FY BTech
BEEE Lab
Expt. 2
Half Wave Rectifier- HWR

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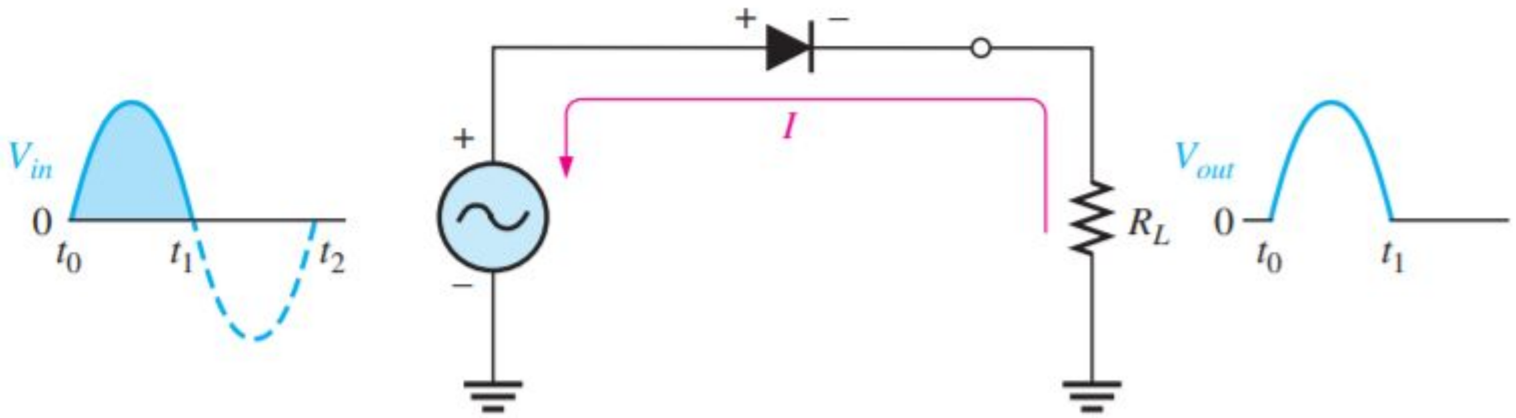
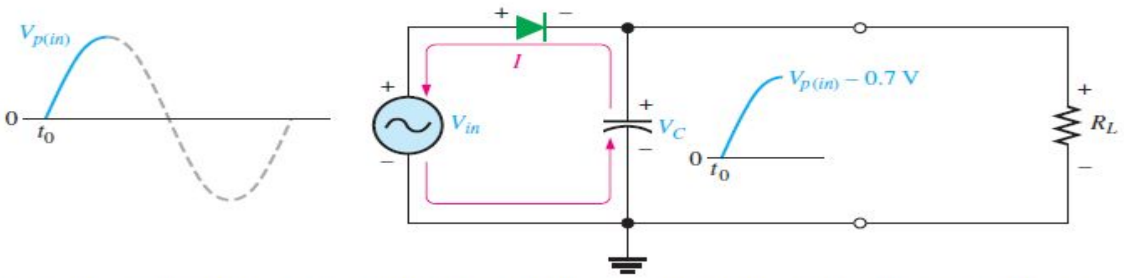
Half Wave Rectifier Circuit

HWR animation can be seen at : https://www.youtube.com/watch?v=8Bzt-FFvRgQ

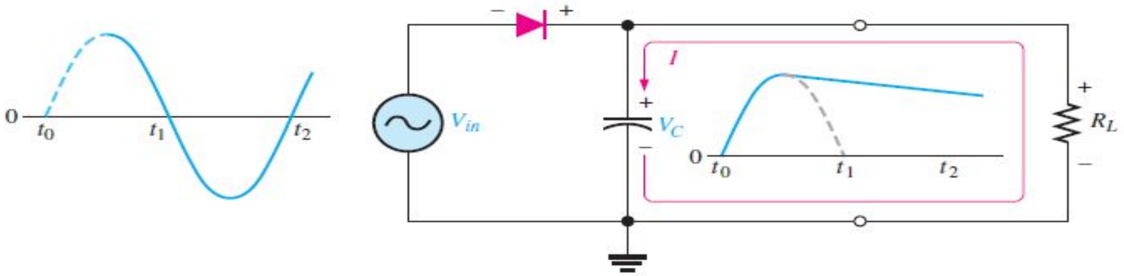


- A diode is connected to an ac source and to a load resistor, R_L, This forms a half-wave rectifier.
- All ground symbols represent the same point electrically.
- Considering the diode as ideal diode, during +ve half cycle of the input voltage , input voltage (Vin) goes positive, the diode is forward-biased and conducts current through the load resistor.
- The current produces an output voltage across the load RL, which has the same shape as the positive half-cycle of the input voltage.

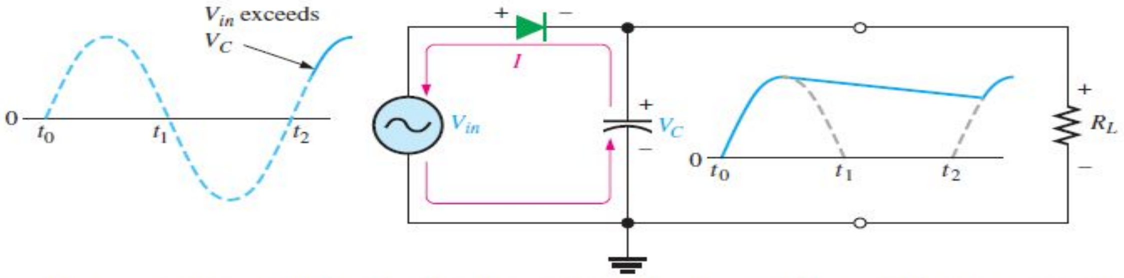
Half-Wave Rectifier with Filter Capacitor



(a) Initial charging of the capacitor (diode is forward-biased) happens only once when power is turned on.

