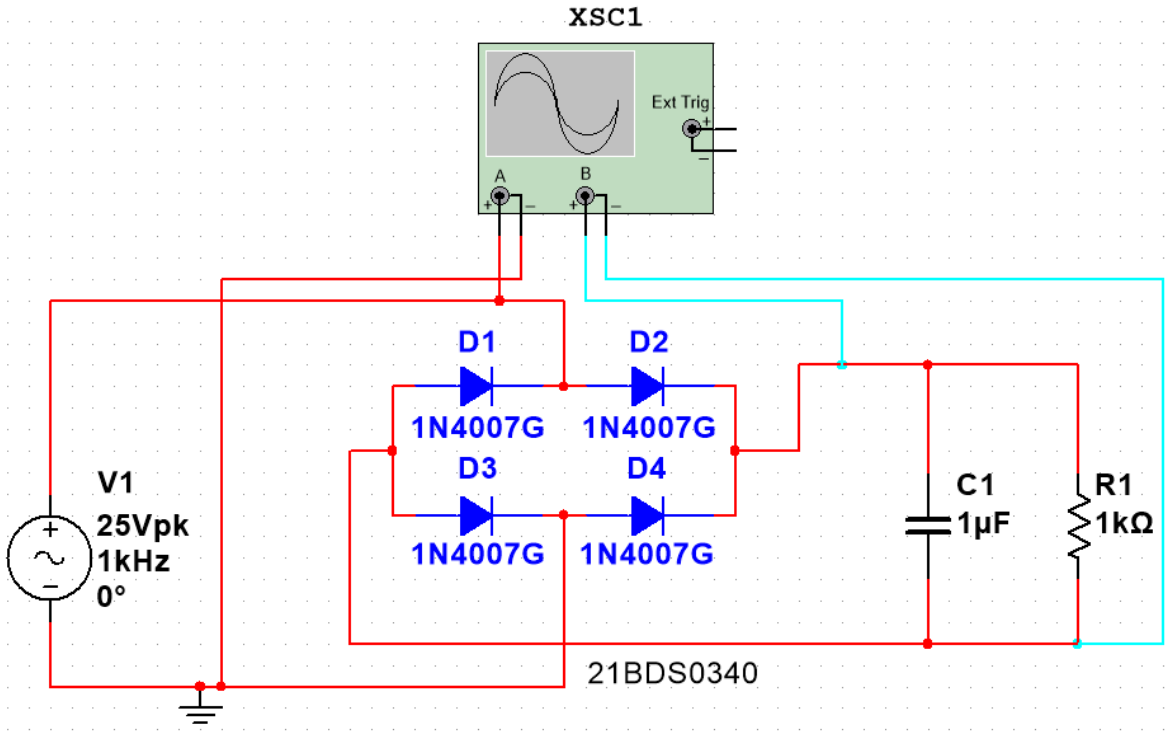
Components Required

Basic – Resistors, Capacitors

