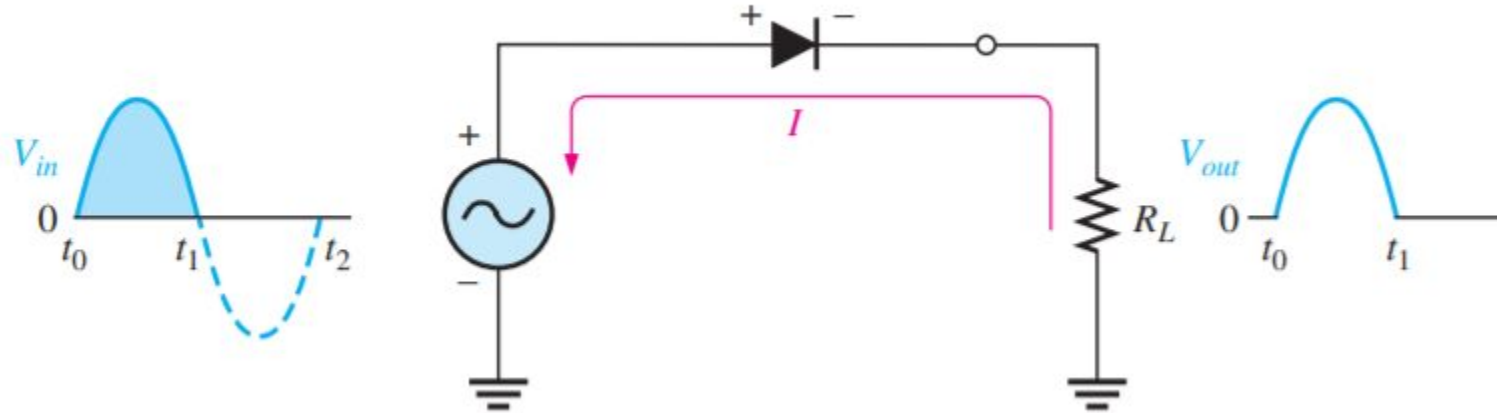


# FY BTech BEEE Lab Expt. 2 Half Wave Rectifier- HWR

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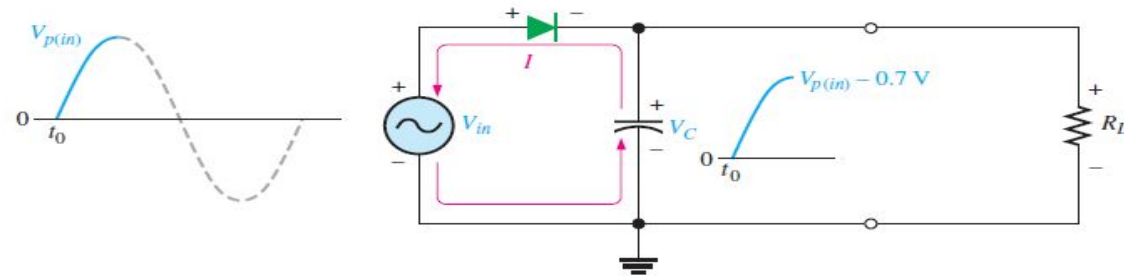
# Half Wave Rectifier Circuit

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

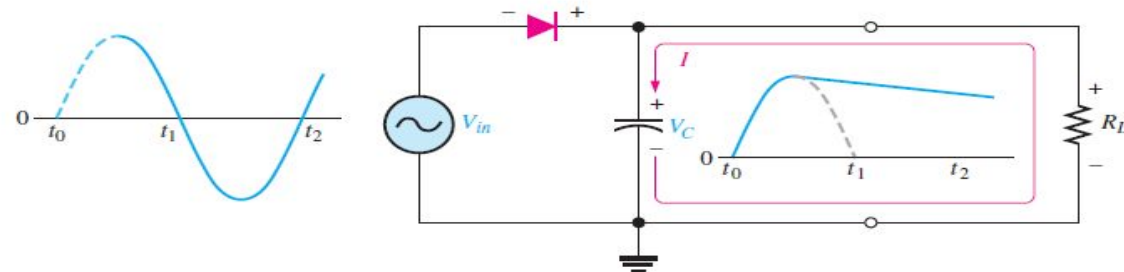


- A diode is connected to an ac source and to a load resistor,  $R_L$ , This forms a half-wave rectifier.
- All ground symbols represent the same point electrically.
- Considering the diode as ideal diode, during +ve half cycle of the input voltage , input voltage ( $V_{in}$ ) goes positive, the diode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

