

A large, faint watermark of the Boğaziçi University logo is centered in the background. It features a circular emblem with the university's name in Turkish and English, and the founding year 1863.

Boğaziçi University

A stylized graphic of a pendulum is positioned on the left side of the slide. It consists of a vertical blue line with a horizontal bar at the top, and two blue spheres of different sizes hanging from it by thin lines.

**Introductory
Phys Labs**

OSCILLOSCOPE

PHYL 201

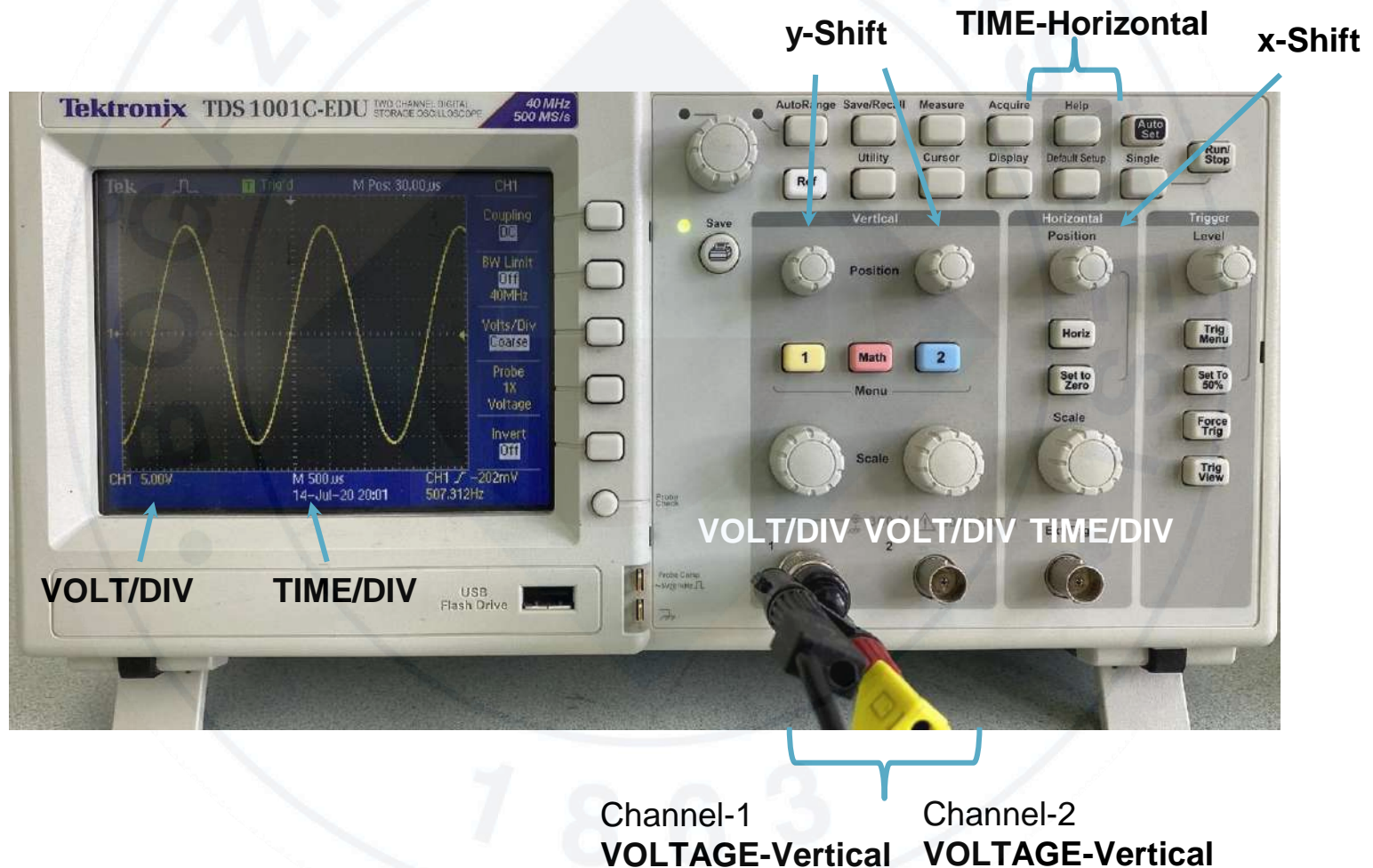
BOĞAZIÇI ÜNİVERSİTESİ

THEORY

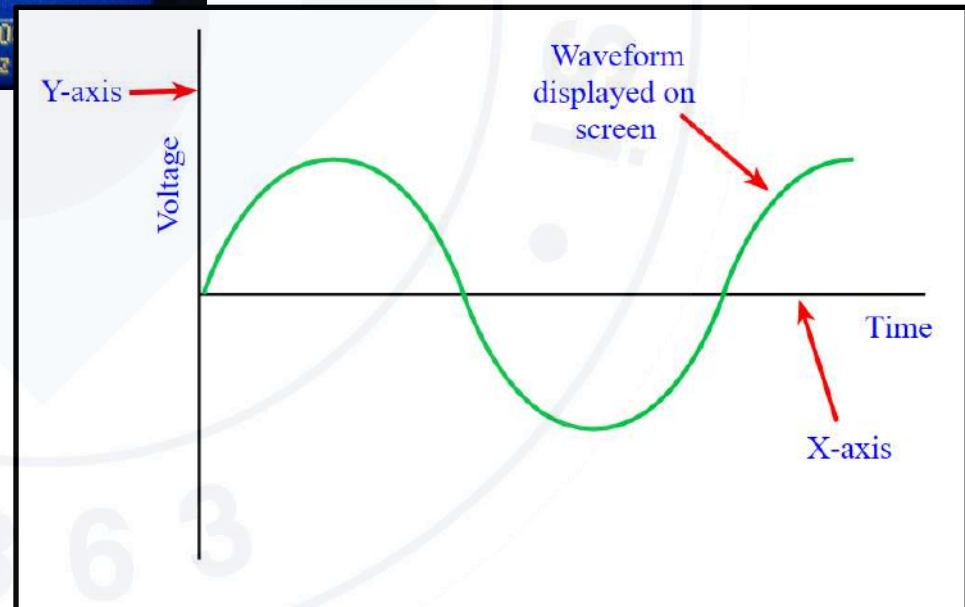
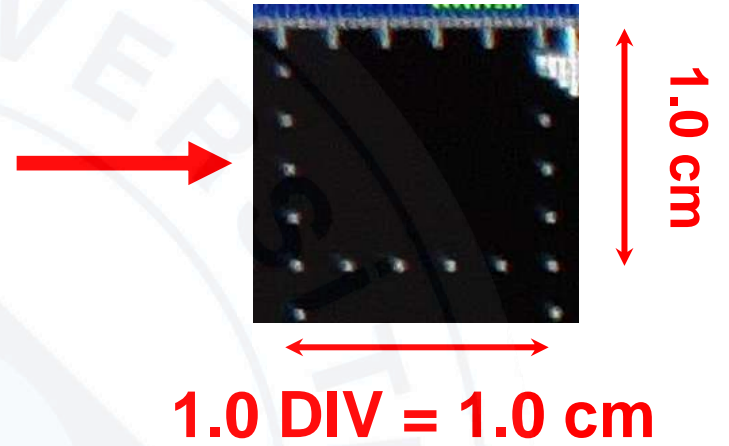
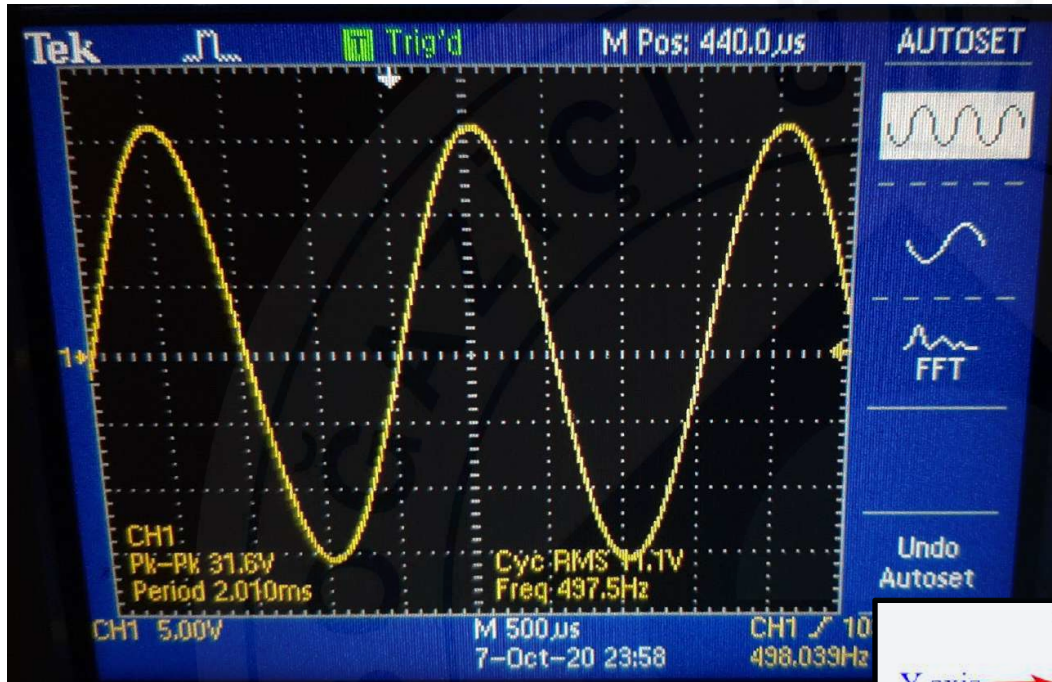
1863

