Spring 2023

EEE/ETE 141L

Electrical Circuits-I Lab (Sec-19)

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Instructor: Md. Rabiul Karim Khan

Lab Report 09: Characteristics of RL circuit for the Square Wave as an Input Signal.

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Date of Submission:
21 May 2023

Group no.: 05

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Experiment Name: Characteristics of RL circuit for the Square Wave as an Input Signal.

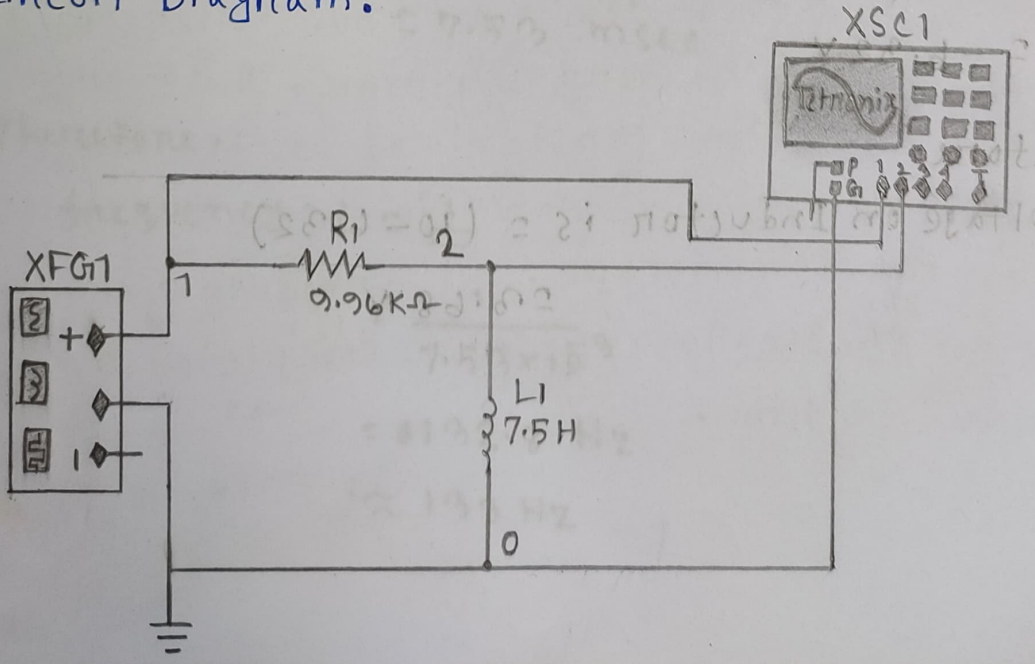
Objectives:

- To learn the use of Function Generator and Oscilloscope.
- To investigate the behaviour of RL Circuit.

Apparatus:

- Breadboard
- Resistors (1 × 9.96 KΩ)
- Inductor (7.5 H)
- Digital Multimeter (DMM)
- Function Generators
- Oscilloscope
- Wires

Circuit Diagram:



Theoritical and Experimental Calculation:

In our RL circuit,

Input voltage, $V_p = 5V$ (square wave)

$\Rightarrow V_0 = 10V$

Resistor, $R = 9.96 K\Omega$

Inductor, $L = 7.5 H$

Therefore,

Time constant, $\tau = L/R$

$= \frac{7.5}{9.96 \times 10^3}$

$= 0.753 ms$

In off state, according to theory,

when, $t = 1\tau$

$V_L = -V_0(1 - e^{-\tau/\tau})$

$= -10(1 - e^{-1})$

$= -6.32 V$

Therefore,

Voltage on Inductor is $= (10 - 6.32)$

$= 3.68 V$

In our experiment,

When $V_2 = 3.68\ V$

We found $\Delta t = 800\ \mu sec$

$= 20.8\ msec$

Therefore, experimental time constant during OFF state is 0.8 msec.

We also found the same time constant during ON state.

Therefore,

$$\text{error} = \left| \frac{0.753 - 0.8}{0.753} \right| \times 100\%$$

$$= 6.24\%$$

We know the time period for a inductor,

$$T = 10\tau$$

$$= 10(0.753)$$

$$= 7.53\ msec$$

Therefore,

$$\text{frequency; } f = \frac{1}{T}$$

$$= \frac{1}{7.53 \times 10^{-3}}$$

$$= 0132.8\ Hz$$

$$\approx 133\ Hz$$

Graph:

Simulation Attached.