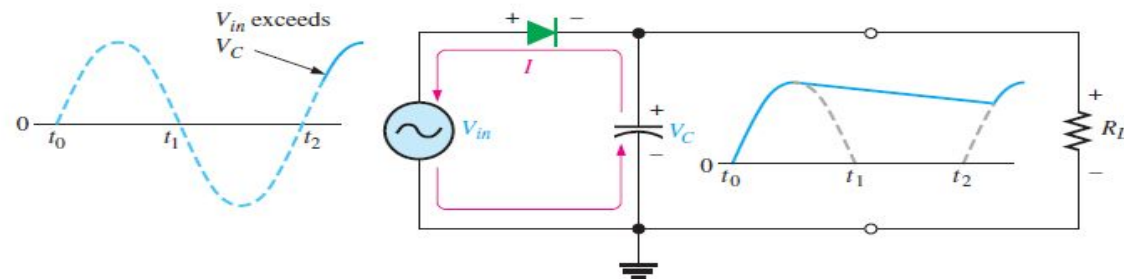
# Half-Wave Rectifier with Filter Capacitor



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

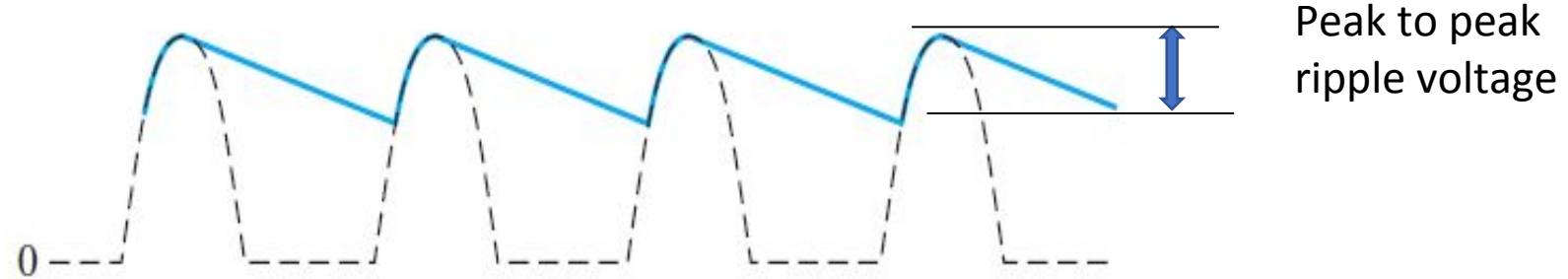


(b) The capacitor discharges through  $R_L$  after peak of positive alternation when the diode is reverse-biased. This discharging occurs during the portion of the input voltage indicated by the solid dark blue curve.

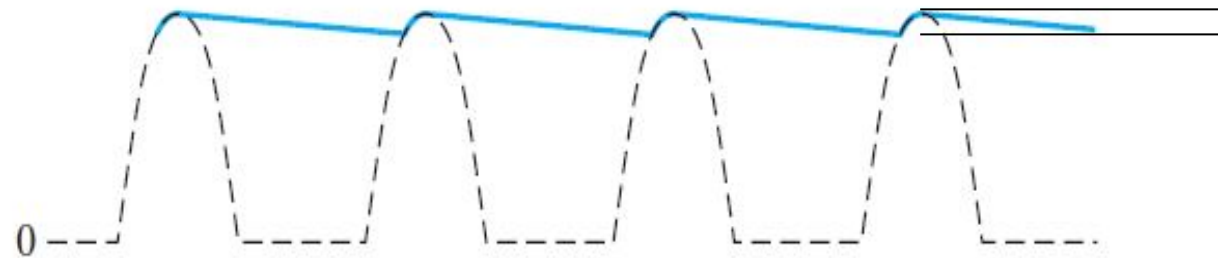


(c) The capacitor charges back to peak of input when the diode becomes forward-biased. This charging occurs during the portion of the input voltage indicated by the solid dark blue curve.