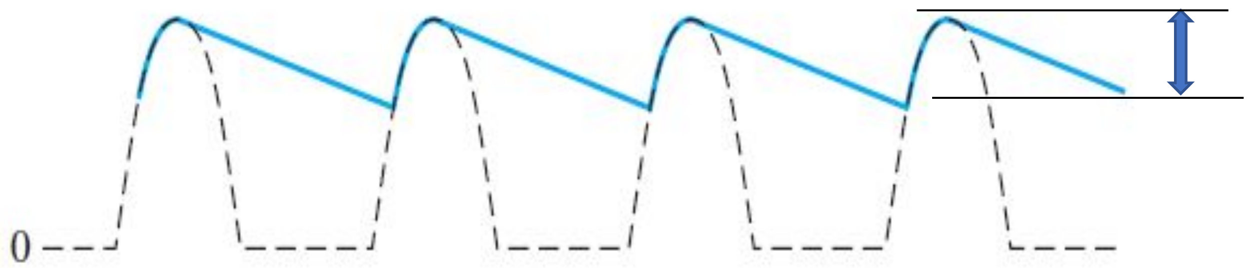


(b) The capacitor discharges through R_L after peak of positive alternation when the diode is reverse-biased. This discharging occurs during the portion of the input voltage indicated by the solid dark blue curve.

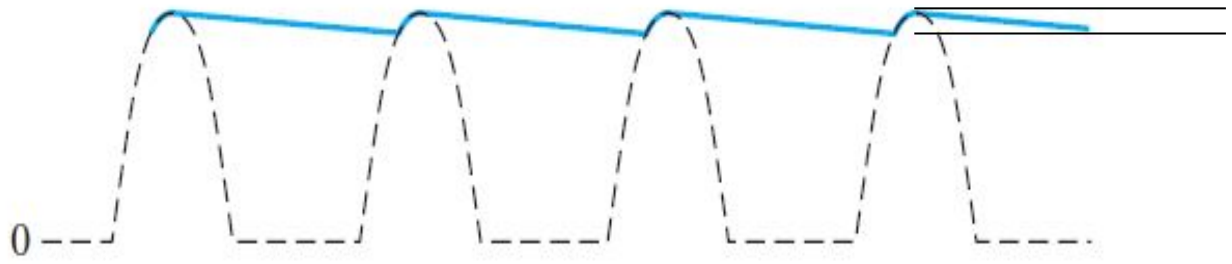


(c) The capacitor charges back to peak of input when the diode becomes forward-biased. This charging occurs during the portion of the input voltage indicated by the solid dark blue curve.

Ripple Voltage Comparison in HWR



(a) Larger ripple (blue) means less effective filtering.



(b) Smaller ripple means more effective filtering. Generally, the larger the capacitor value, the smaller the ripple for the same input and load.

Labwork from each student
Circuit Simulation in Tinkercad

- Create new circuit in Tinkercad
- Select function generator(AC signal source), breadboard, diode, resistance, polarized capacitor, oscilloscope, multimeter
- Select proper component values
- Make the connections to build the circuit
- Start simulation to check its operation
- Share, download and name the image file with roll no., expt no

HWR and HWR with filter circuit simulation in Tinkercad

- AC signal source- Function Generator

  10 V peak to peak, 50 Hz(Mains Supply frequency)

- Component Values suggested-

  RL=10Kohms, C= 10 microF and

  RL=10kohms and C= 1 microF

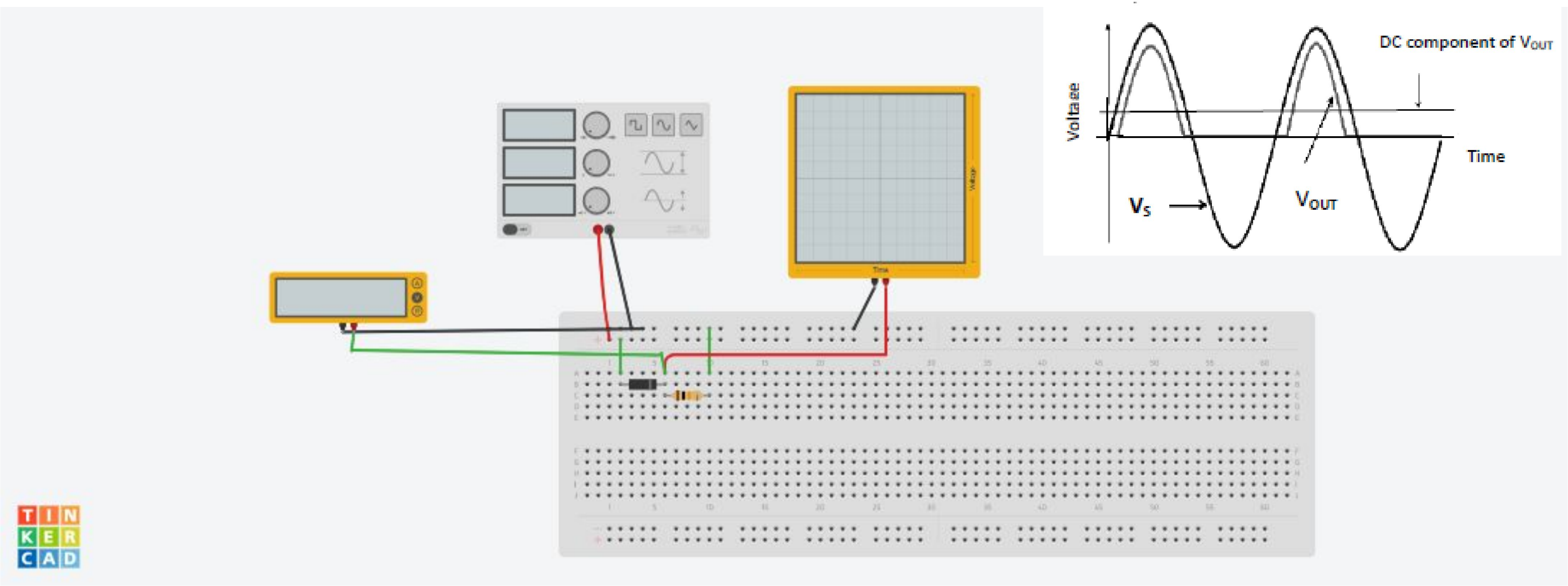
- Waveforms observations on oscilloscope-