Result Analysis:

According to theory, Time constant is 0.753 ms, that means capacitor can gain and lose voltage 63.2% within one time constant. In our experiments, when V_L was 3.68 V, we found that difference of time is 0.8 ms. That means time constant is 0.8 ms approximately same as theory. Therefore, our RL circuits were working perfectly.

Questions and Answers: N/A.

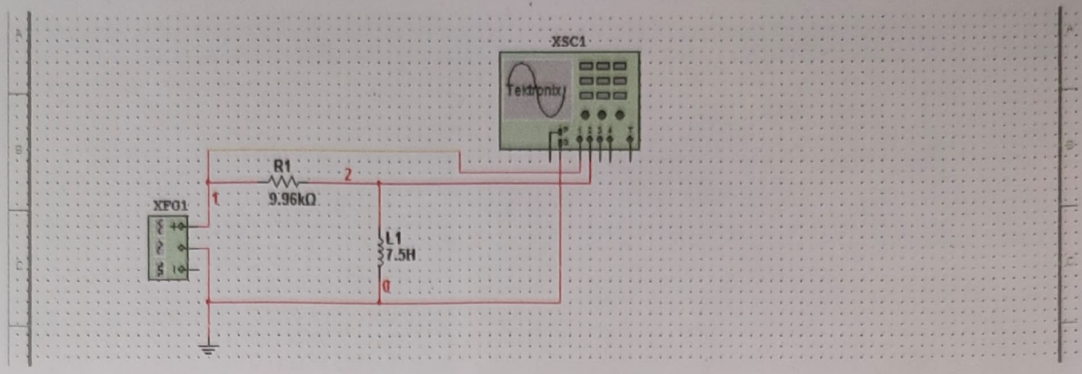
Discussion:

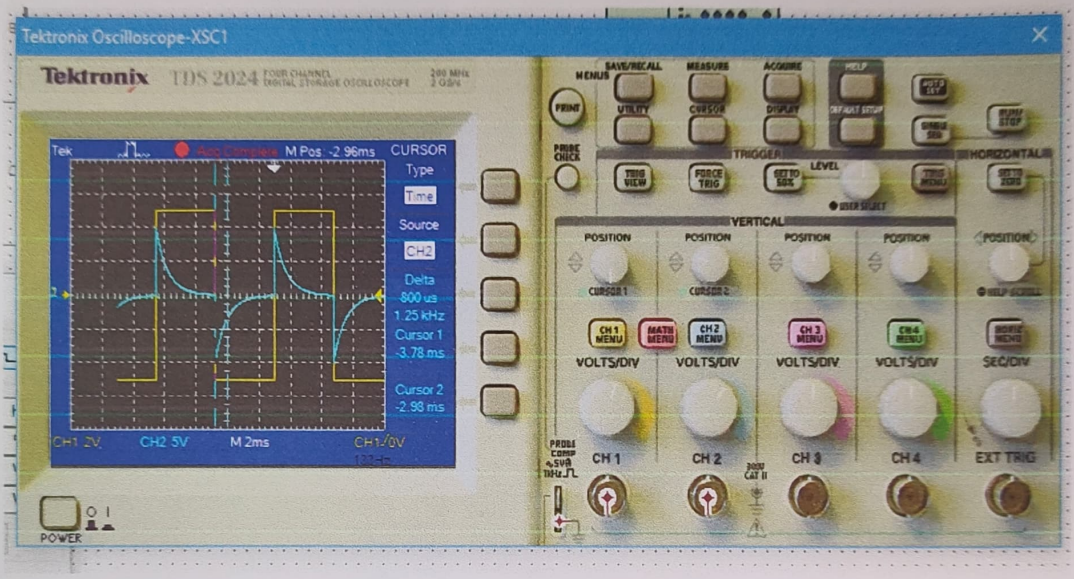
In this experiment, we learned the usage of signal Generator and Oscilloscope. We also observed the On state and Off state behaviour of RL circuits with changing time period. We found that in an RL circuits Inductor can gain 63% Voltage of its remaing capacity in every L/R time. That's why L/R is called the time constant of an RL circuit. In this experiment, we don't face any difficulties operating the oscilloscope. We properly learnt the usage of oscilloscope and completed the experiment in time.