# 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

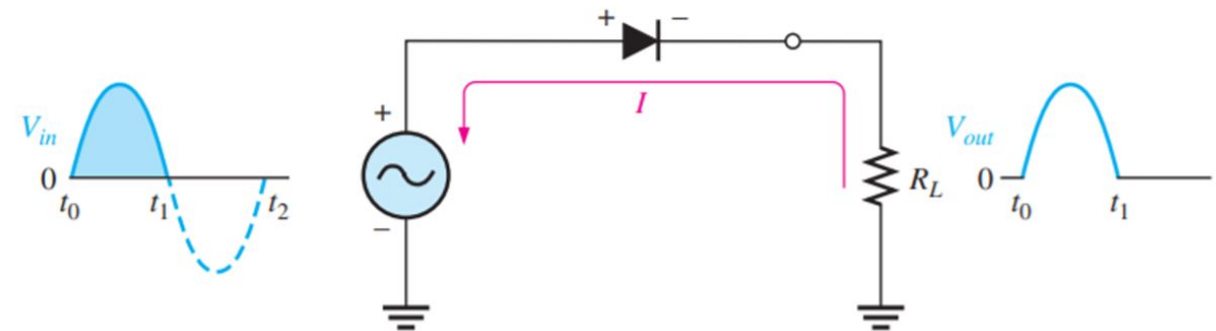
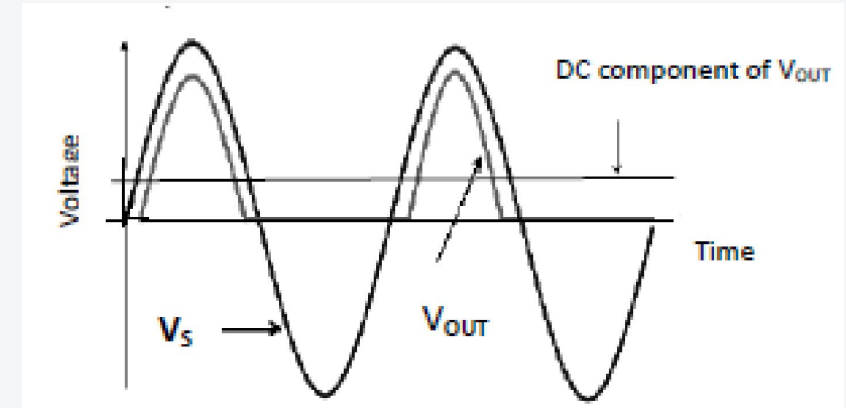
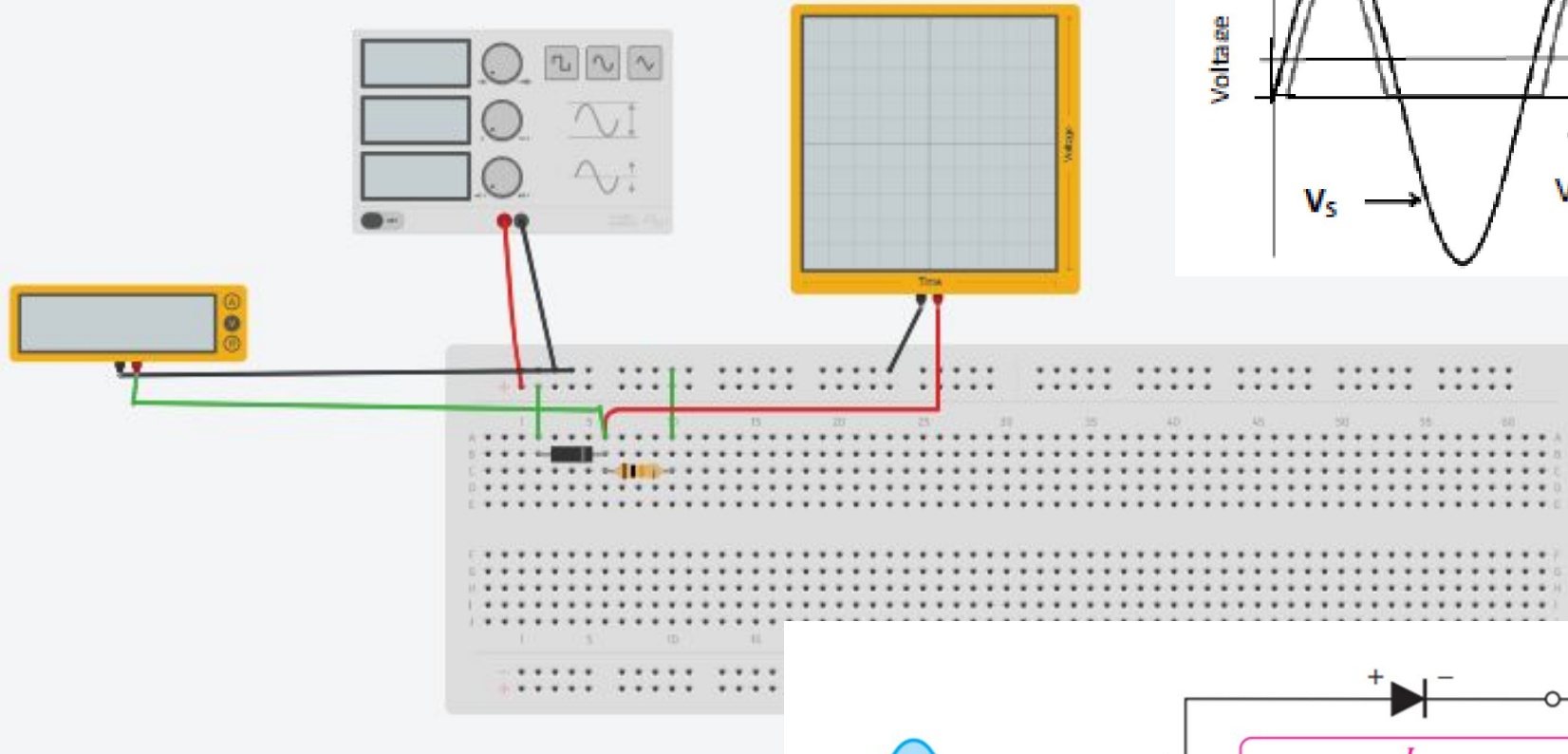
## Circuit Simulation in Tinkercad