  Case 1-HWR output without filter capacitor

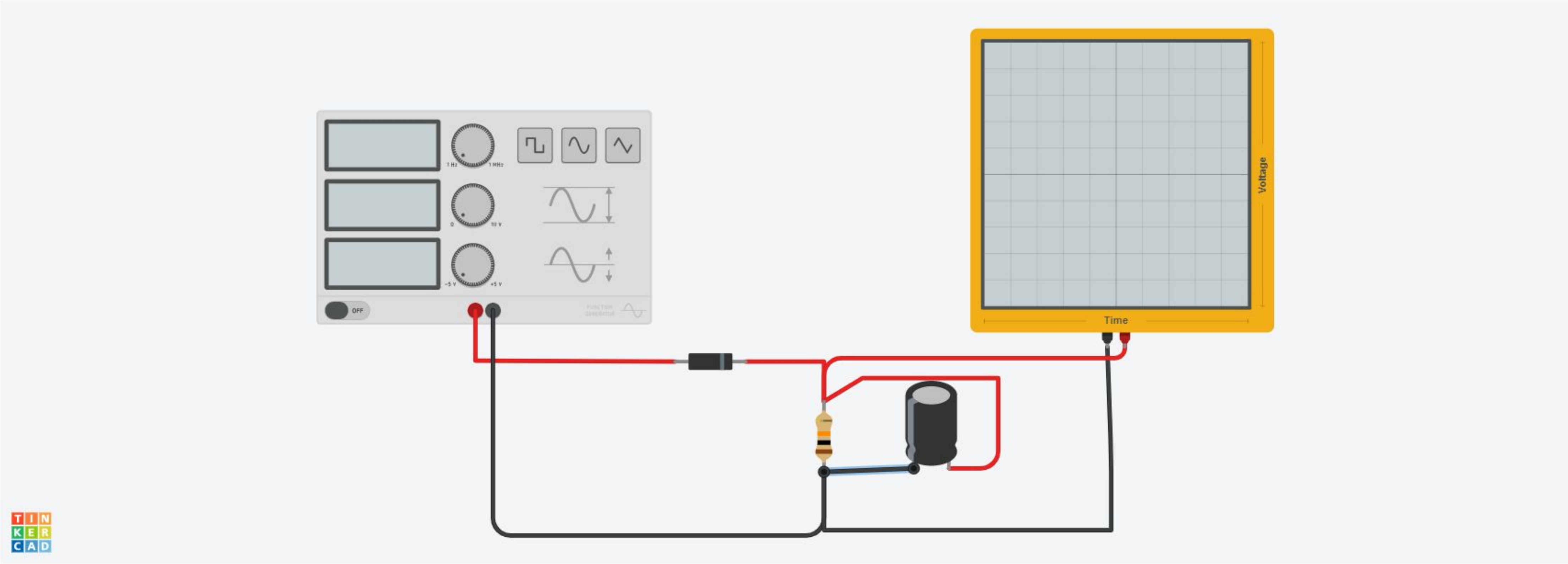
  Case 2-HWR output with filter capacitor for both capacitors