OSCILLOSCOPE

Oscilloscopes display the change of an electrical signal over time, with voltage and time as the Y- and X-axes, respectively, on a calibrated scale. The waveform can then be analyzed for properties such as amplitude, frequency, rise time, time interval, distortion, and others.

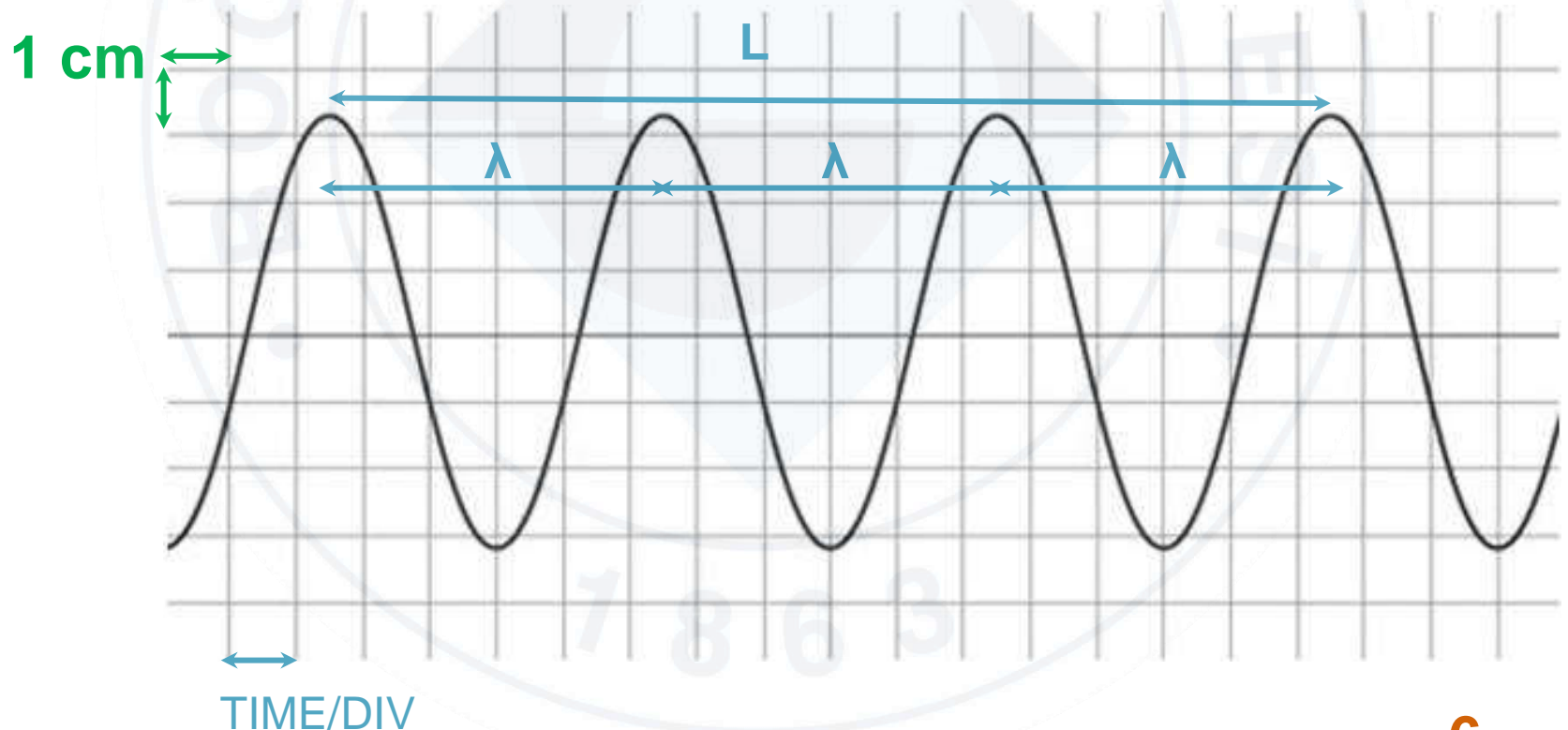


OSCILLOSCOPE



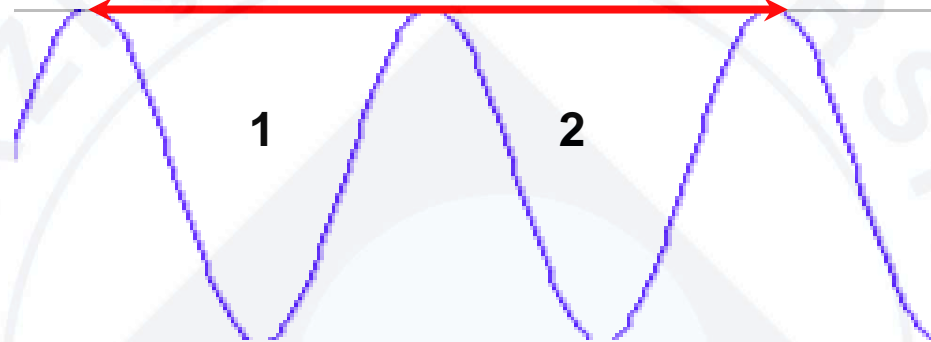
TIME MEASUREMENT

- $\lambda(\text{cm}) = L(\text{cm}) / \text{\#of full cycle}$
- $T(\text{s}) = \lambda(\text{cm}) \times \text{TIME/DIV}$
(s/cm)
- $f(\text{Hz}) = 1 / T(\text{s})$