- 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

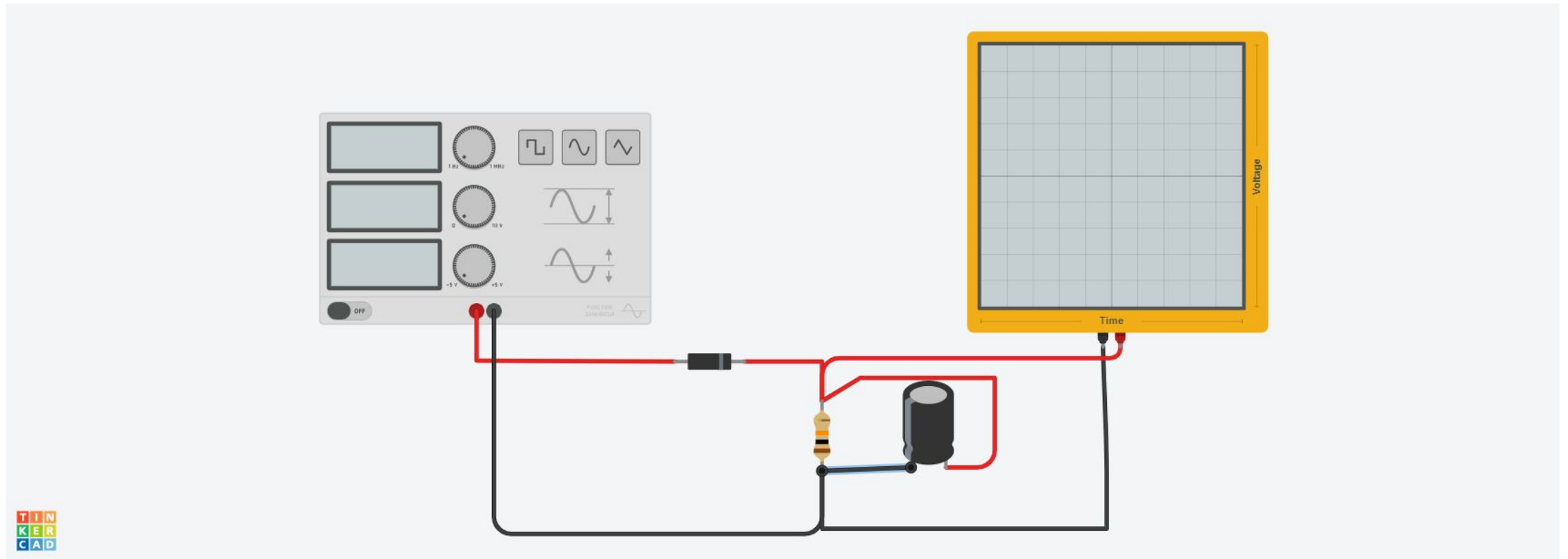
# HWR and HWR with filter circuit simulation in Tinkercad