- Readings, Calculations, result verification

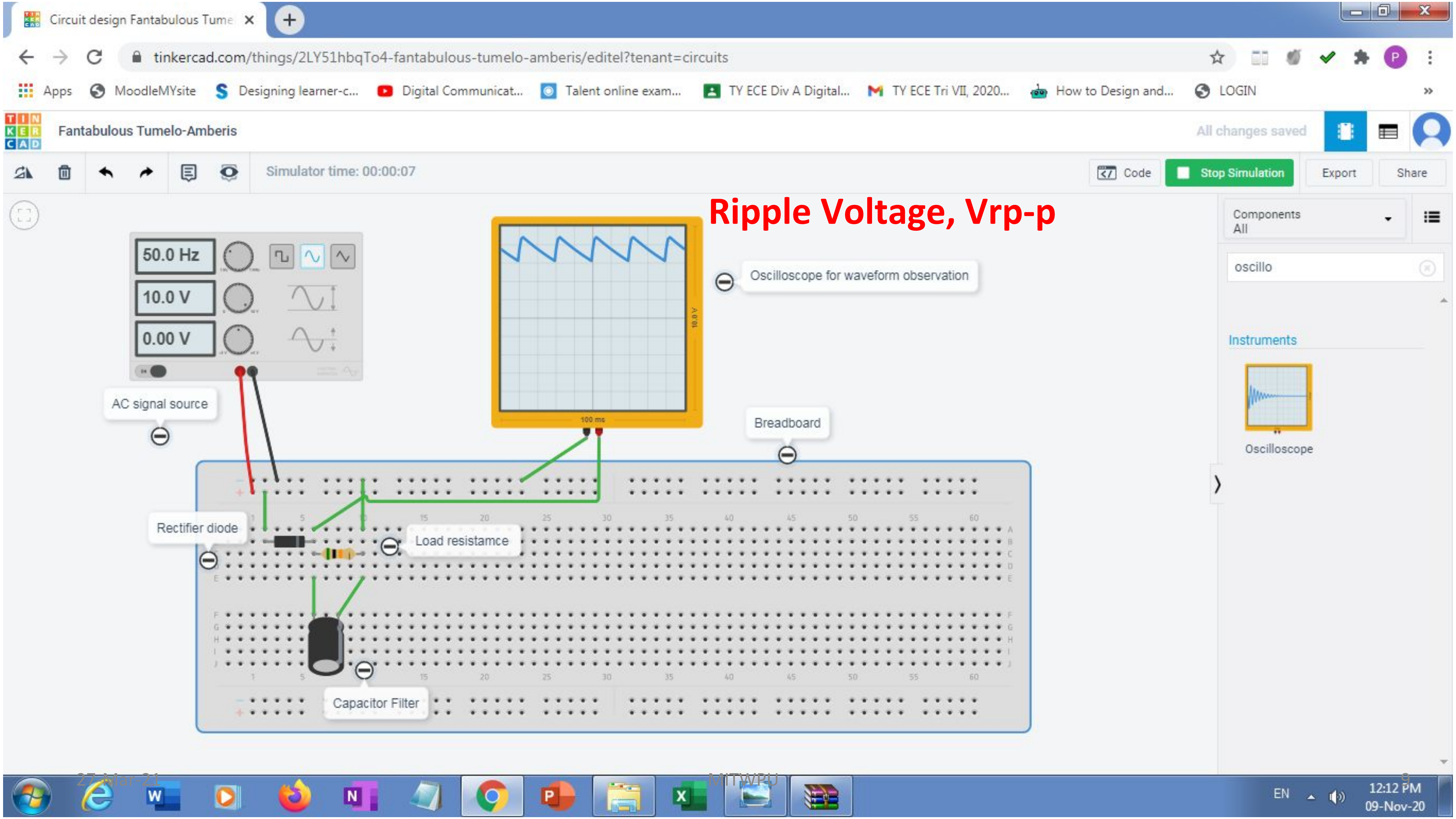
HWR without C filter

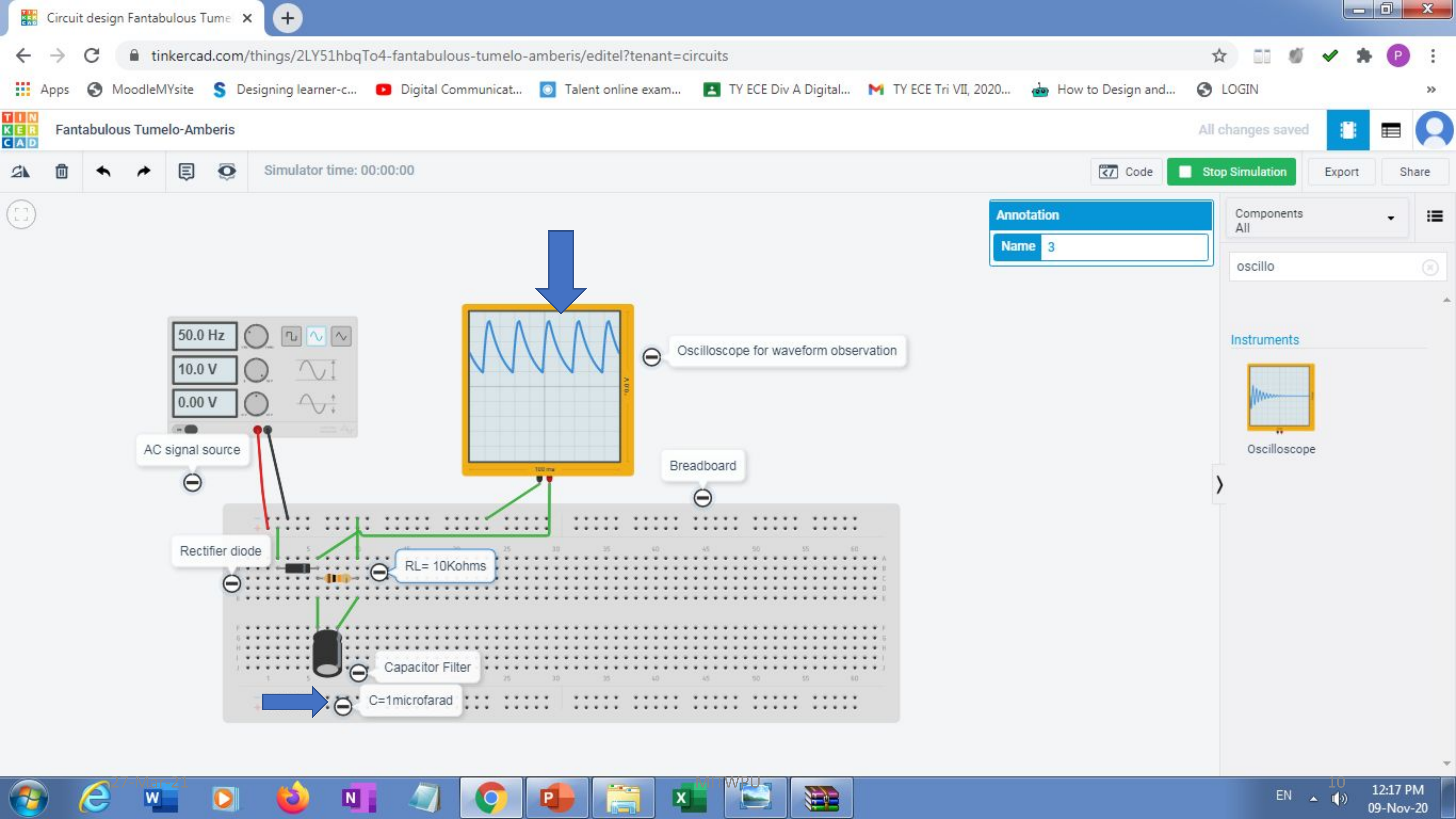


HWR with C - Circuit without breadboard will not be acceptable



Tinkercad Simulation Results




Circuit design Fantabulous Tume
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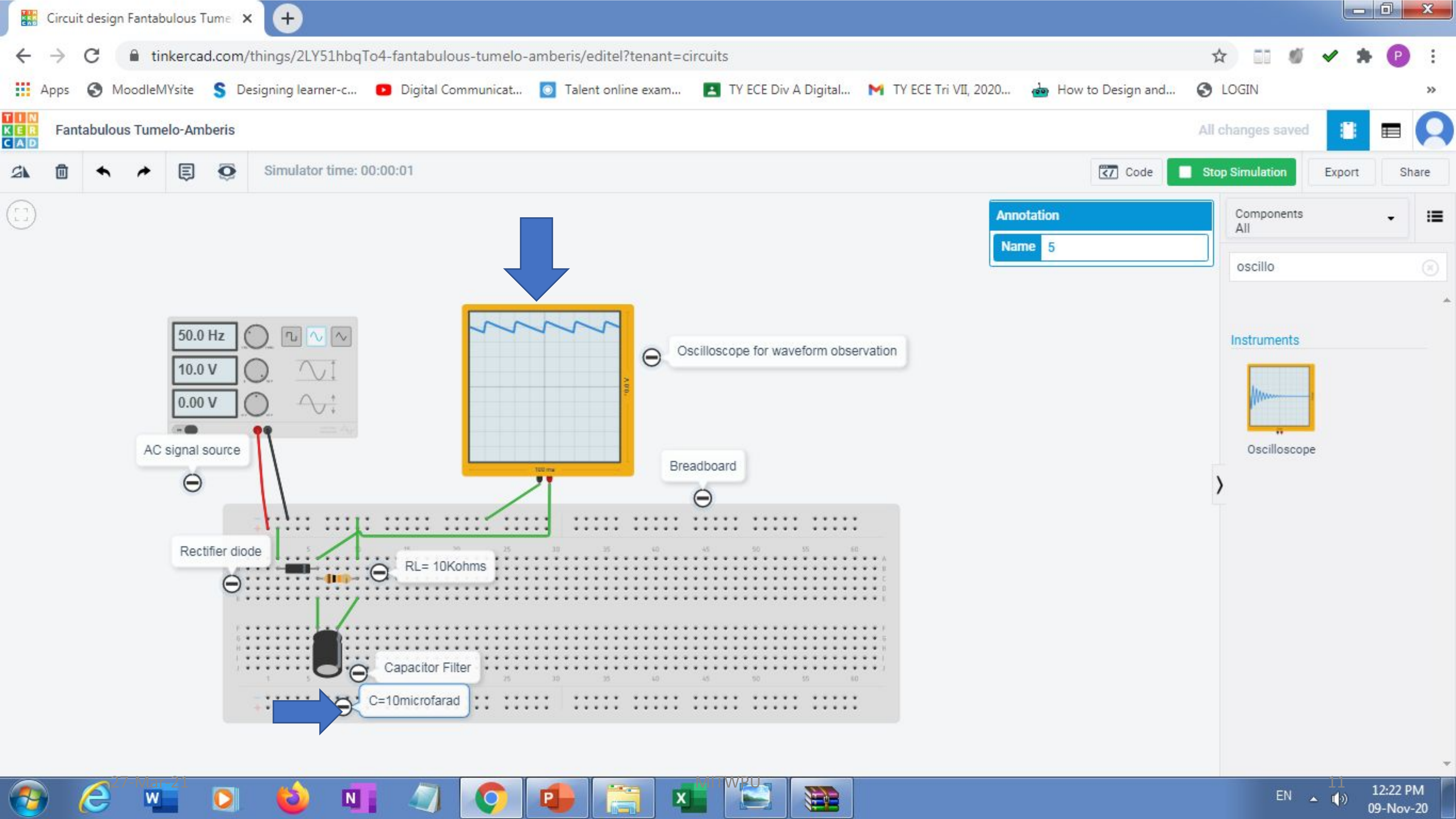
All changes saved
Simulator time: 00:00:00
Code
Stop Simulation
Export
Share
Annotation
Name 3
Components All
oscillo
Instruments
Oscilloscope
50.0 Hz
10.0 V
0.00 V
AC signal source
Oscilloscope for waveform observation
Breadboard
Rectifier diode
RL= 10Kohms
Capacitor Filter
C=1microfarad
12:17 PM
09-Nov-20