EXAMPLE #1

$$L(\text{cm}) = 10.0 \text{ cm}$$



3 peaks, 2 full cycles

$$\text{TIME/DIV} = 10.0 \mu\text{s/cm}$$

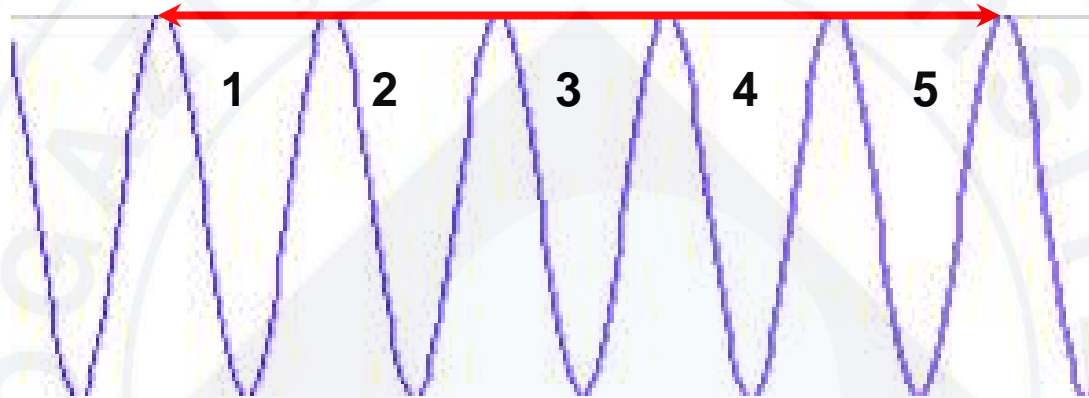
$$\lambda = 10.0/2 = 5.00 \text{ cm}$$

$$T = \lambda \times \text{TIME/DIV} = 5.00 \text{ cm} \times 10.0 \mu\text{s/cm} = 50.0 \mu\text{s}$$

$$f = 1/50.0 (\mu\text{s})^{-1} = 20.0 \times 10^3 \text{ Hz}$$

EXAMPLE #2

$$L(\text{cm}) = 10.0 \text{ cm}$$



6 peaks, 5 full cycles

$$\text{TIME/DIV} = 25.0 \mu\text{s/cm}$$

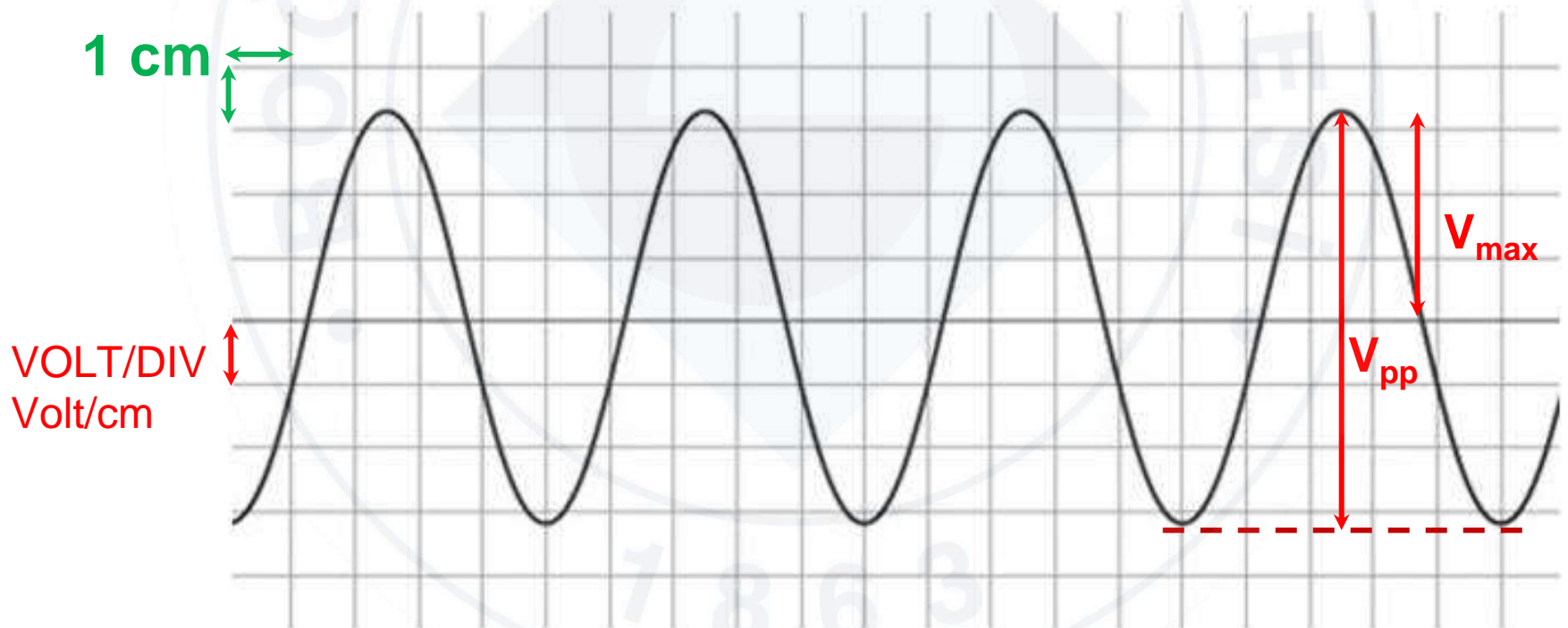
$$\lambda = 10.0/5 = 2.00 \text{ cm,}$$

$$T = 2.00 \times 25.0 \mu\text{s} = 50.0 \mu\text{s}$$

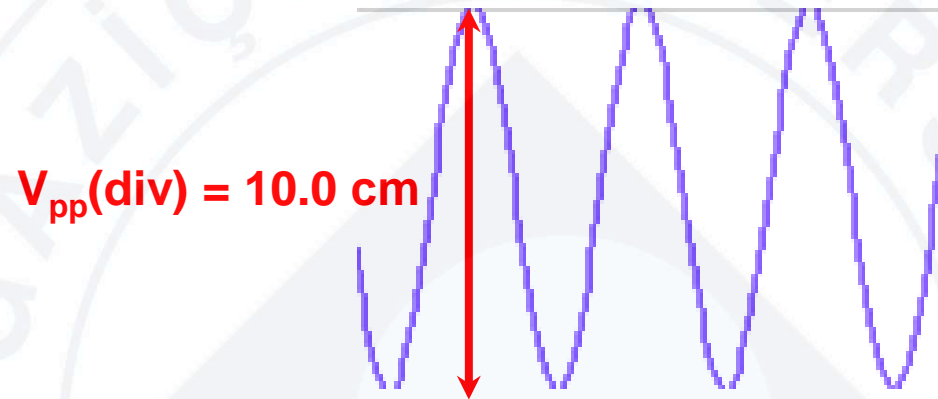
$$f = 1/50.0 (\mu\text{s})^{-1} = 20.0 \times 10^3 \text{ Hz}$$

VOLTAGE MEASUREMENT

- $V_{pp}(\text{Volt}) = V_{pp}(\text{cm}) \times \text{VOLT/DIV}$
- $V_{\text{max}}(\text{Volt}) = V_{pp}(\text{Volt}) / 2$
- $V_{\text{rms}}(\text{Volt}) = V_{\text{max}} / \sqrt{2}$



EXAMPLE #2



$$\text{VOLT/DIV} = 5.00 \text{ Volt/cm}$$

$$V_{pp}(\text{Volt}) = V_{pp}(\text{div}) \times \text{VOLT/DIV} = 10.0 \times 5.00 = 50.0 \text{ V}$$

$$V_{\text{max}}(\text{Volt}) = V_{pp}(\text{Volt}) / 2 = 50.0 / 2 = 25.0 \text{ V}$$