- 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 to be added in the lab manual

# HWR without C filter

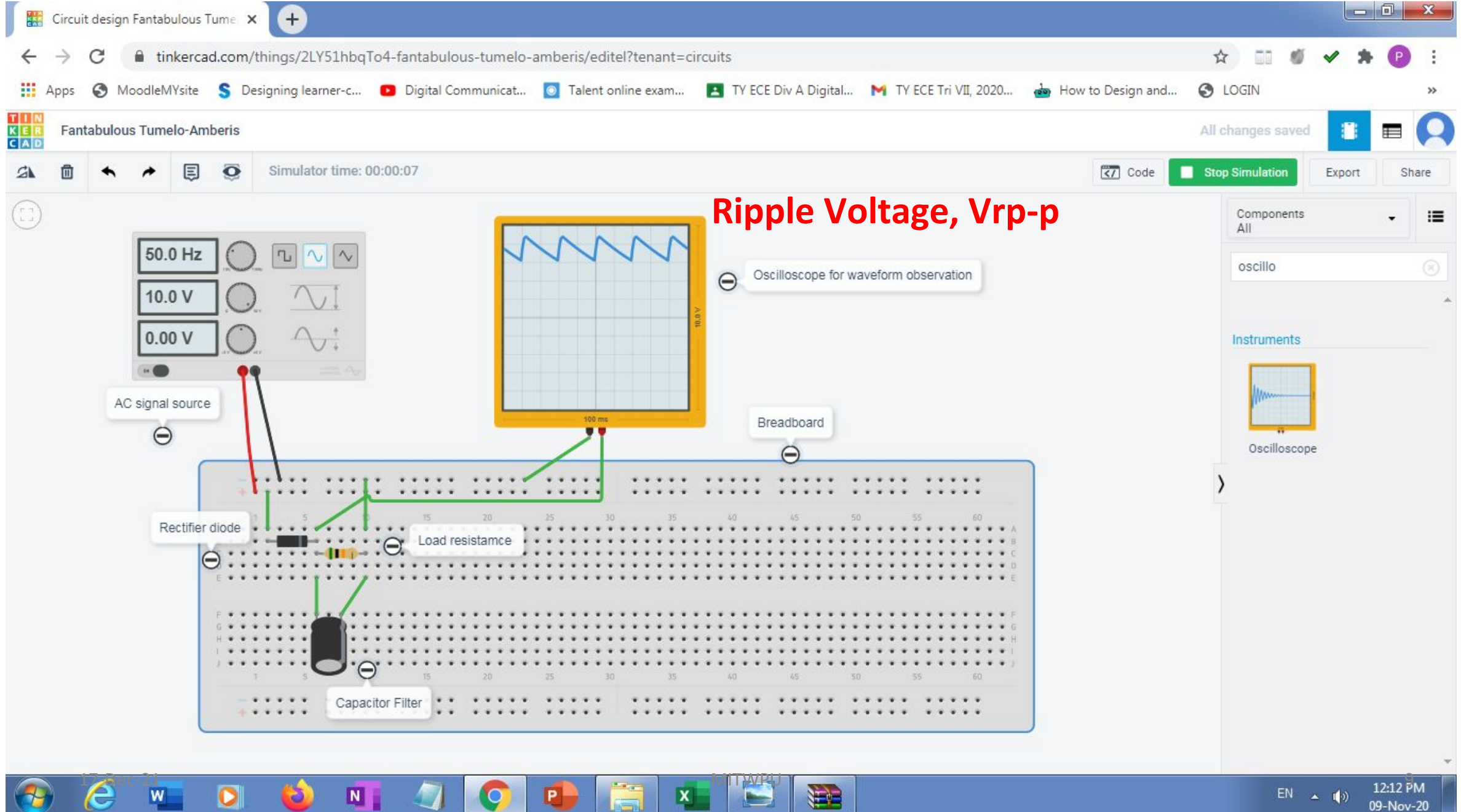


# HWR with C - Circuit without breadboard will not be acceptable





# Tinkercad Simulation Results



Circuit design Fantabulous Tume

+

← → ↺

tinkercad.com/things/2LY51hbqTo4-fantabulous-tumelo-amberis/editel?tenant=circuits

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TINKERCAD

Fantabulous Tumelo-Amberis

All changes saved

📄 Code