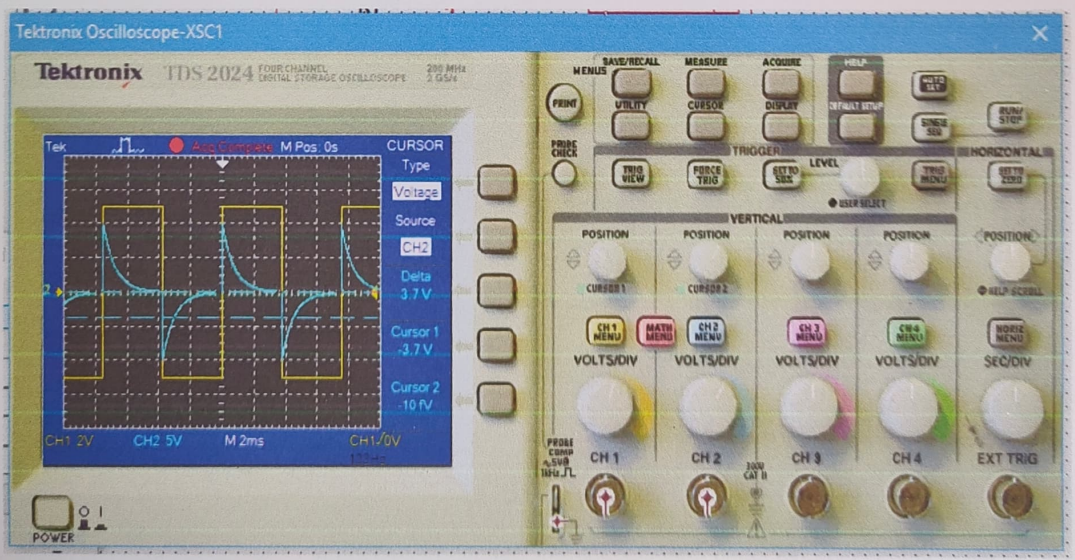
Attachment:

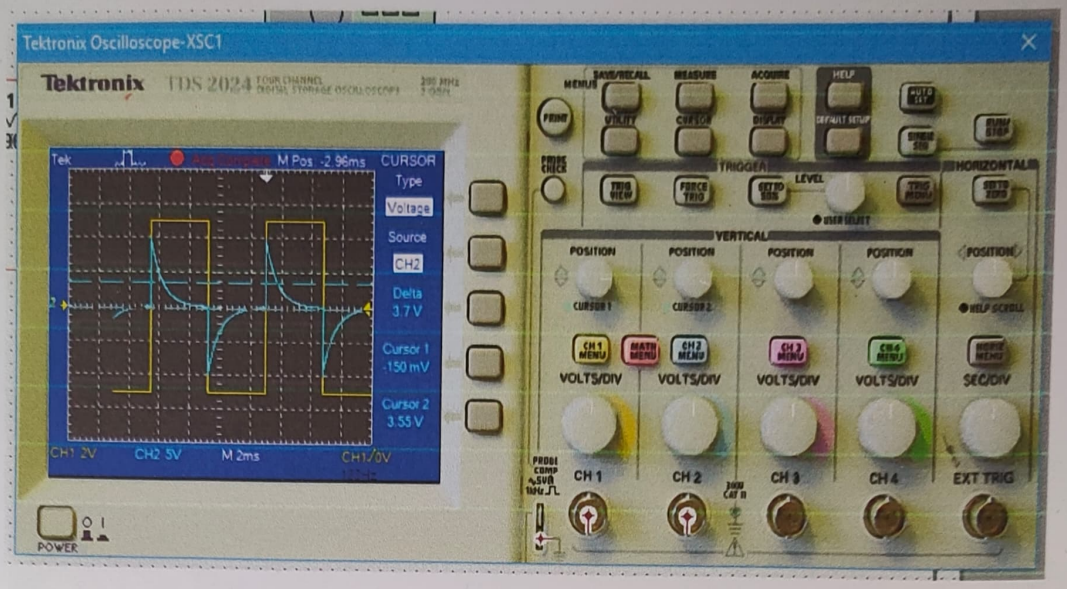
01. Graph using Multisim.