$$V_{\text{rms}}(\text{Volt}) = V_{\text{max}} / \sqrt{2} = 17.7 \text{ V}$$

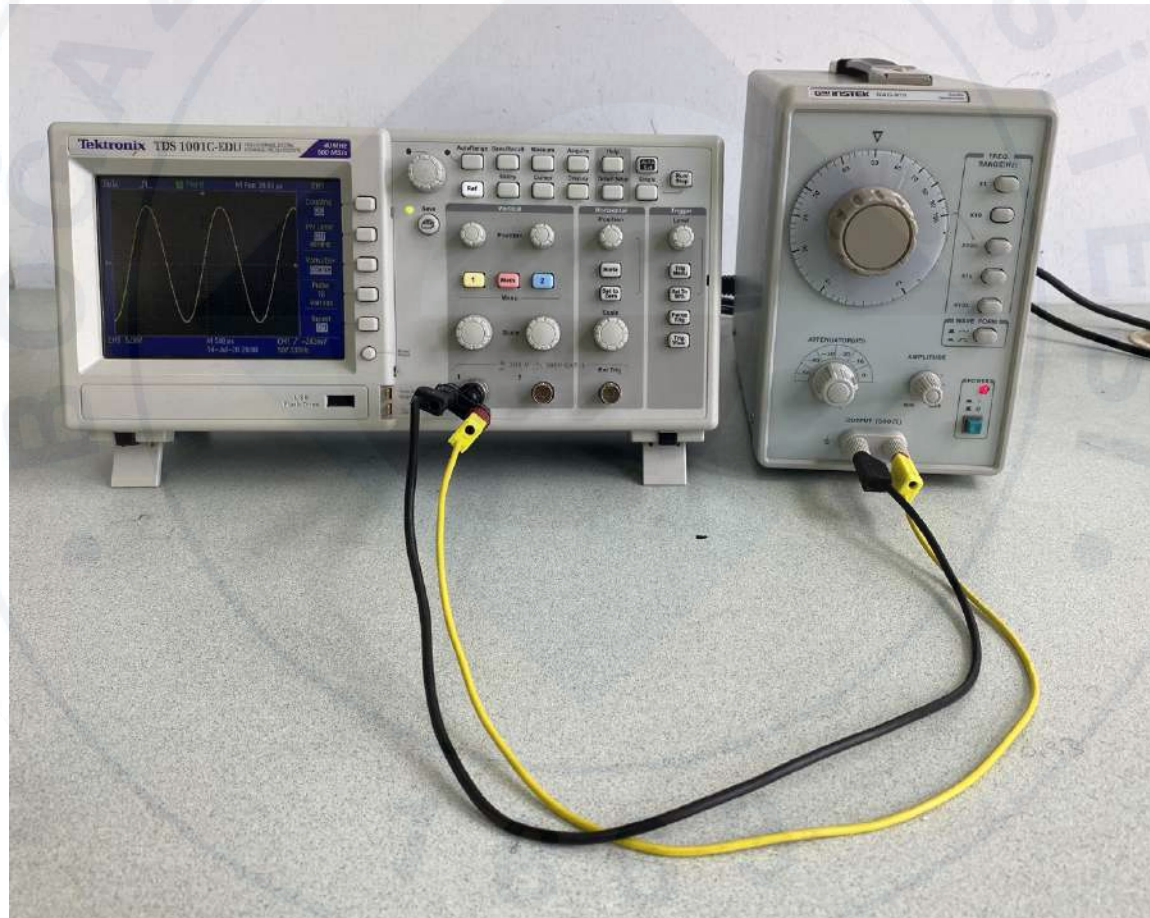
A large, faint, light blue watermark of the Boğaziçi University seal is centered in the background. The seal is circular and contains the text "BOĞAZIÇI ÜNİVERSİTESİ" around the top and "1863" at the bottom. In the center of the seal is a shield with a triangle and a circle.

EXPERIMENT SETUP

OSCILLOSCOPE

Oscillator generates sinusoidal waves (adjustable between 10 Hz – 10 MHz).

Oscilloscope is connected to oscillator to observe to generated signal.



OSCILLOSCOPE

Oscillator(Power supply) is set to $50 \times 10 = 500$ Hz

Current signal frequency indicator

Frequency tuning knob



Frequency multipliers

Sine vs Square Wave button

Voltage knob

A large, faint watermark of the Boğaziçi University seal is centered in the background. The seal is circular and contains the text "BOĞAZIÇI ÜNİVERSİTESİ" around the top and "1863" at the bottom. In the center of the seal is a diamond shape containing a sun and a crescent moon.

DATA-TAKING

PART 1: Given f_{TV} with 2 different Time/div settings. You will take 2 measurements of frequency, 1 measurement of voltage.

PART 2: Given f_{TV} (3rd) with 1 Time/div settings. You will take 1 measurement of frequency.

UNKNOWN FREQUENCY: Given f_{unknow} and with 1 Time/div settings. You will take 1 measurement of frequency and voltage.

