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DEPARTMENT OF
ELECTRONICS AND COMMUNICATION ENGINEERING
College of Engineering and Technology, SRM IST, Chennai

MINI PROJECT REPORT

EVEN Semester, 2022-23

Lab code & Name : 18ECC201J – Analog Electronic Circuits

Year & Semester : II Year, IV Sem

Project Title : Class A Power Amplifier

Lab Supervisor : Mrs N Veni

Team Members Name and Reg No : RA2111004010200: Dhananjay Srinivas
RA2111004010203: Kartik Gowda
→ RA2111004010207: Saket Kumar

Reg. No	RA2111004010200	RA2111004010203	RA2111004010207
Mark split up			
Novelty in the project work (2 marks)	2	2	2
Level of understanding of the design formula (4 marks)	4	4	4
Contribution to the project (2 Marks)	2	2	2
Report writing (2 Marks)	2	2	2
Total (10 Marks)	10	10	10

Date: 24/4/23

Signature of Lab Supervisor

Department of ECE ★ SRM IST ★ Kattankulathur-603 203

CLASS A POWER AMPLIFIER

OBJECTIVE :

To Study and determine efficiency of class A power amplifier.

ABSTRACT:

The function of power amplifier is to raise the power level of input signal. Class A power amplifier is one in which the output current flows during the entire cycle of input signal. Thus the operating point is selected in such a way that the transistor operates only over the linear region of its load line. So this amplifier can amplify input signal of small amplitude. As the transistor operates over the linear portion of load line the output wave form is exactly similar to the input wave form. Hence this amplifier is used where freedom from distortion is the prime aim. we are interested in delivering maximum AC power to the load, while consuming the minimum DC power possible from the supply we are mostly concerned with the "conversion efficiency" of the amplifier.

INTRODUCTION:

The common emitter class-A amplifier is designed to produce a large output voltage swing from a relatively small input signal voltage of only a few millivolt's and are used mainly as "small signal amplifiers". However, sometimes an amplifier is required to drive large resistive loads such as a loudspeaker or to drive a motor in a robot and for these types of applications where high switching currents are needed Power Amplifiers are required.

We are interested in delivering maximum AC power to the load, while consuming the minimum DC power possible from the supply we are mostly concerned with the "conversion efficiency" of the amplifier.

The main disadvantage of power amplifiers and especially the Class A amplifier is that their overall conversion efficiency is very low as large currents mean that a considerable amount of power is lost in the form of heat.

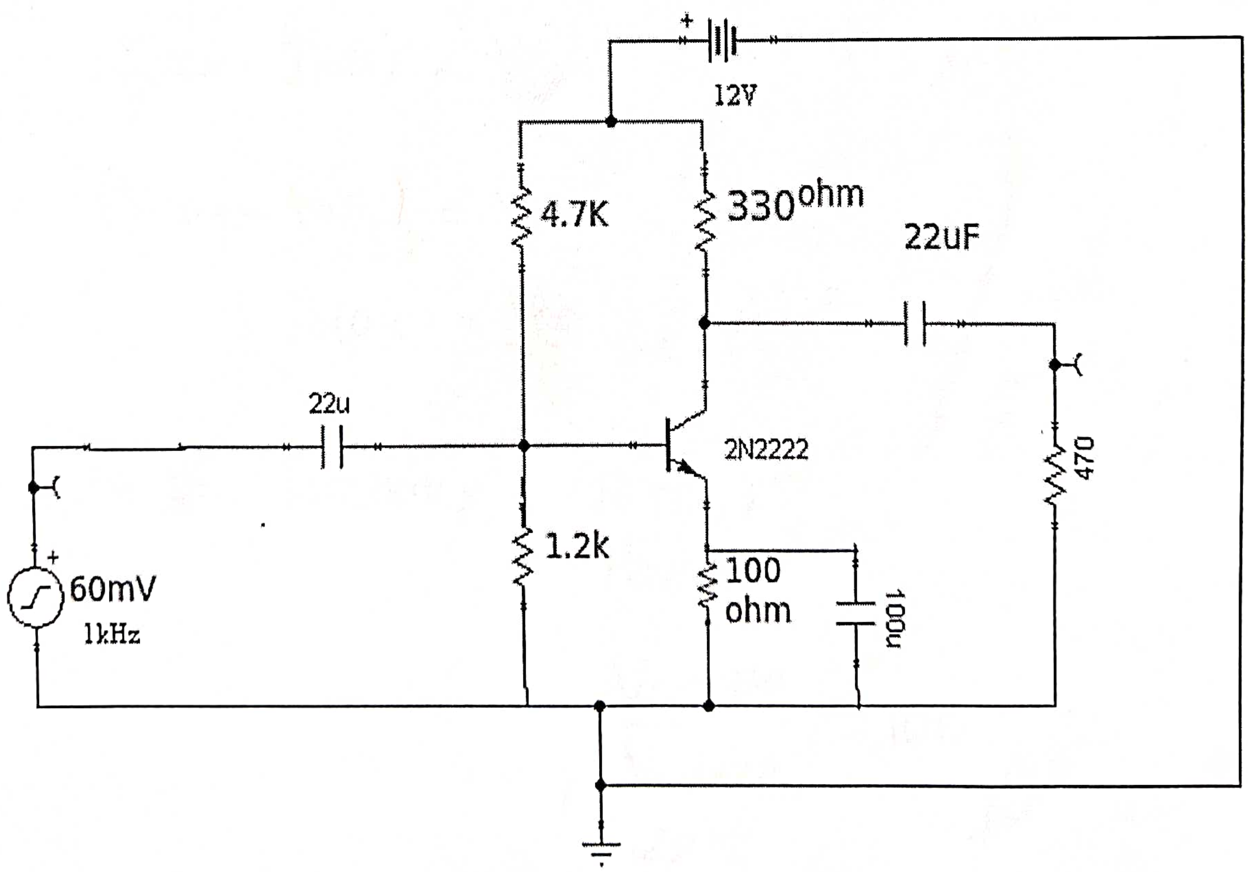
HARDWARE REQUIREMENT/DESCRIPTION:

Transistor(2N2222),Resistors,Capacitors,Function Generator,CRO.

CIRCUIT/ COMPONENTS SPECIFICATIONS:

Supply voltage (V_{CC})	+5V
Transistor	2N2222
Resistors	4.7K,1.2K,330ohm,100ohm,470ohm
Capacitors	22uf,100uf
Function Generator	1
CRO	1
Connecting wires	-

CIRCUIT DIAGRAM:



DESIGN FORMULA:

THEROTICAL CALCULATIONS:

$$I_{CQ} = \frac{V_{CC}/R_L}{2}$$

$$I_{CQ} = \frac{I_C}{2}$$

$$P_{in}(d.c) = \frac{V_{CC} \times V_{CC}}{2R_L} = \frac{V_{CC}^2}{2R_L}$$

$$P_o(a.c) = \frac{(V_{max} - V_{min}) \times (I_{max} - I_{min})}{8}$$

$$(I_{max} - I_{min}) = \frac{V_{CC}}{R_L}$$

$$(V_{max} - V_{min}) = V_{CC}$$

$$P_o(a.c) = \frac{V_{CC}}{8R_L} = \frac{V_{CC}^2}{8R_L}$$

$$\% \text{ of Efficiency} = \frac{P_o(a.c)}{P_{in}(d.c)} \times 100$$

$$= \frac{V_{CC}^2/8R_L}{V_{CC}^2/2R_L} \times 100$$

$$= 25\%$$

PRACTICAL CALCULATIONS:

$R_L = 470\Omega$ $I_{CQ} = 2mA$ (From multimeter) $V_{CC} = +5V$

(1) $P_{ac} = \frac{(V_o)^2}{8 \times R_L} = \frac{0.8 \times 0.8}{470 \times 8} = 0.00017W$

$P_{dc} = V_{cc} \times I_{cq} = 5V \times 2mA = 10 \times 10^{-3}$

% Efficiency $= \frac{P_{ac}}{P_{dc}} \times 100 = \frac{0.00017}{10 \times 10^{-3}} \times 100 = 1.7\%$

(2) $P_{ac} = \frac{(V_o)^2}{8 \times R_L} = \frac{1 \times 1}{8 \times 470} = 0.00026W$

$P_{dc} = V_{cc} \times I_{cq} = 5V \times 2mA = 10 \times 10^{-3}$

% Efficiency $= \frac{P_{ac}}{P_{dc}} \times 100 = \frac{0.00026}{10 \times 10^{-3}} \times 100 = 2.6\%$