🛑 Stop Simulation

📄 Export

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Simulator time: 00:00:00

Annotation

Name 3

Components

All

oscillo

Instruments

Oscilloscope

AC signal source

50.0 Hz

10.0 V

0.00 V

Rectifier diode

RL= 10Kohms

Capacitor Filter

C=1microfarad

Breadboard

Oscilloscope for waveform observation

100 ma

17-Dec-21

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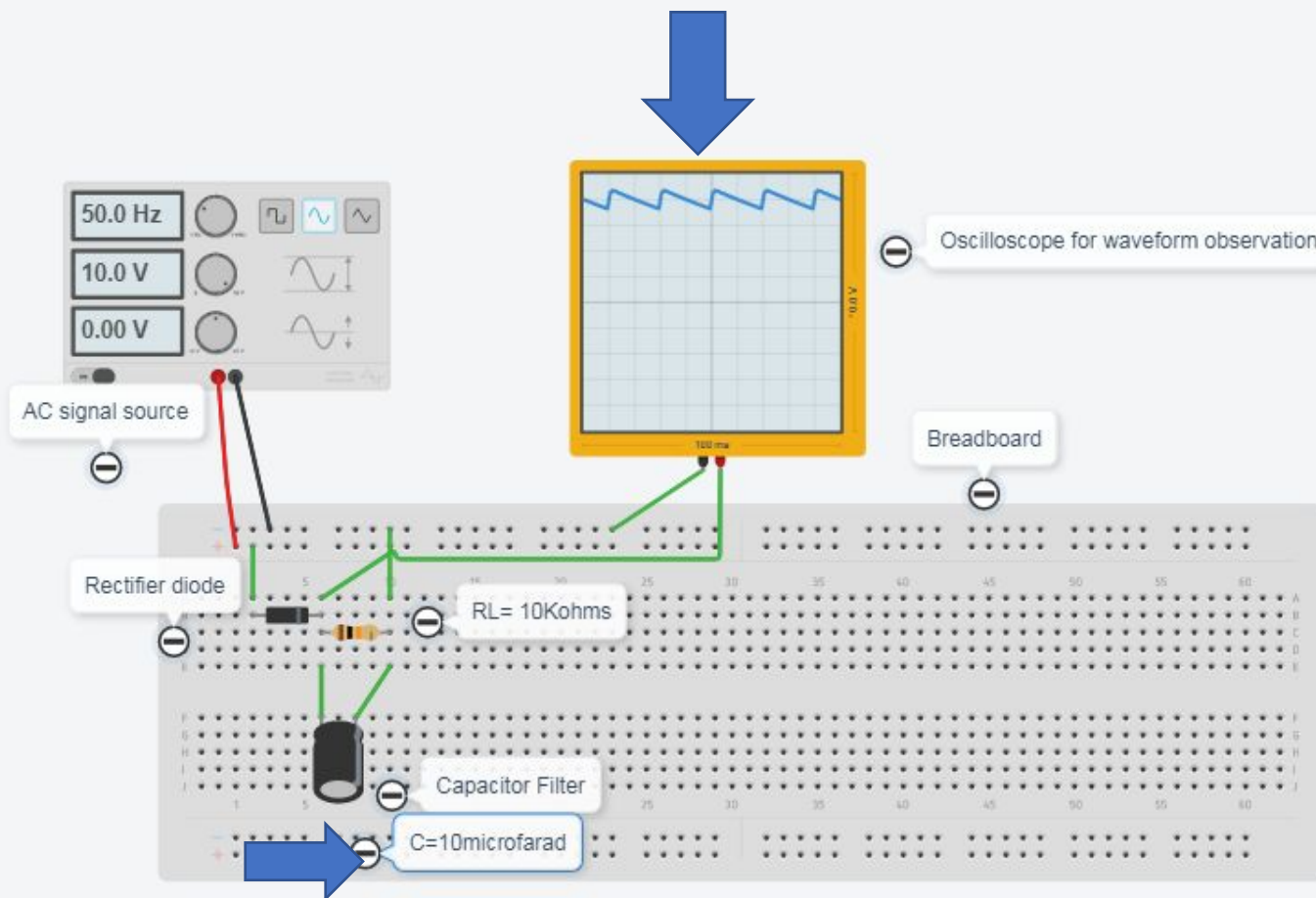
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## Instruments