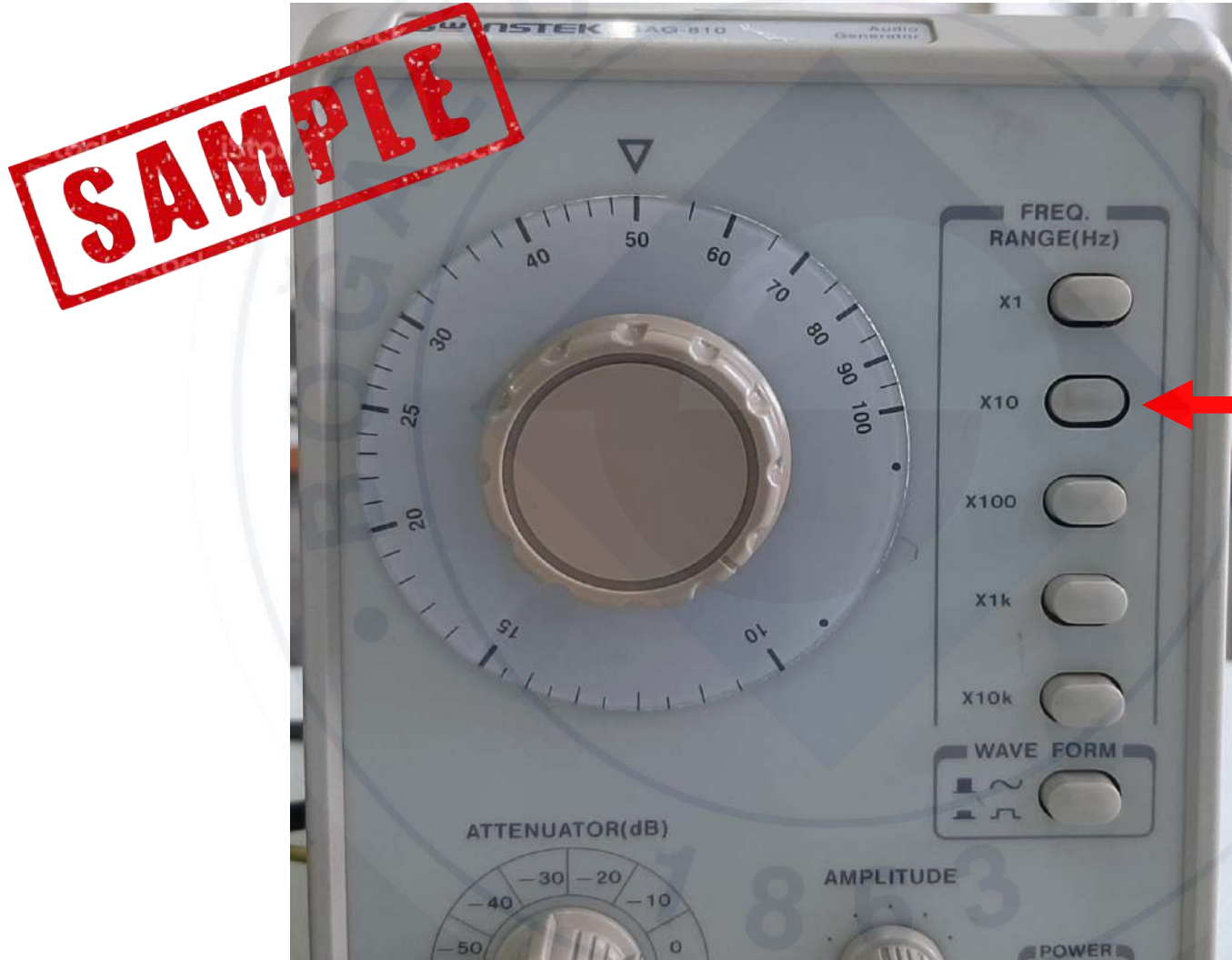
BOĞAZIÇI ÜNİVERSİTESİ

PART 1,2

1863

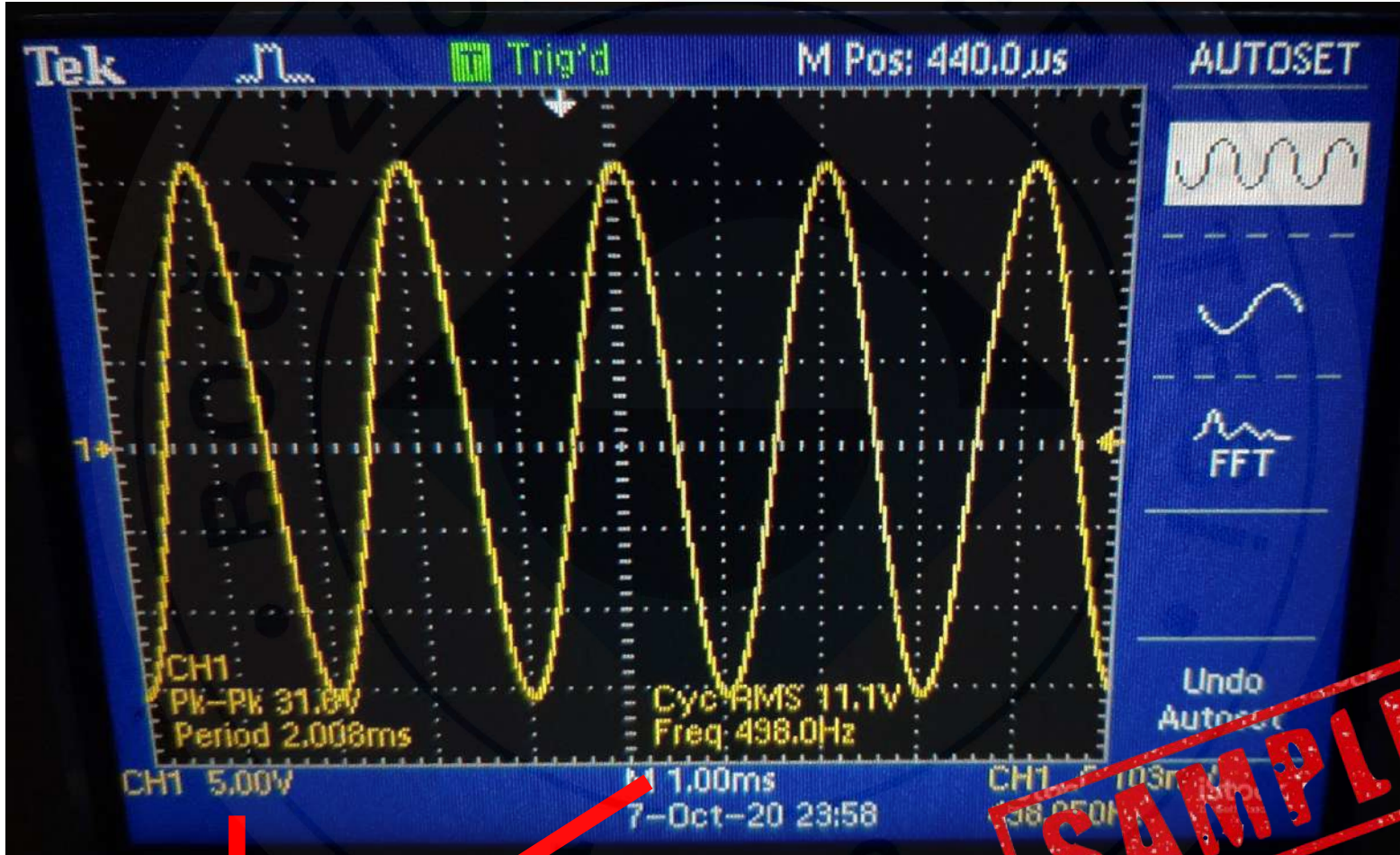
OSCILLOSCOPE

Read the Frequency of the Oscillator.