(3) $P_{ac} = \frac{(V_o)^2}{8 \times R_L} = \frac{1.4 \times 1.4}{8 \times 470} = 0.00052W$

$P_{dc} = V_{cc} \times I_{cq} = 5V \times 2mA = 10 \times 10^{-3}$

% Efficiency $= \frac{P_{ac}}{P_{dc}} \times 100 = \frac{0.00052}{10 \times 10^{-3}} \times 100 = 5.2\%$

(4) $P_{ac} = \frac{(V_o)^2}{8R_L} = \frac{1.7 \times 1.7}{8 \times 470} = 0.00076W$

$P_{dc} = V_{cc} \times I_{cq} = 5V \times 2mA = 10 \times 10^{-3}$

% Efficiency $= \frac{P_{ac}}{P_{dc}} \times 100 = \frac{0.00076}{10 \times 10^{-3}} \times 100 = 7.6\%$

DESIGN ISSUES:

1. Maximum supply voltage should not exceed 15V
2. Efficiency: Class A amplifiers are known for their low efficiency, as they operate in the linear region of the output devices, which results in a high power dissipation.
3. Biasing: The biasing of the output devices is critical in Class A amplifiers, as it determines the quiescent current flowing through the devices. The biasing circuit needs to be designed to ensure that the devices are biased at the correct operating point
4. Power supply design: A Class A amplifier requires a high-quality power supply to deliver clean and stable power to the amplifier circuit

APPROACH / PROCEDURE / METHODOLOGY:

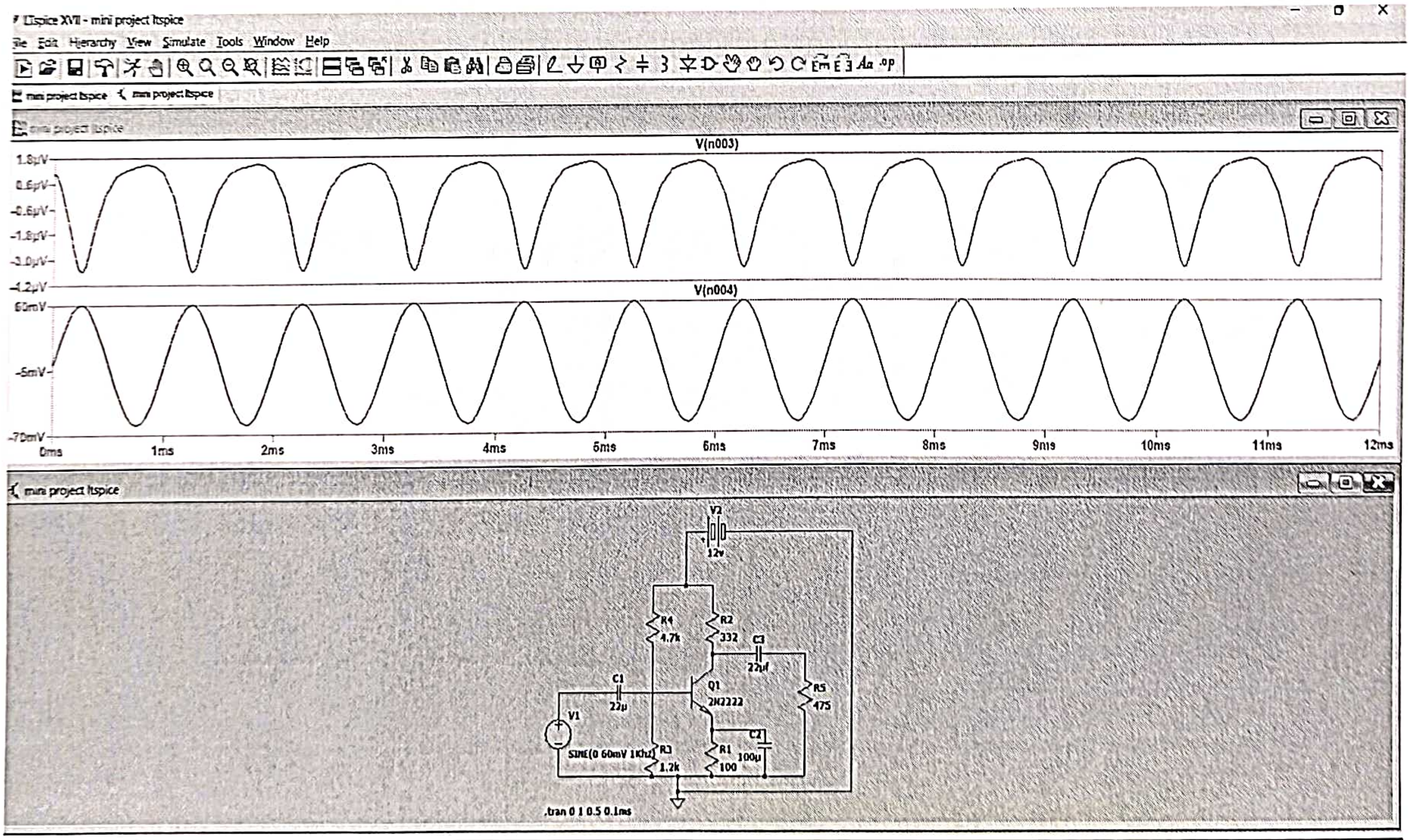
1. Select different components and place them in the breadboard according to the circuit diagram.
2. Apply the input ac signal voltage of 40mV (p-p),30mV,20mV,10mVone by one and simulate the circuit.
3. Observe the output wave form on CRO and measure the output voltage V_0
4. Now connect the ammeter/multimeter at collector terminal of transistor.
5. Disconnect the ac signal from input and measure the collector current Ic in ammeter.
6. Calculate the efficiency by using practical calculations compare it with theoretically calculated efficiency.