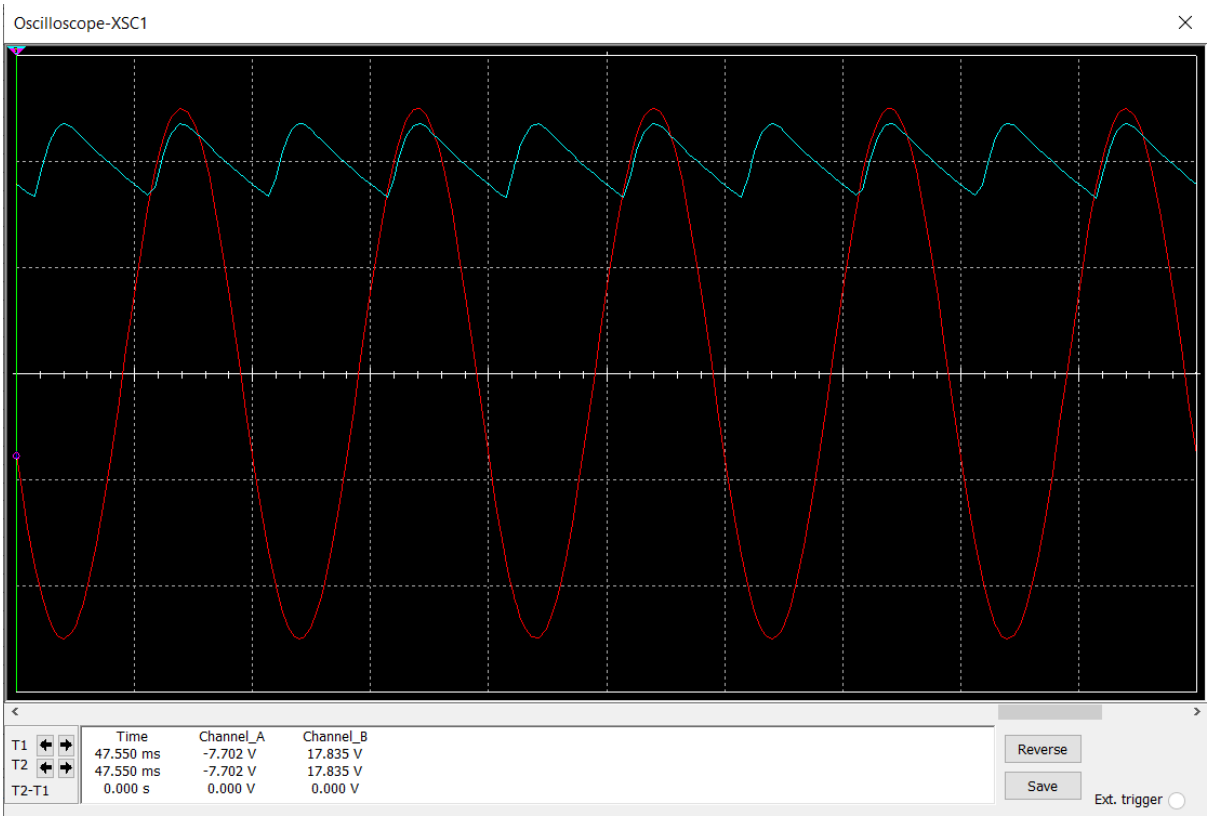
Sources – Power Sources – AC_Power, Ground