OSCILLOSCOPE

Read Time/Div-1 & Volt/Div. Determine λ , T , f and V_{PP} , V_{max} , V_{RMS}

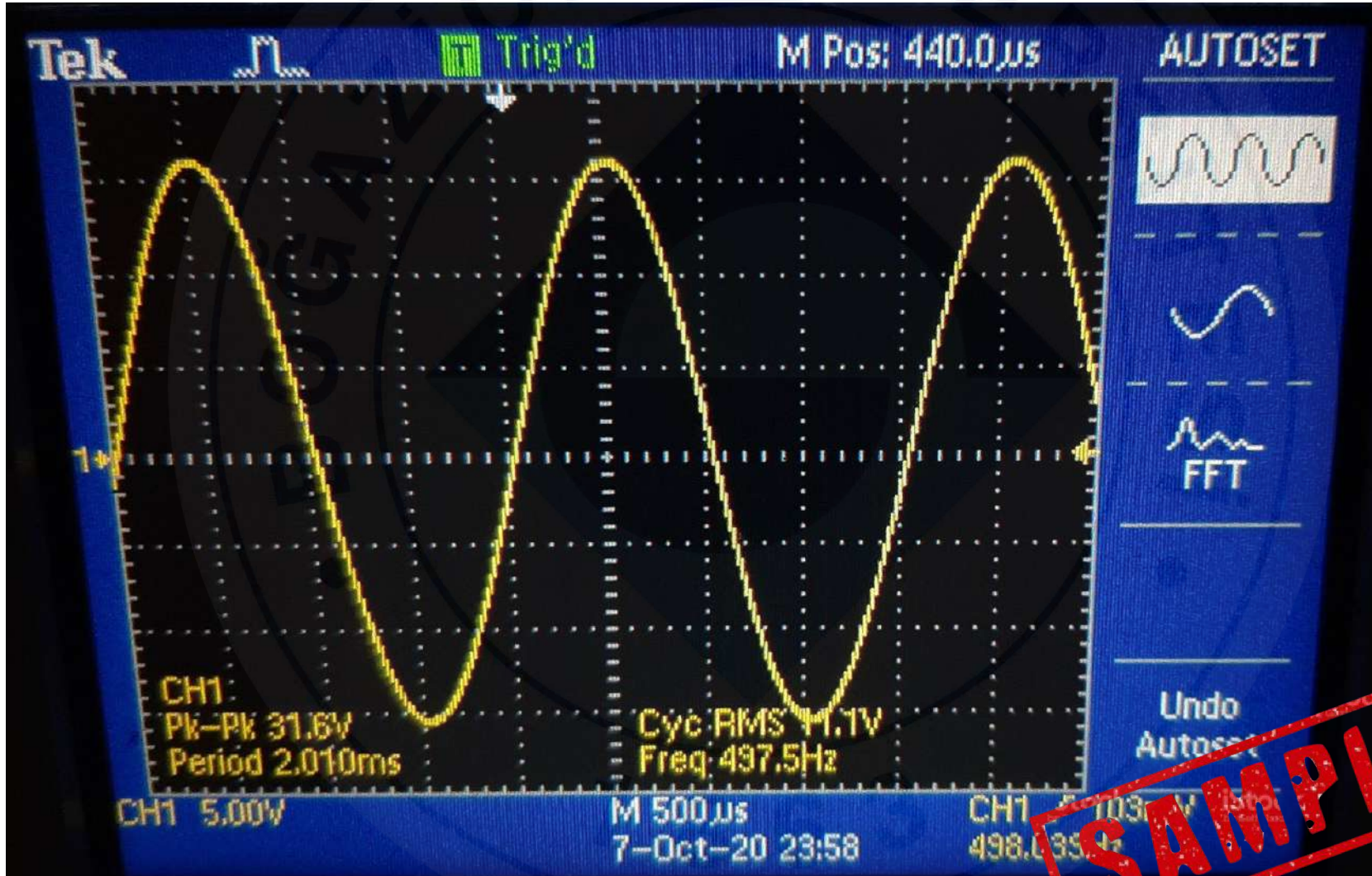


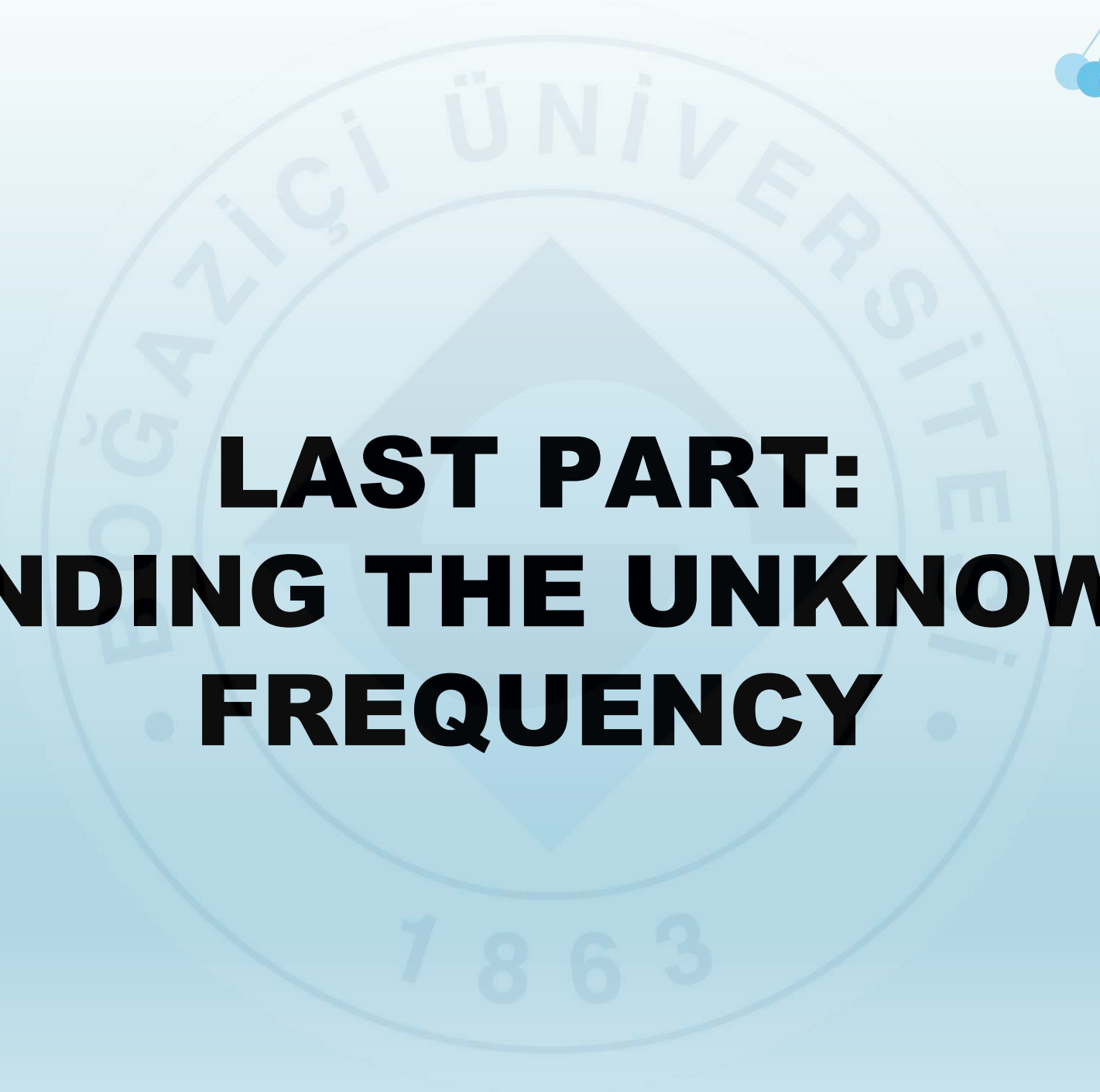
SAMPLE

ALL DIGITS ARE SIGNIFICANT!

OSCILLOSCOPE

Read Time/Div-2. Determine λ , T and f.

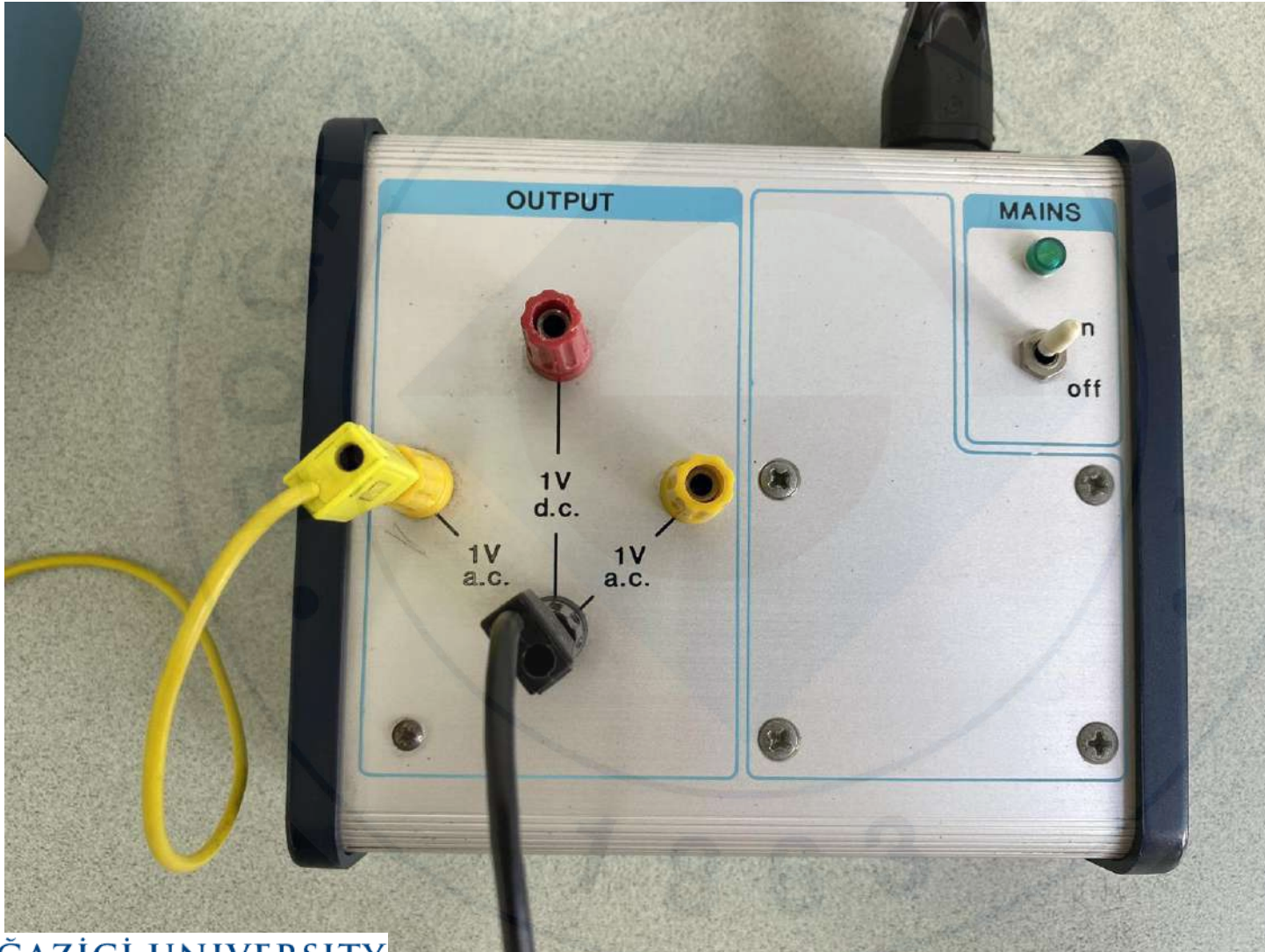


The background features a large, faint watermark of the Fırat University logo. It is a circular emblem with the text 'FIRAT ÜNİVERSİTESİ' around the top and '1863' at the bottom. In the center is a shield with a triangle on top and a crescent moon and star below it.