OBSERVATION:

S.NO	INPUT VOLTAGE(Vi) (Volts)	OUTPUT VOLTAGE(Vo) (Volts)	P(ac)=Vo^2/8RL (Watts)	P(dc)=Vcc*Icq	%Efficiency= {P(ac)/P(dc)}*100
1.	50mV	0.8V	0.00017	10×10^{-3}	1.7%
2.	60mV	1V	0.00026	10×10^{-3}	2.6%
3.	80mV	1.4V	0.00052	10×10^{-3}	5.2%
4.	100mV	1.7V	0.00076	10×10^{-3}	7.6%

NOTE-Icq is the current measured at collector terminal when AC input signal is zero

SIMULATIONS ON LTSPICE:



RESULTS:

The efficiency of Class A Power Amplifier has been determined and verified.

CONCLUSIONS:

Percentage efficiency of Class A Amplifier = 1.7%(When Vin=50mv)

Percentage efficiency of Class A Amplifier = 2.6%(When Vin=60mv)

Percentage efficiency of Class A Amplifier = 5.2%(When Vin=80mv)

Percentage efficiency of Class A Amplifier = 7.6%(When Vin=100mv)

REFRENCES:

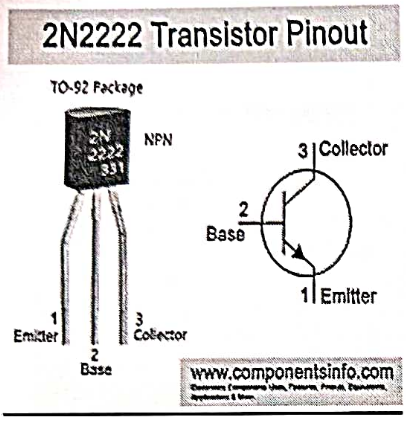
https://vikramlearning.com/jntuh/notes/electronic-circuits-and-pulse-circuits-

https://www.electronics-tutorials.ws/amplifier/amplifier-classes.html

APPENDIX:

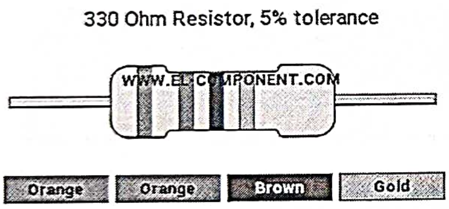
1.Transistor(2N2222)

The 2N2222 is a common NPN bipolar junction transistor (BJT) used for **general purpose low-power amplifying or switching applications.**