Simulate – Instruments – Oscilloscope

Simulated Circuit Diagram



Simulation Output



Calculations

RMS voltage $V_{r,rms} = \frac{V_{rpp}}{2\sqrt{3}}$

$= 2.01\ V$

DC voltage $V_{dc} = V_m - \left(\frac{V_{rpp}}{2}\right)$

$= 20.03\ V$

Ripple Factor $\gamma = \frac{V_{r,rms}}{V_{dc}}$

$= 0.1$

S. No.	Parameter	Value
1	RMS voltage $V_{r,rms}$	2.01 V
2	DC voltage V_{dc}	20.03 V
3	Ripple Factor γ	0.1

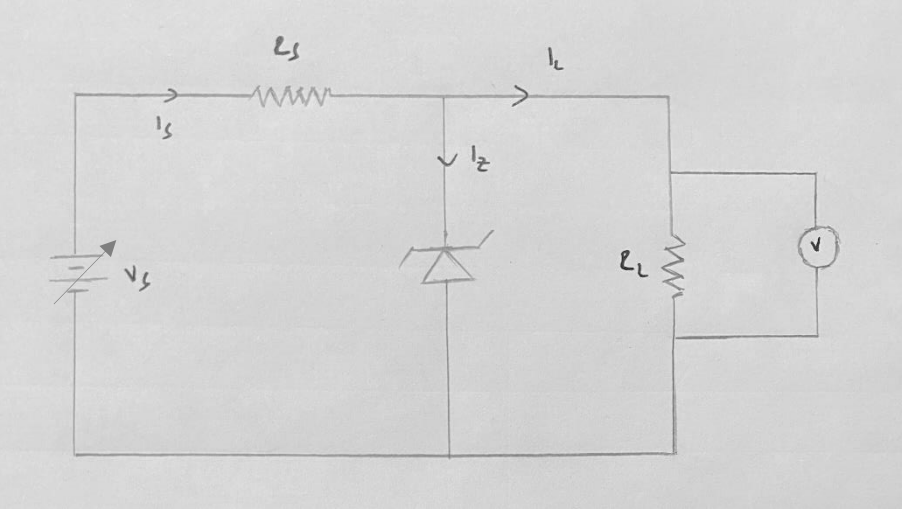
Verification Message

Exercise No.: 2 Date: 17/03/22

Zener Diode as a Voltage Regulator

Line Regulation

Circuit Diagram



Components Required

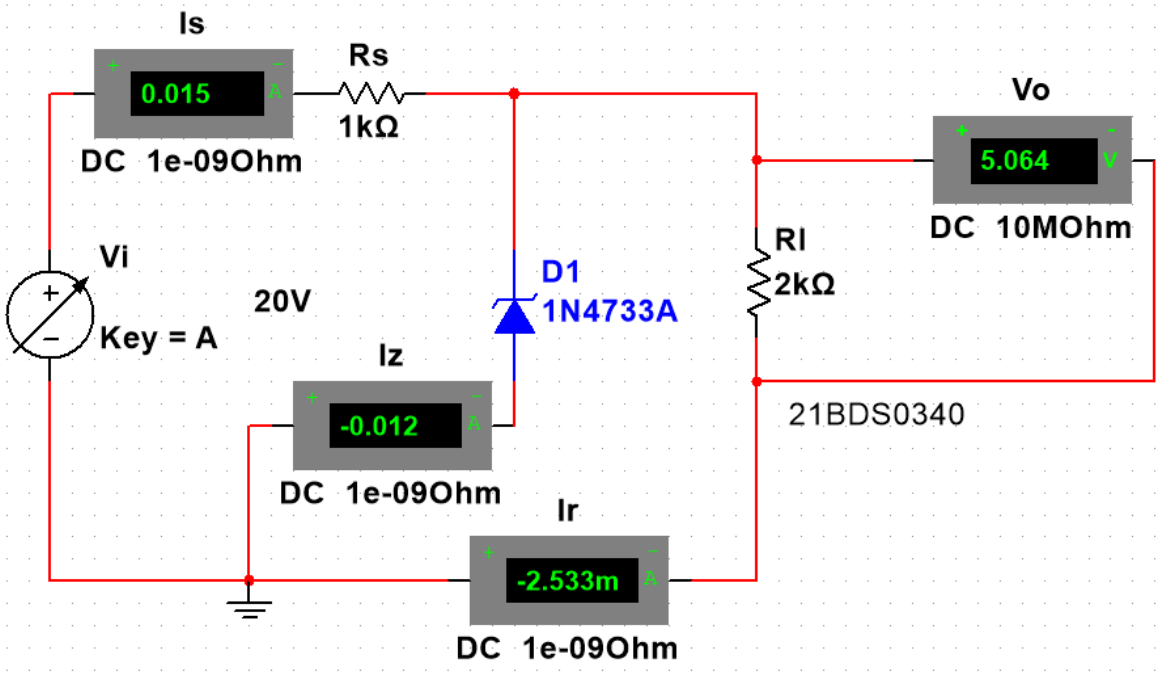
Basic – Resistors

Sources – Power Sources – Variable DC Power, Ground

Diodes – Zener – 1N4733A

Toolbars – Measurement Components – Ammeter, Voltmeter

Simulated Circuit Diagram



Calculations

In line regulation, load resistance is constant and input voltage varies. V_s must be sufficiently large to turn the zener diode on.

$$V_L = V_2 = \frac{V_{1min} \times R_L}{(R_s + R_L)}$$

So, the minimum turn-on voltage V_{1min} is:

$$V_{1min} = \frac{V_2 \cdot (R_s + R_L)}{R_L}$$

Taking:

$V_2 = 5.1\ V$

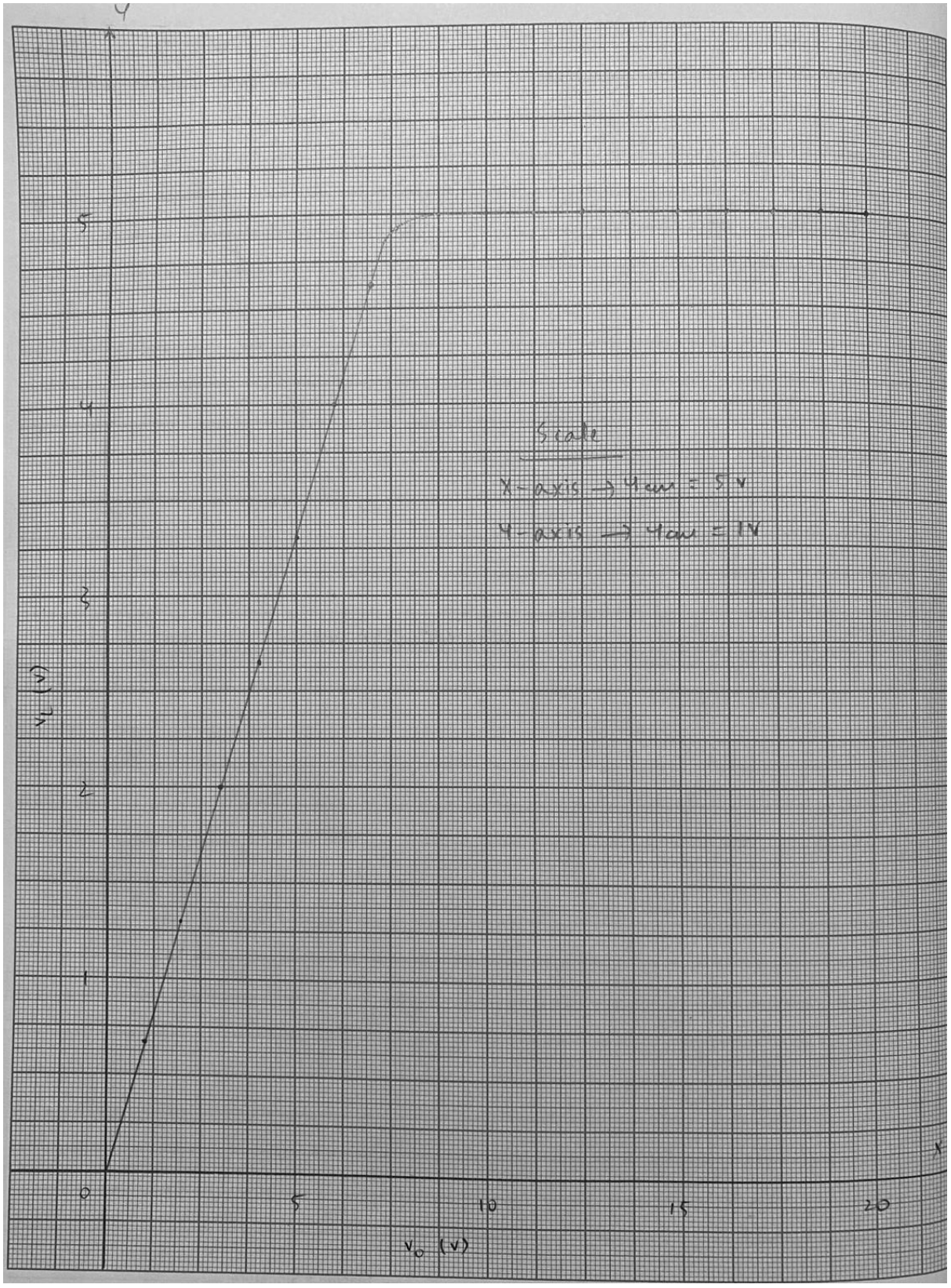
$R_s = 1000\ ohm$

$R_L = 2000\ ohm$

$$\therefore V_{1min} = \frac{5.1 \times 3000}{2000}$$

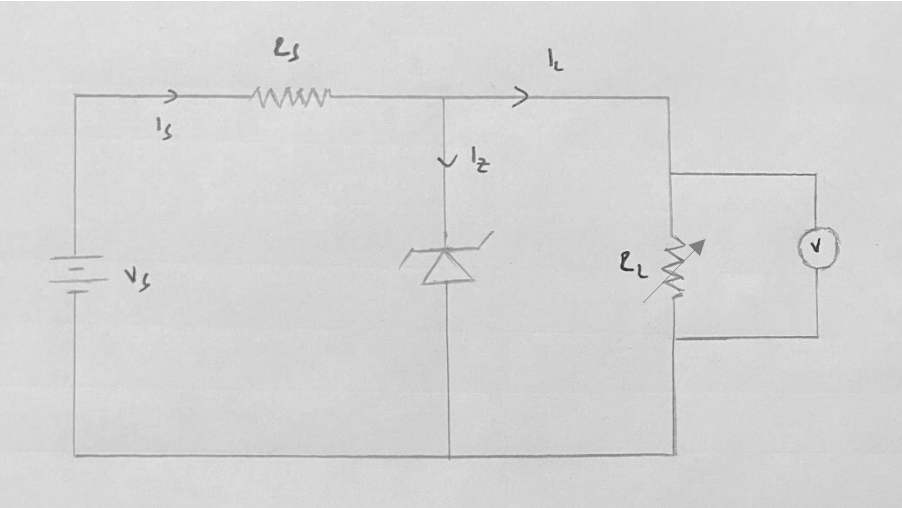
$$= 7.65\ V$$

Graph



Load Regulation

Circuit Diagram



Components Required

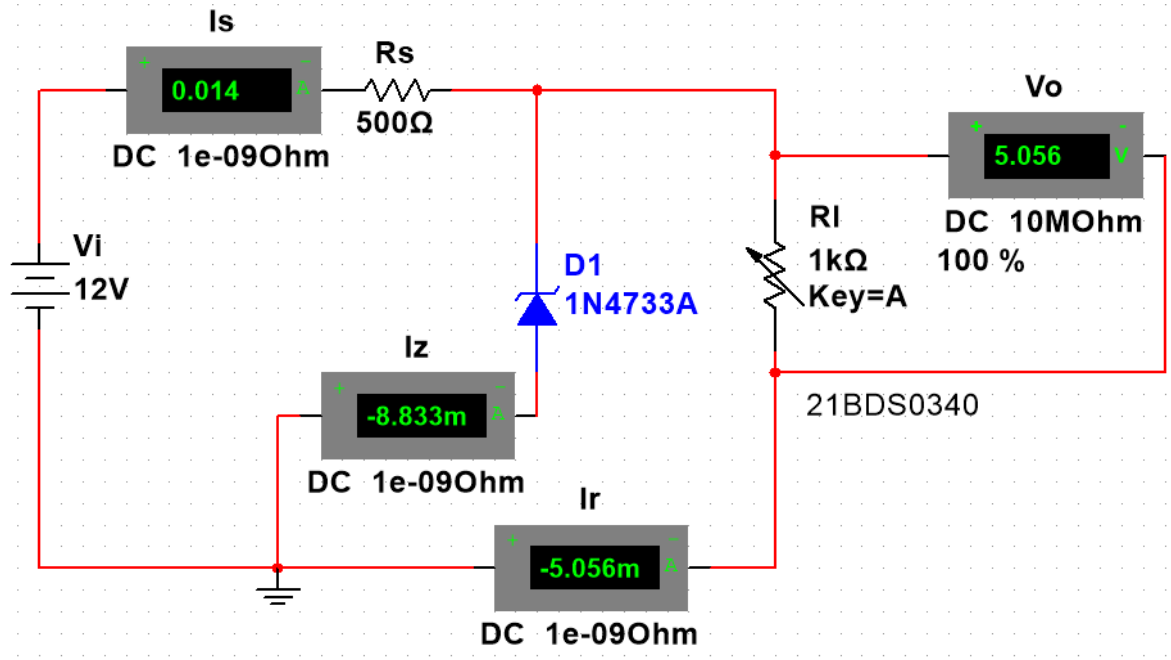
Basic – Resistor, Variable Resistor

Sources – Power Sources –DC Power, Ground

Diodes – Zener – 1N4733A

Toolbars – Measurement Components – Ammeter, Voltmeter

Simulated Circuit Diagram



Calculations

In load regulation, input voltage is constant and load resistance varies. Too small a load, will result in making the zener diode off.

$$V_L = V_2 = \frac{V_1 \times R_{Lmin}}{(R_S + R_{Lmin})}$$

So the minimum load resistance R_L:

$$R_{Lmin} = \frac{V_2 \times R_S}{V_1 - V_2}$$

Taking:

$V_2 = 5.1\,V$

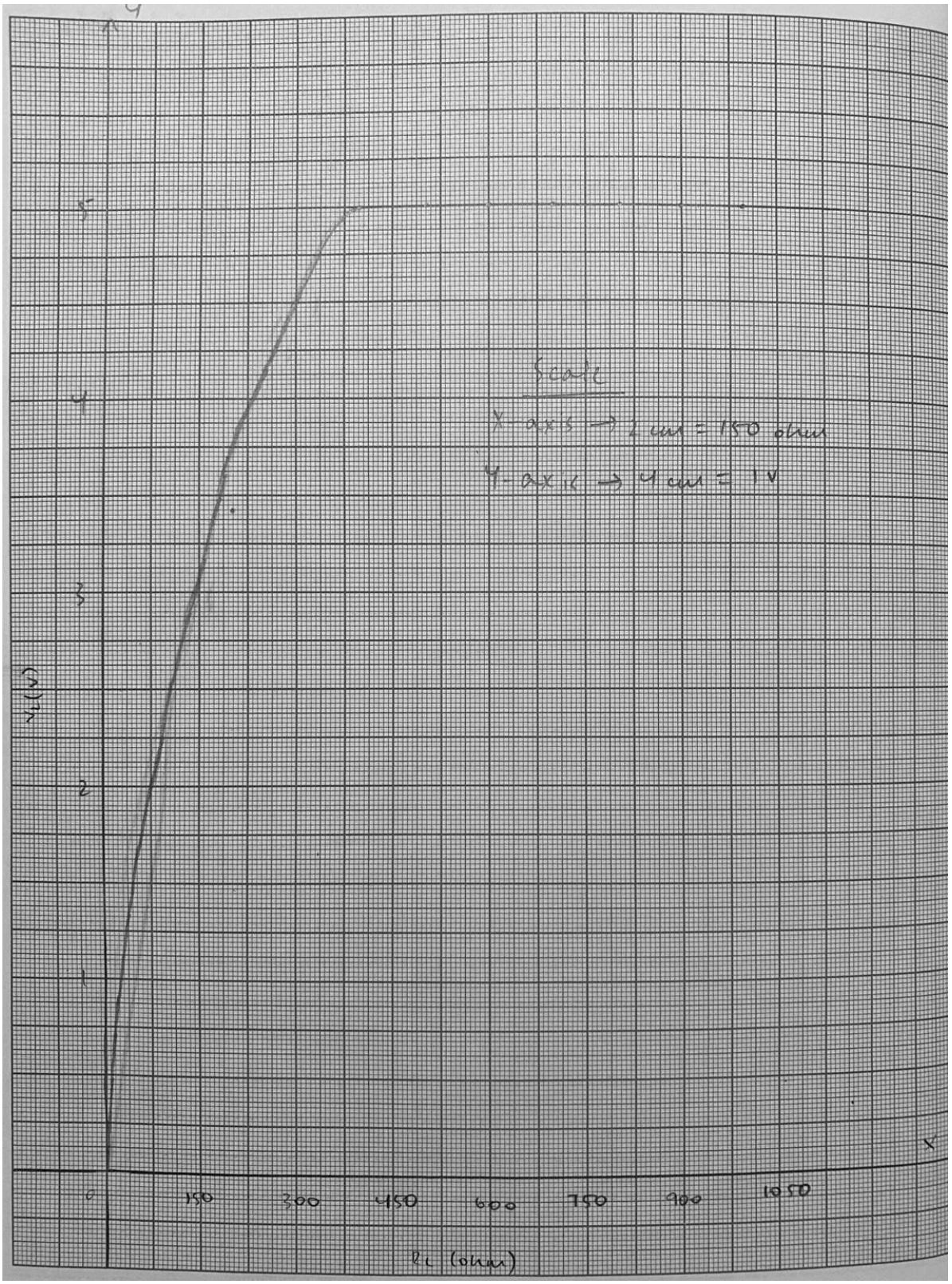
$R_S = 500$ ohm

$V_1 = 12\,V$

$$\therefore R_{Lmin} = \frac{5.1 \times 500}{12 - 5.1}$$

$$= 369.57 \text{ ohm}$$

Graph


Scale
X axis → 1 cm = 150 ohm
Y axis → 4 cm = 1 V
5
4
3
2
1
0
150
300
450
600
750
900
1050
R_L (ohm)

Verification Message