**LAST PART:
FINDING THE UNKNOWN
FREQUENCY**

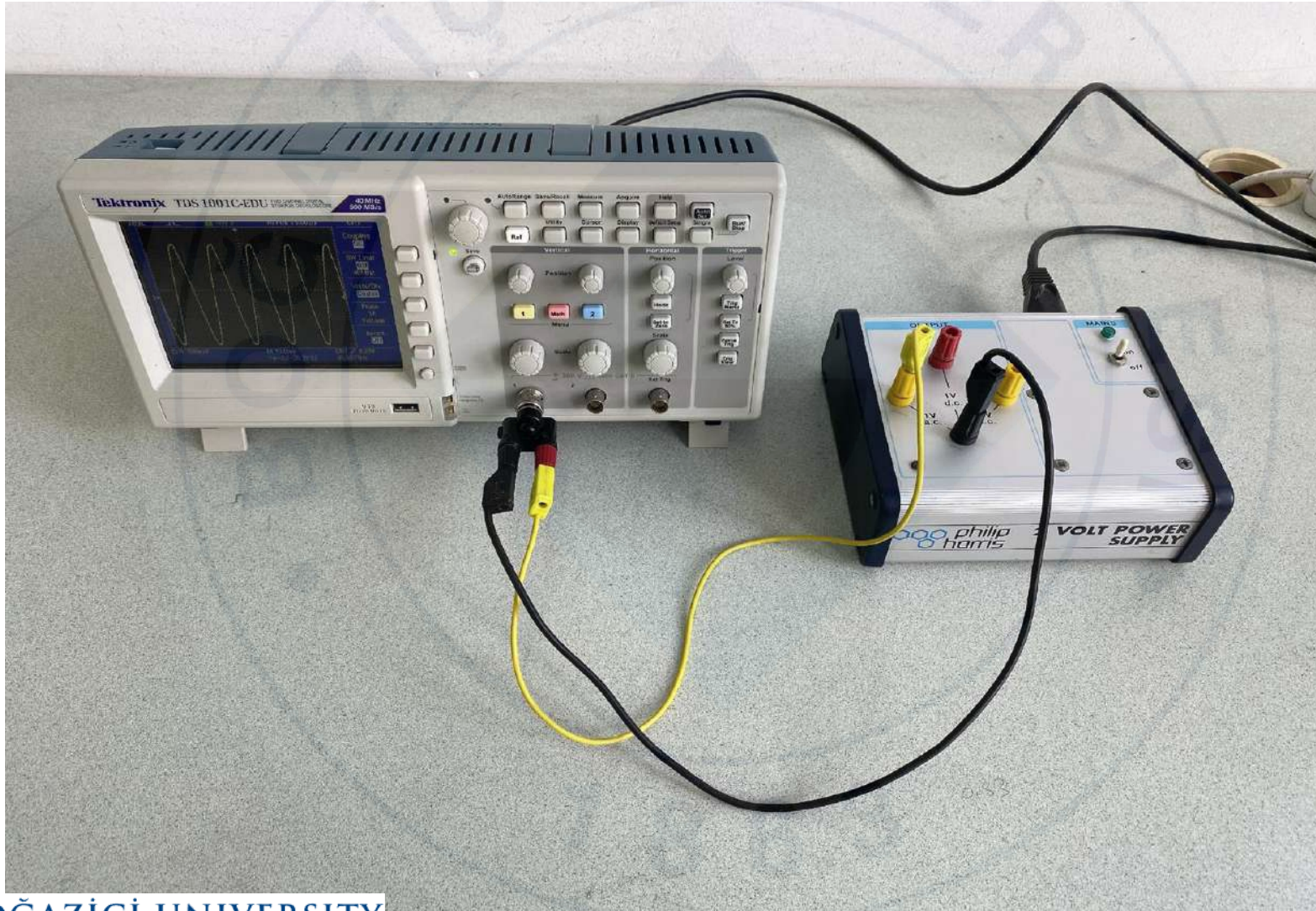
OSCILLOSCOPE

Unknown Frequency:

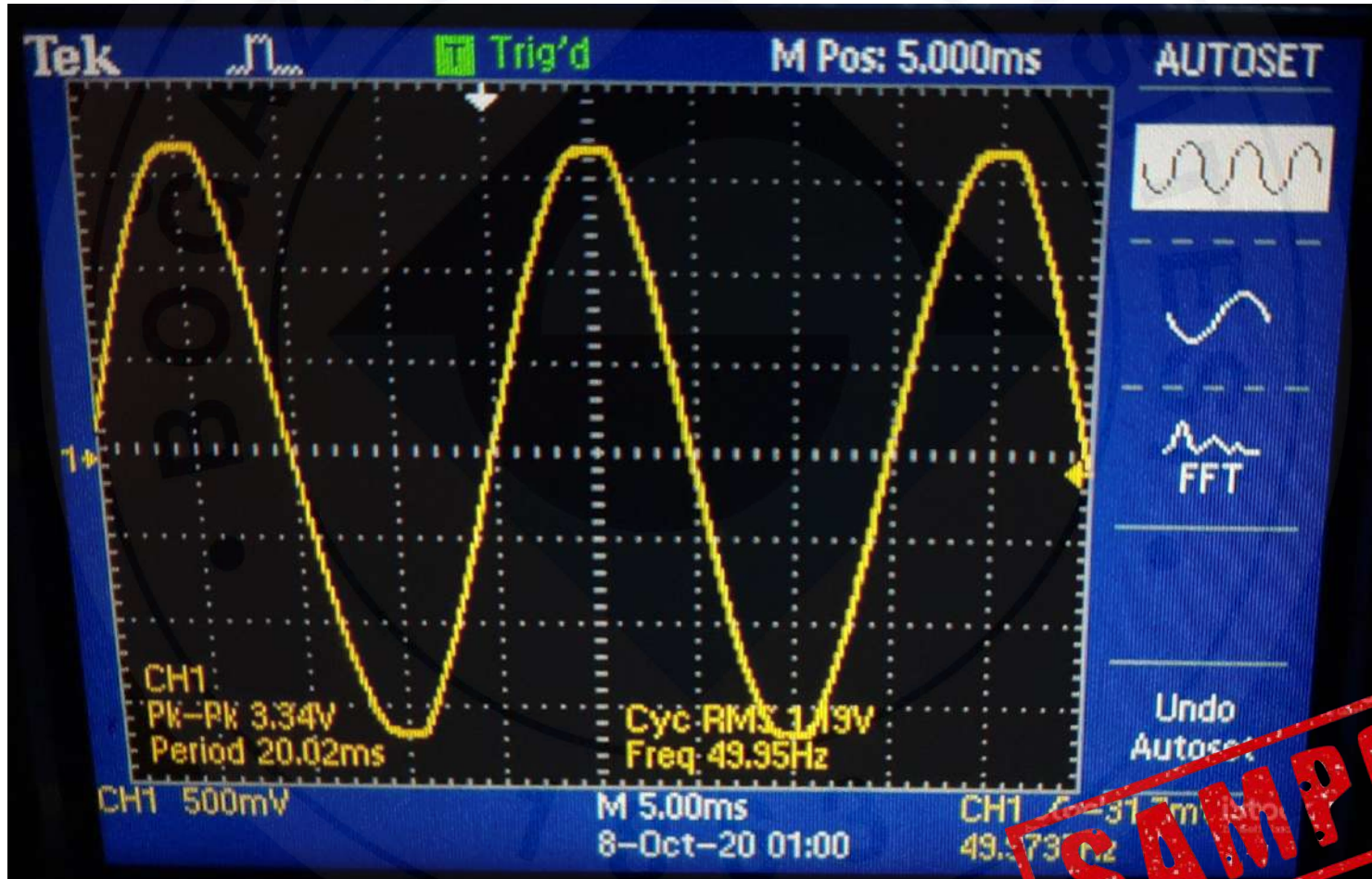


OSCILLOSCOPE

Unknown Frequency:

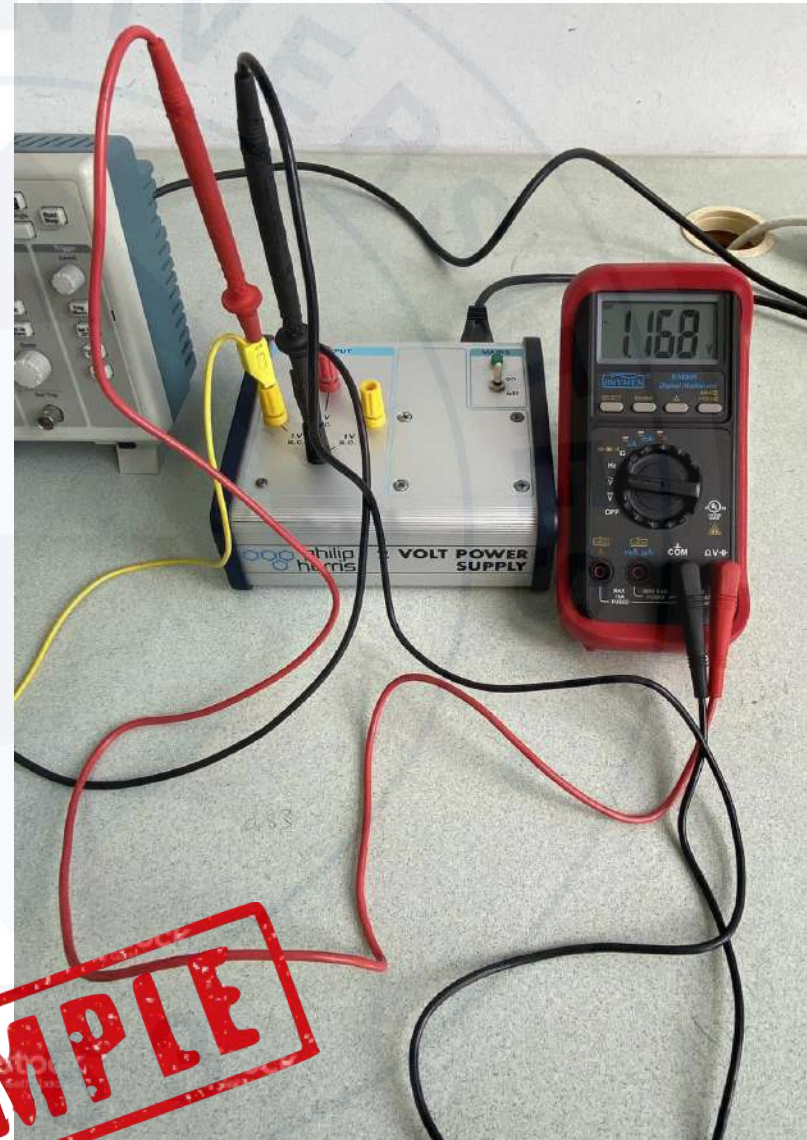


Read Time/Div and Volt/Div for Unknown Frequency. Determine λ , T , f and V_{PP} , V_{max} , V_{RMS}



OSCILLOSCOPE

Read V_{app} of unknown source.
Compare with V_{RMS}



$$\text{Length of one wave } (\lambda) = \dots\dots\dots \frac{L}{\# \text{ of waves}} \dots\dots\dots$$

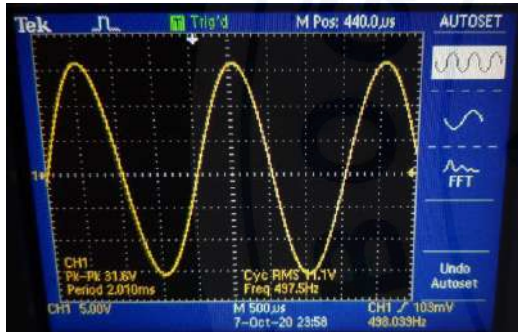
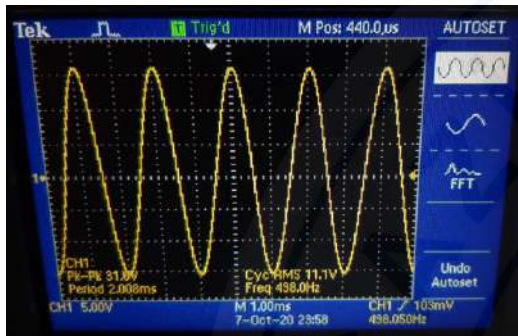
$$\text{Period } (T) = \dots\dots\dots \lambda \times \frac{\text{Time}}{\text{Div}} \dots\dots\dots$$

$$\text{Frequency } (f) = \dots\dots\dots \frac{1}{T} \dots\dots\dots$$

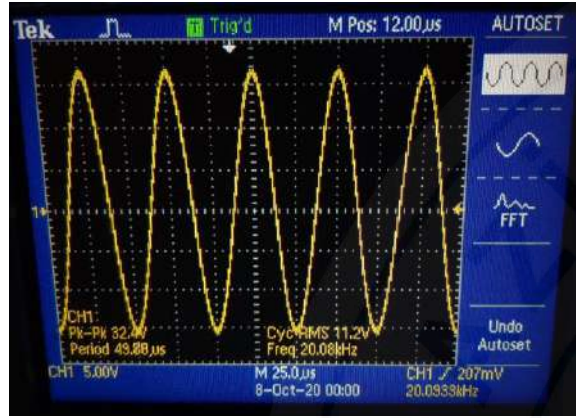
$$V_{pp} \text{ (Volt)} = \dots\dots\dots V_{pp}(\text{div}) \times \frac{\text{Volt}}{\text{Div}} \dots\dots\dots$$

$$V_{\max} = \dots\dots\dots \frac{V_{pp}(\text{Volt})}{2} \dots\dots\dots$$

$$V_{\text{rms}} = \dots\dots\dots \frac{V_{\max}}{\sqrt{2}} \dots\dots\dots$$



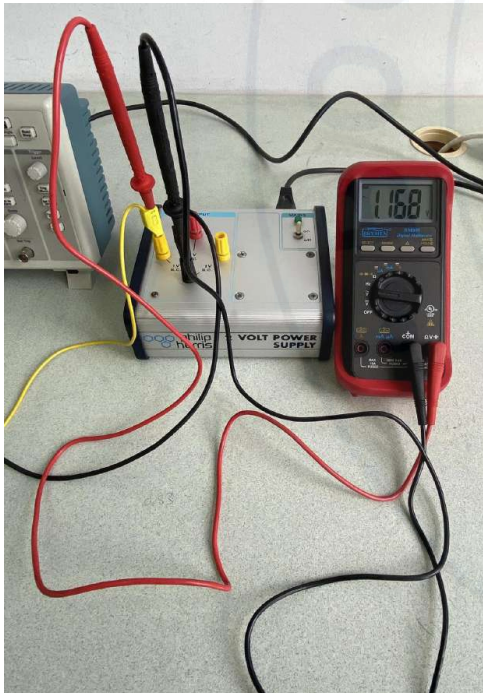
f_{TV}	500 Hz.
TIME MESAUREMENTS	
1 st Reading	[TIME / DIV] ₁
	L_1
	# of waves ₁ in L_1
	Length of the wave, λ_1
	Period, T_1
Frequency, f_{EV-1}	
2 nd Reading	[TIME / DIV] ₂
	L_2
	# of waves ₂ in L_2
	Length of the wave, λ_2
	Period, T_2
	Frequency, f_{EV-2}
$f_{EV} = (f_{EV-1} + f_{EV-2})/2$	
% Error for f:	
VOLTAGE MEASUREMENT	
[VOLT / DIV]	
V_{pp} (div)	
V_{pp} (Volt)	
$V_{max} = V_{pp} / 2$	
$V_{rms} = V_{max} / \sqrt{2}$	



f_{TV}	20,000 Hz.
TIME MESAUREMENTS	
[TIME / DIV]	
L	
# of waves in L	
Length of the wave, λ	
Period, T	
Frequency, f_{EV}	

% Error for f :

UNKNOWN FREQUENCY:
 $V_{measured} = V_{TV}$



TIME MESAUREMENTS	
[TIME / DIV]	
L	
# of waves in L	
Length of the wave, λ	
Period, T	
Frequency, f_{EV}	

VOLTAGE MEASUREMENT	
[VOLT / DIV]	
V_{pp} (div)	
V_{pp} (Volt)	
$V_{max} = V_{pp} / 2$	
$V_{rms} = V_{max} / \sqrt{2}$	

% Error for V_{rms} :