Circuit design Fantabulous Tume
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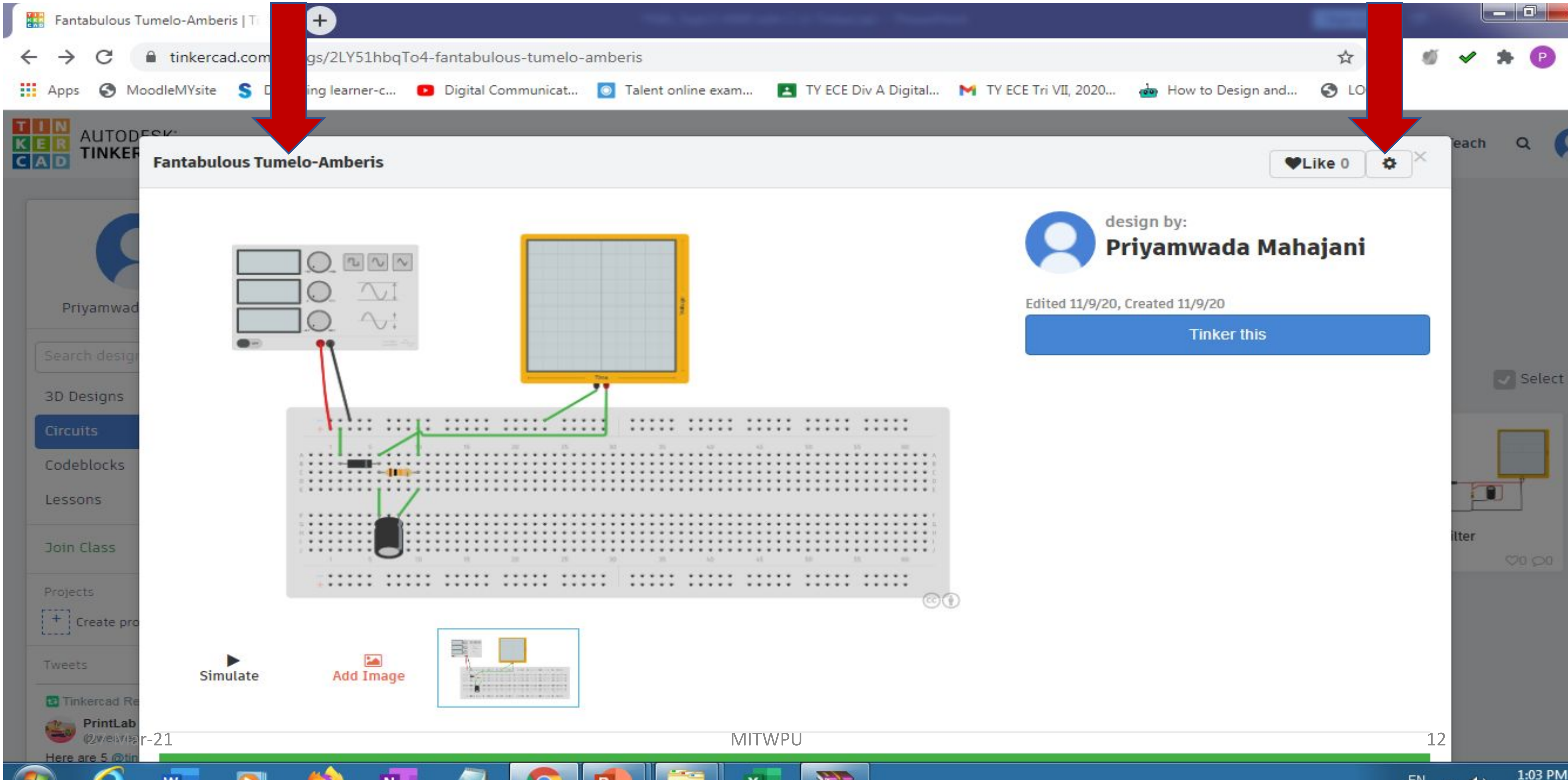
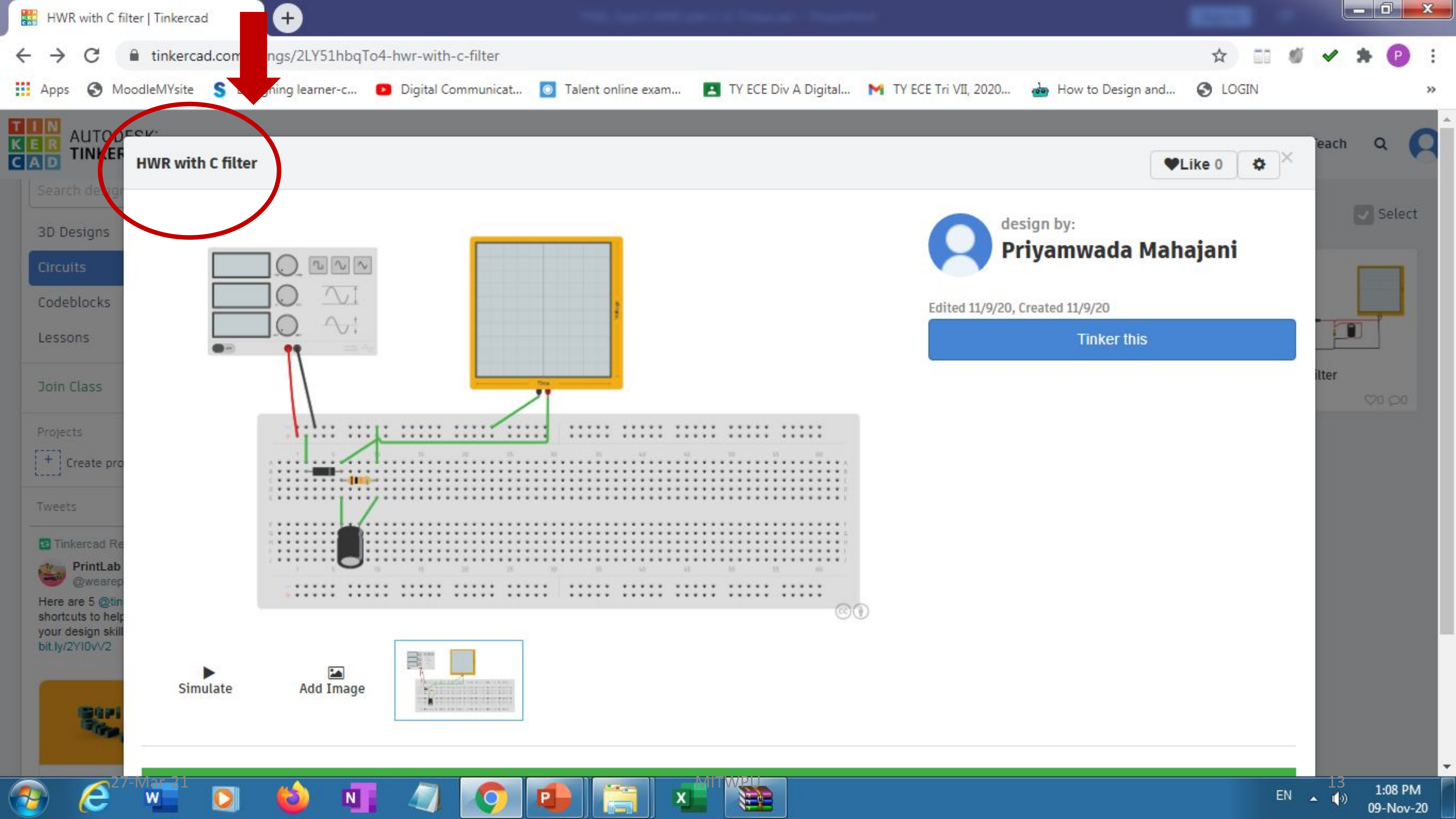
Fantabulous Tumelo-Amberis
All changes saved
Simulator time: 00:00:01
Code
Stop Simulation
Export
Share
Annotation
Name 5
Components All
oscillo
Instruments
Oscilloscope
50.0 Hz
10.0 V
0.00 V
AC signal source
Oscilloscope for waveform observation
Breadboard
Rectifier diode
RL= 10Kohms
Capacitor Filter
C=10microfarad
12:22 PM
09-Nov-20