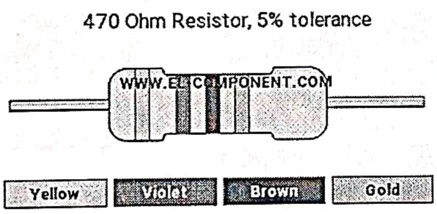


2.Resistors

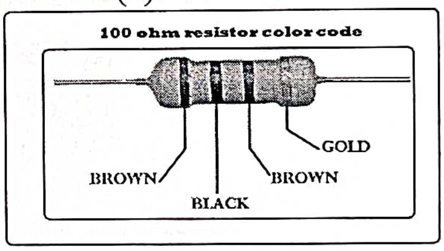
(a)330ohm



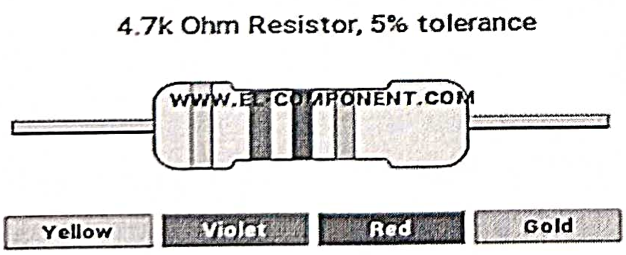
(b)470ohm



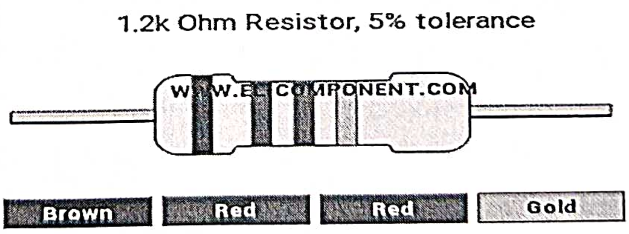
(c)100ohm



(d)4.7k

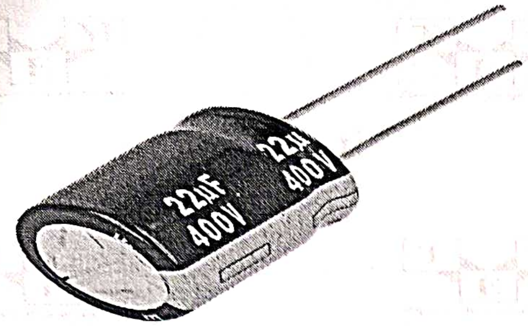


(e)1.2k

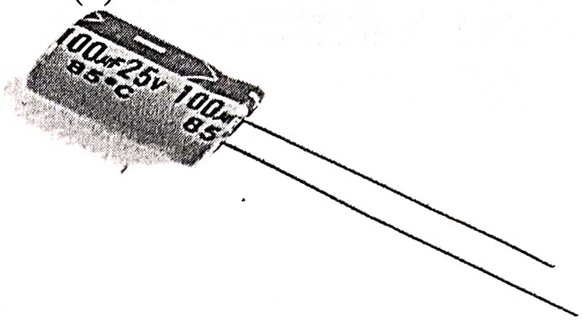


3.Capacitors