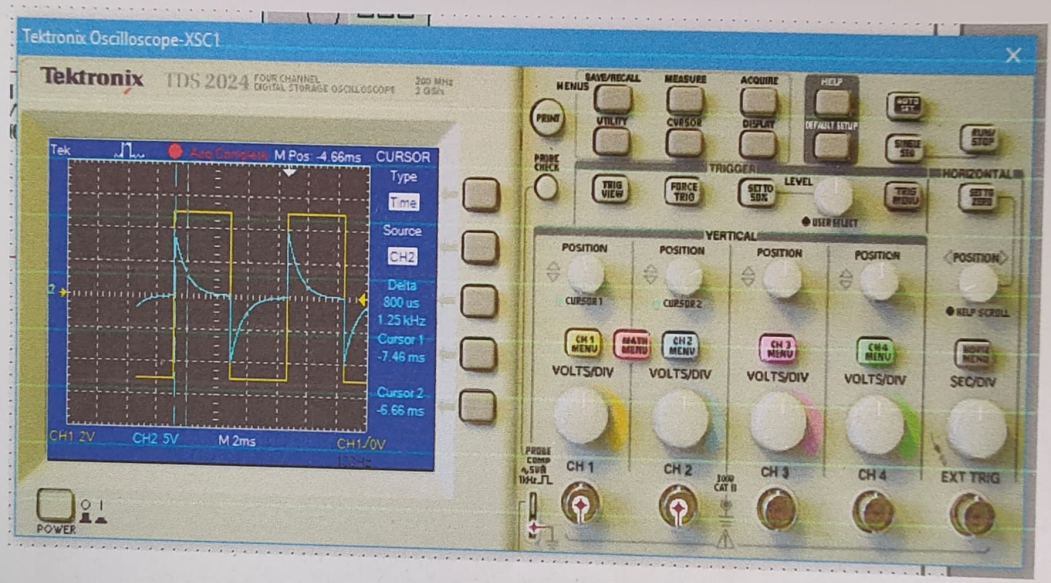
02. Simulation using Multisim.








Tektronix Oscilloscope-XSC1
Tektronix
TDS 2024
FOUR CHANNEL DIGITAL STORAGE OSCILLOSCOPE
200 MHz 2 GS/s
Tek
M Pos: -2.96ms
CURSOR
Type
Voltage
Source
CH2
Delta
3.7 V
Cursor 1
-150 mV
Cursor 2
3.55 V
CH1 2V
CH2 5V
M 2ms
CH1 0V
POWER
MENUS
SAVE/RECALL
MEASURE
ACQUIRE
HELP
PRINT
UTILITY
CURSOR
DISPLAY
DEFAULT SETUP
AUTO SET
RUN/STOP
SINGLE SEQ
PROBE CHECK
TRIGGER
TRIG VIEW
FORCE TRIG
SET TO 50%
LEVEL
TRIG MENU
HORIZONTAL
SET TO ZERO
USER SELECT
VERTICAL
POSITION
CURSOR 1
CURSOR 2
HELP SCROLL
CH 1 MENU
MATH MENU
CH 2 MENU
CH 3 MENU
CH 4 MENU
HORIZ MENU
VOLTS/DIV
SEC/DIV
PROBE COMP ~5Vpp 1kHz
CH 1
CH 2
300V CAT II
CH 3
CH 4
EXT TRIG