How to name the circuit?




HWR with C filter | Tinkercad
HWR with C filter
Like 0
design by:
Priyamwada Mahajani
Edited 11/9/20, Created 11/9/20
Tinker this
Simulate
Add Image
3D Designs
Circuits
Codeblocks
Lessons
Join Class
Projects

Theoretical and Practical Result verification

Calculation of ripple factor, r

1. Ripple Factor without filter= r = 1.21

2. Ripple Factor with filter= r = $V_{r\,rms}/V_{DC}$

To calculate V r rms, use Vr rms=Vrpp/2√3,

Measure Vr pp from Oscilloscope,

Measure VDC on multimeter

$$\text{Ripple factor}, r = 1/\ 2fCR\sqrt{3}$$

Lab Continuous Assessment- LCA
Lab Submission

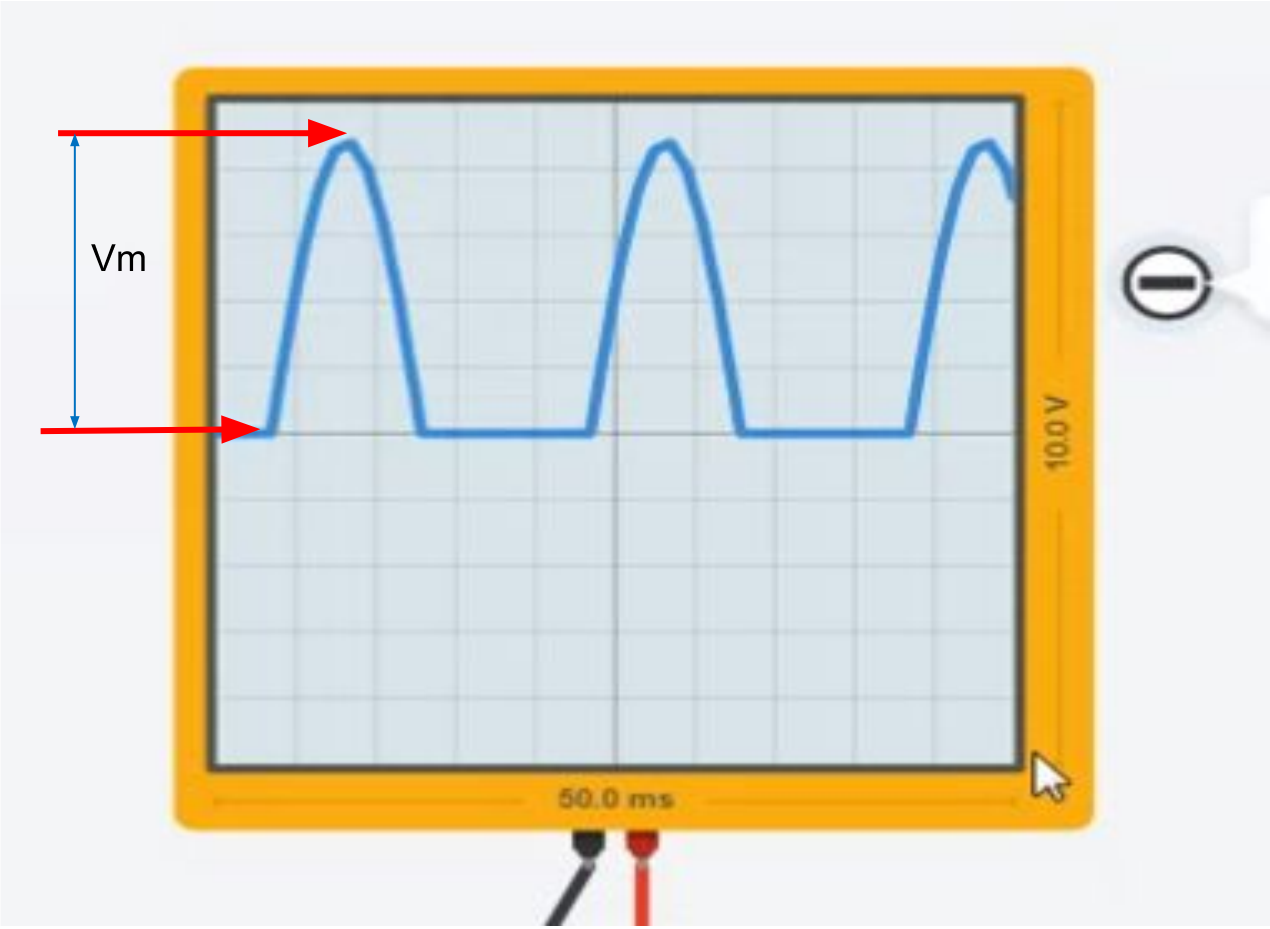
- Timely submission of one file in Teams/ google classroom/ CANVAS…
- Lab manual with readings and calculations, graph, conclusion
- Handwritten Answers to postlab questions
- Tinkercad circuit and component list with proper name with your roll no.
- Your learning experience with Tinkercad

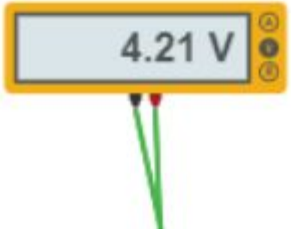
Sample results

- Case 1- Ripple factor verification in HWR
- Case 2 – Ripple factor verification in HWR with C

- Students need to complete the result table as per their calculations

Ripple factor without filter		Ripple factor with filter	
Theoretical	**Practical**	**Theoretical**	**Practical**





-Reading using Millimeter

-Voltage across Load Resistor(VL DC)