A graph of a function on a coordinate plane. The function is a damped oscillation, starting with a large amplitude and decreasing towards the x-axis as x increases. The curve crosses the x-axis at regular intervals, indicating a periodic component. The amplitude of the oscillations decreases exponentially as x increases.

## Oscilloscope



# How to name the circuit?

The screenshot displays the Tinkercad web interface. The browser address bar shows the URL `tinkercad.com/projects/2LY51hbqTo4-fantabulous-tumelo-amberis`. The project title is **Fantabulous Tumelo-Amberis**. The design is credited to **Priyamwada Mahajani**, with a 'Like 0' button and a settings icon. The circuit diagram shows a breadboard with a battery, a resistor, and a green wire connecting to a digital display. The interface includes a sidebar with navigation options like '3D Designs', 'Circuits', 'Codeblocks', and 'Lessons'. The top bar includes a search bar and a 'Tinker this' button. Two red arrows point to the title and the settings icon.

Search design

3D Designs

Circuits

Codeblocks

Lessons

Join Class

Projects

Create project

Tweets

Tinkercad Re...

PrintLab

Here are 5 @tin...

Simulate

Add Image

MITWPU

12

1:03 PM

♥ Like 0

design by:

**Priyamwada Mahajani**

Edited 11/9/20, Created 11/9/20

## Tinker this

Simulate

 Add Image

# Theoretical and Practical Result verification

Calculation of ripple factor,  $r$

1. Ripple Factor without filter=  $r = 1.21$

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

**To calculate  $V_{r\text{ rms}}$ , use  $V_{r\text{ rms}}=V_{r\text{ pp}}/2\sqrt{3}$ ,**

**Measure  $V_{r\text{ pp}}$  from Oscilloscope,**

**Measure  $V_{\text{DC}}$  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



# Sample results -Case1

- 
- I/P amplitude =10V(P-P)
- $V_{LDC} = V_m / \pi = 5V / 3.14 = 1.59v$
- $V_{LDC}(\text{ON Meter}) = 1.51v$
- $V_{rms} = V_m / 2 = 5 / 2 = 2.5v$

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

# Case 2

Case 2 Ripple factor verified in HWR with Filter -  
Using formula - Theoretical.

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

$$= \underline{\underline{0.057}}$$

(2) Using readings in Tinkercad instruments -  
CRO - Used for  $V_{rpp}$  measurement  
Multimeter - Used for  $V_{LDC}$  measurement.  
 $V_p \rightarrow 10V_{pp}$ , 50Hz sine wave.

$$r = \frac{V_{rms}}{V_{LDC}}$$

$$\ast \quad V_{rms} = \frac{V_{rpp}}{2\sqrt{3}} = \frac{0.9}{2\sqrt{3}} = 0.26 \quad \leftarrow \text{From CRO.}$$

$$\ast \quad V_{LDC} = 4.27V \quad \leftarrow \text{From Multimeter.}$$

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