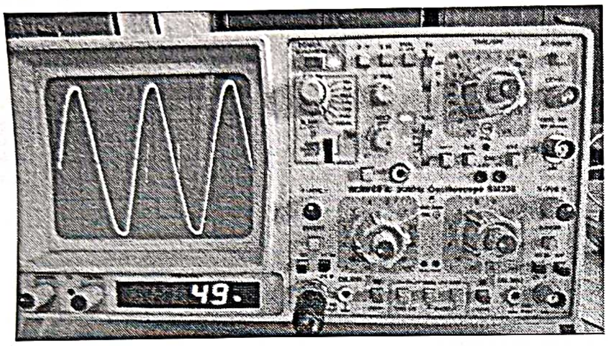
(a)22uF



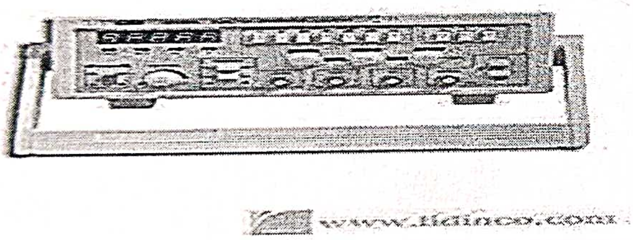
(b)100uF



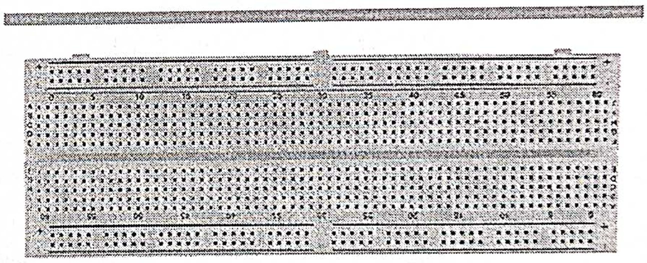
4.CRO Cathode ray oscilloscope



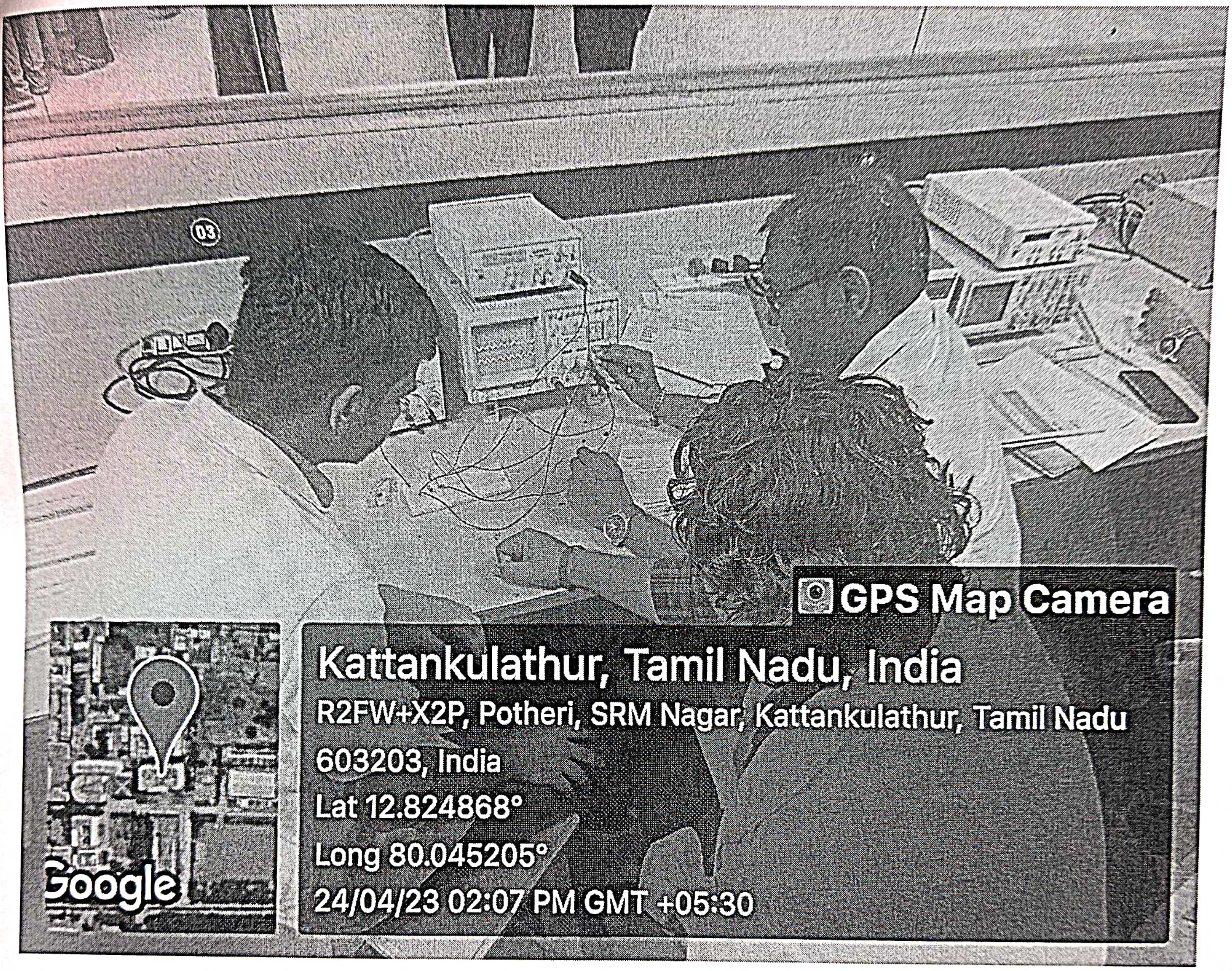
5.Function Generator



6.Breadboard



GROUP PHOTO: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