Tektronix Oscilloscope-XSC1
Tektronix
TDS 2024
FOUR CHANNEL DIGITAL STORAGE OSCILLOSCOPE
200 MHz 2 GS/s
Tek
M Pos: -4.66ms
CURSOR
Type
Time
Source
CH2
Delta
800 us
1.25 kHz
Cursor 1
-7.46 ms
Cursor 2
-6.66 ms
CH1 2V
CH2 5V
M 2ms
CH1 0V
POWER
MENUS
SAVE/RECALL
MEASURE
ACQUIRE
HELP
PRINT
UTILITY
CURSOR
DISPLAY
DEFAULT SETUP
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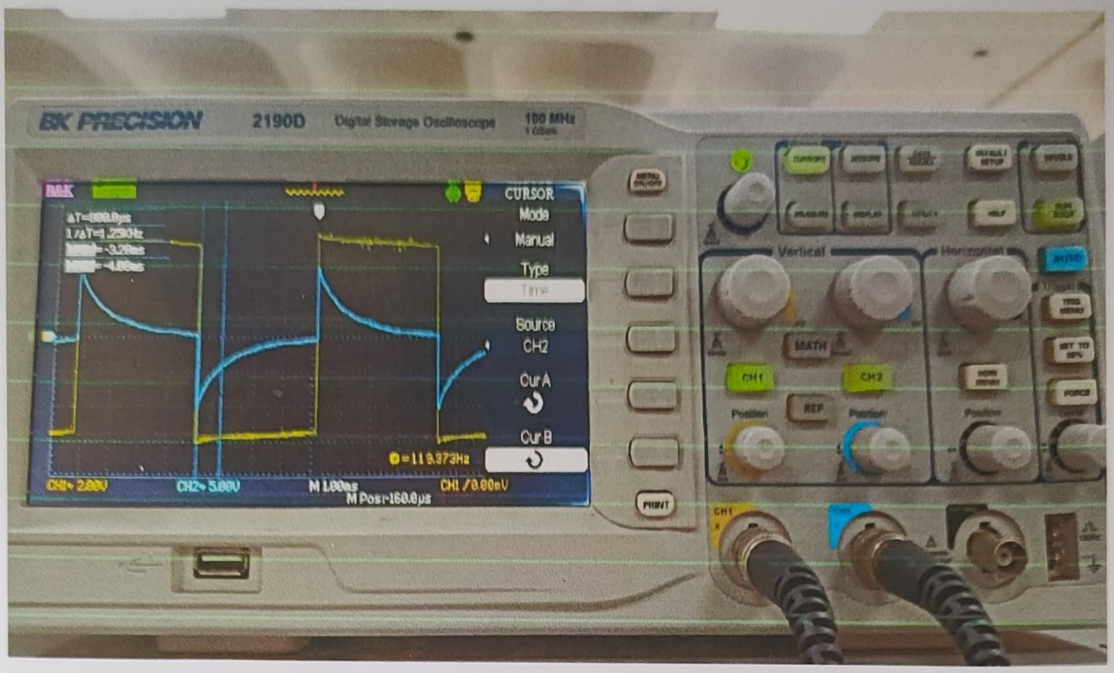
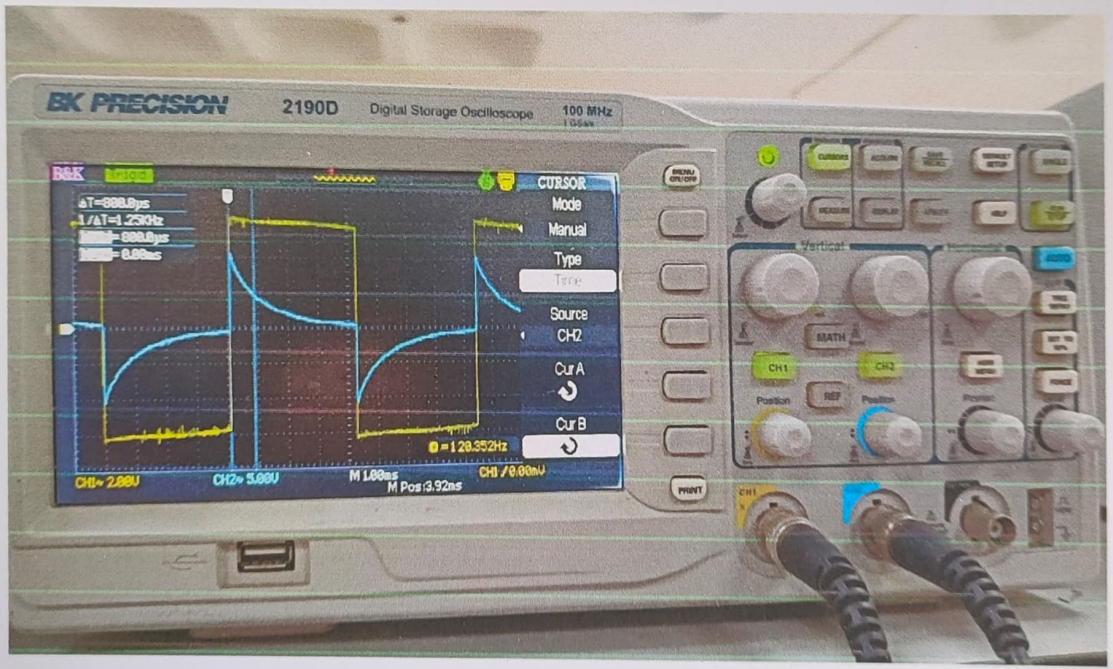

BK PRECISION
2190D
Digital Storage Oscilloscope
100 MHz
CURSOR
Mode
Manual
Type
Source
CH2
Cur A
Cur B
Vertical
Horizontal
MATH
CH1
CH2
REF
Position
PRINT