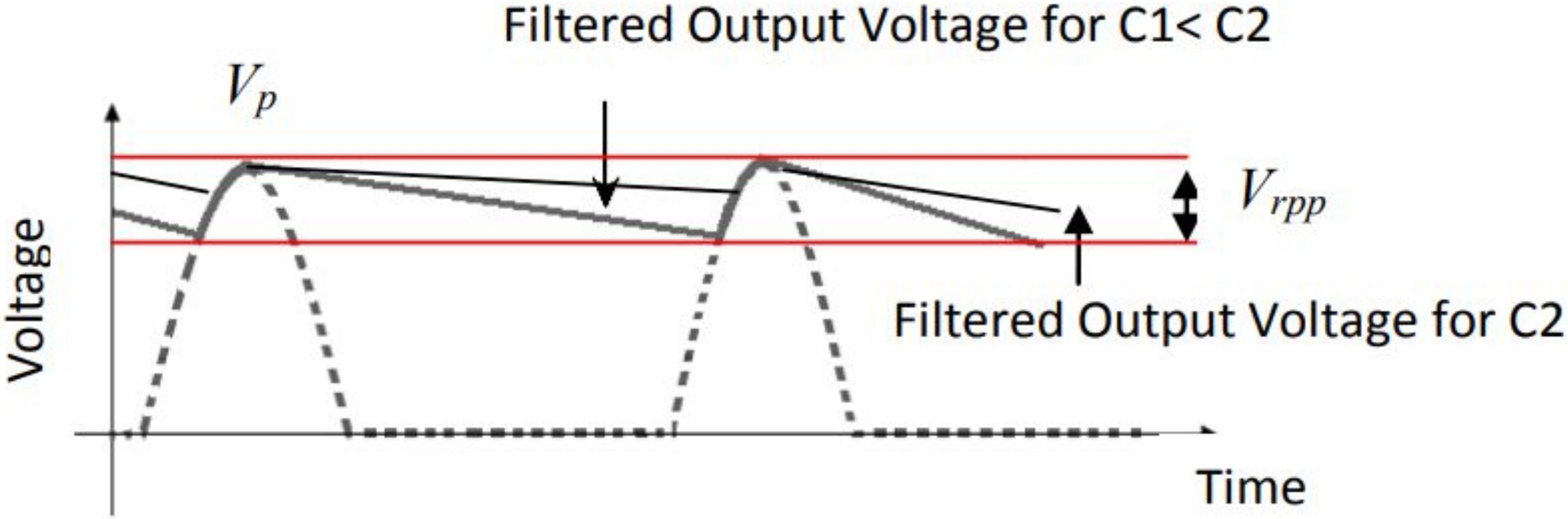
Sample results -Case1

-

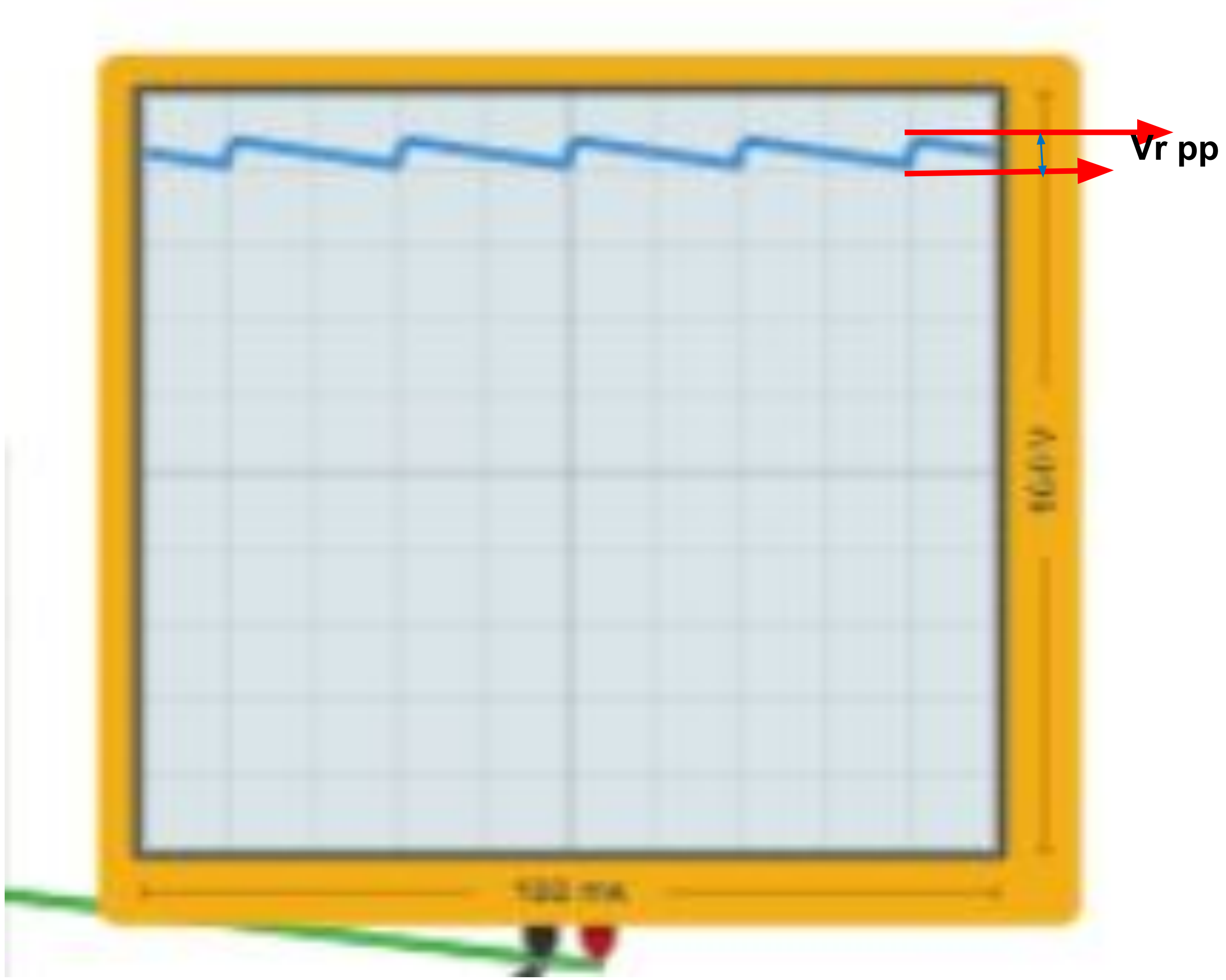
- I/P amplitude =10V(P-P)

- V_{LDC}= Vm/∏= 5V/3.14=1.59v
- V_{LDC}(ON Meter)=1.51v
- Vrms = Vm /2=5/2=2.5v

- r= $\sqrt{\left(\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1\right)}$
- **r=√(**2.5/1.51)^2-1
- r=1.31


Filtered Output Voltage for C1< C2
V_p
V_{rpp}
Filtered Output Voltage for C2
Voltage
Time

Vrpp(Ripple Voltage)



How to take Readings(HWR)

- Theoretical
- Input Amplitude=10 Vpp(FG)
- Vm=Vpp/2=10/2=5
- V_{Ldc} = Vm / π =5/3.14=1.59v
- $V_{rms} = \frac{V_m}{2}$ =5/2=2.5

r= $\sqrt{\left(\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1\right)}$

- Practical(Without Filter)
- Measure on CRO=Vm=4.5
- V_{LDC} from Multimeter= 1.48
- ------------------------------------
- Practical(With Filter)
- Measure on CRO=Vm
- V_{LDC} from Multimeter
- V_{rpp} from CRO=0.4
- $V_{r\_rms} = \frac{V_{rpp}}{2\sqrt{3}}$
- r =Vr rms/V_{LDC}

Ripple factor , r = 1/ 2fCR√3 Theoretical

Case 2

Case 2 Ripple factor verif^n in HWR with Filter -

Using formula - Theoretical.

(1) $r = \frac{1}{2fRC\sqrt{3}} = \frac{1}{2\times 50\times 10\times 10^{3}\times 10\times 10^{-6}\times\sqrt{3}}$

$= 0.057$.

(2) Using readings in Tinkercad instruments -

CRO - Used for $V_{r_{pp}}$ measurement

Multimeter - Used for V_{LDC} measurement.

$V_P \rightarrow 10V_{p\text{-}p}$, 50Hz sine wave.

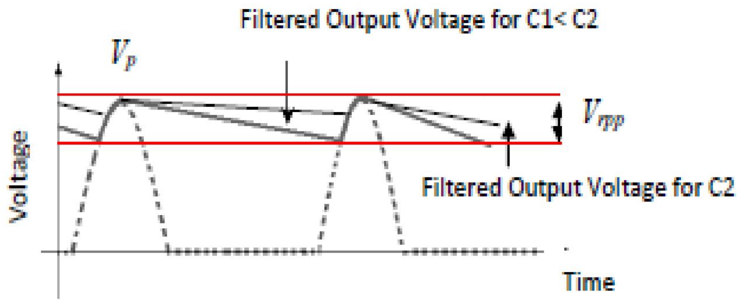
$\gamma = \frac{V_{r_{rms}}}{V_{LDC}}$.

From CRO.

* $V_{r_{rms}} = \frac{V_{r_{pp}}}{2\sqrt{3}} = \frac{0.9}{2\sqrt{3}} = 0.26$.

* $V_{LDC} = 4.27V$ ← From Multimeter.

$r_{practical} = \frac{0.26}{4.27} = 0.060$



Sr. no.	C(μF)	Values / Quantities	V_{rpp}	V_{Ldc}	I_{Ldc}
1	**C1=**	Theoretical			
		Practical			
2	**C2=**	Theoretical			
		Practical			

Values / Quantities	C(μF)	V_{rpp}	V_{Ldc}	I_{Ldc}
Theoretical	100	1.16 V	5/π = 1.6 V	1.6 mA
Practical	100	0.4 V	1.72	1.72/1000 = 1.72 mA