BK PRECISION
2190D
Digital Storage Oscilloscope
100 MHz
CURSOR
Mode
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CH2
Cur A
Cur B
MATH
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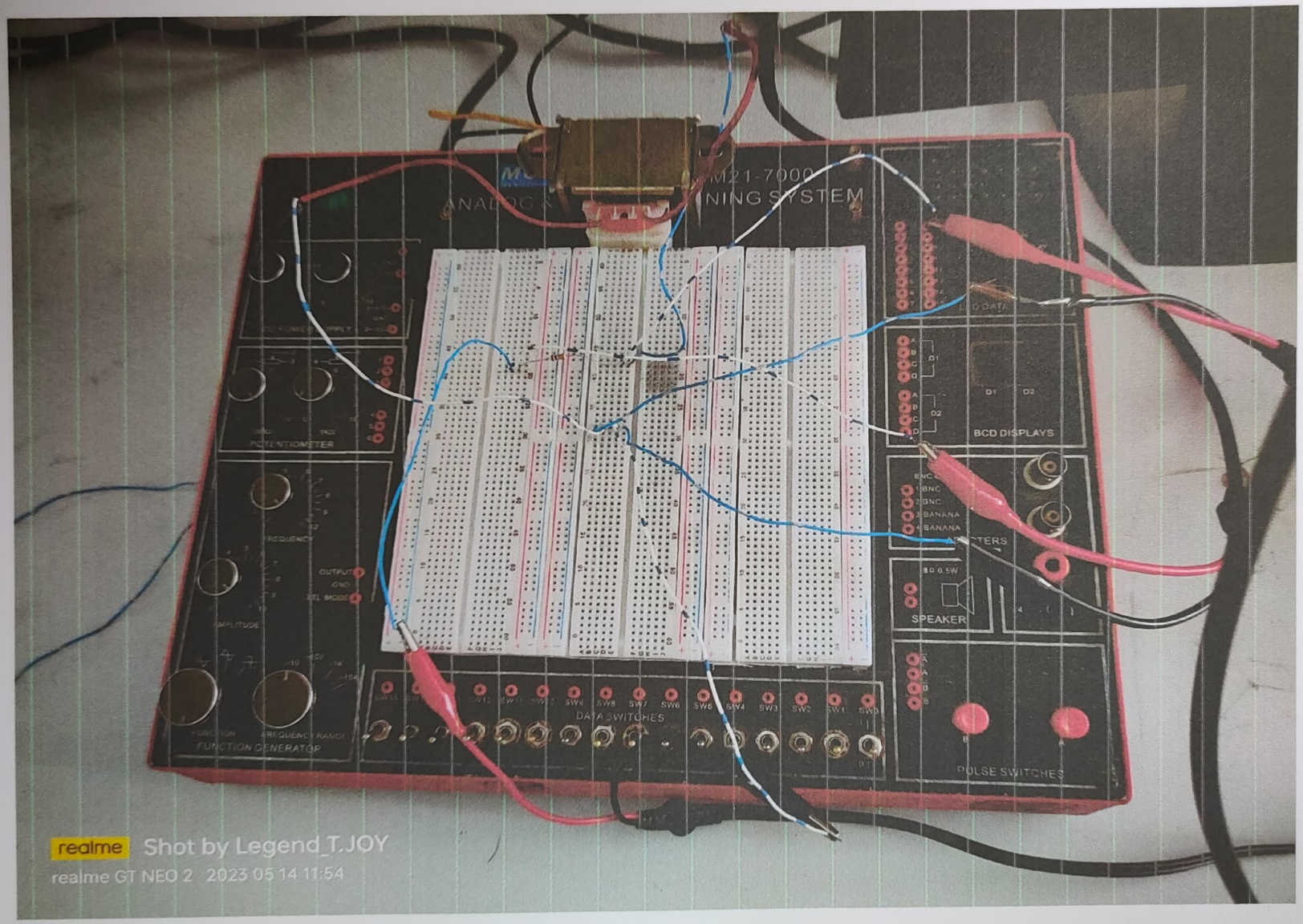
BCD DISPLAYS
SPEAKER
DATA SWITCHES
PULSE SWITCHES
FUNCTION GENERATOR
POTENTIOMETER
realme Shot by Legend_T.JOY
realme GT NEO 2 2023 05 14 11:54