Section - A.

Basic Electronics I

Indian Institute of Information Technology Vadodara

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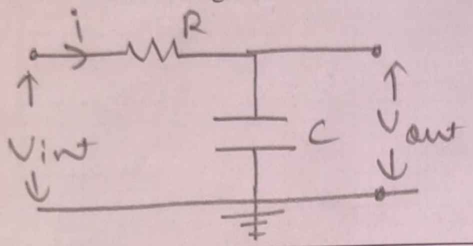
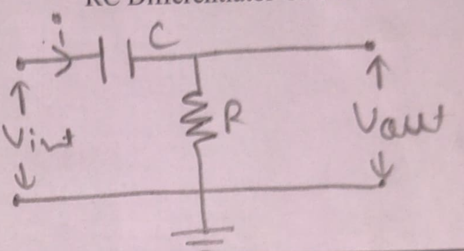
Laboratory Report (to be submitted on the same day)

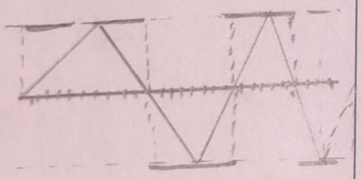
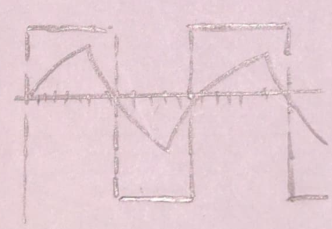
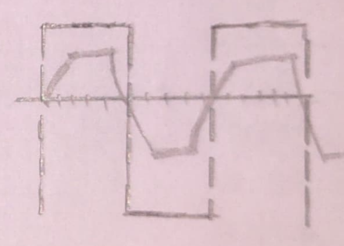
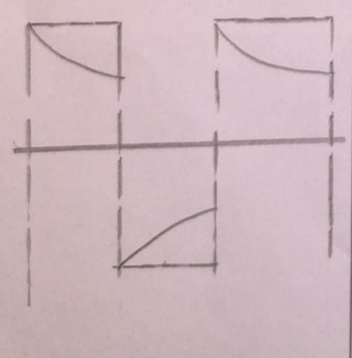
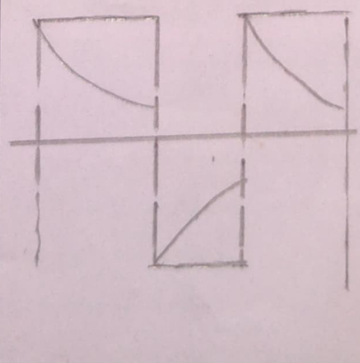
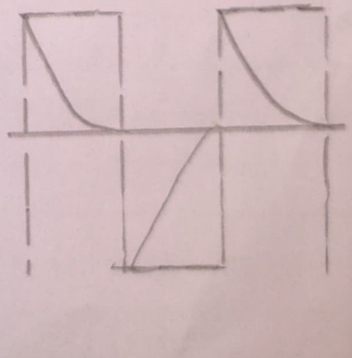
Objective: Study of Time and Frequency response of RC circuit.

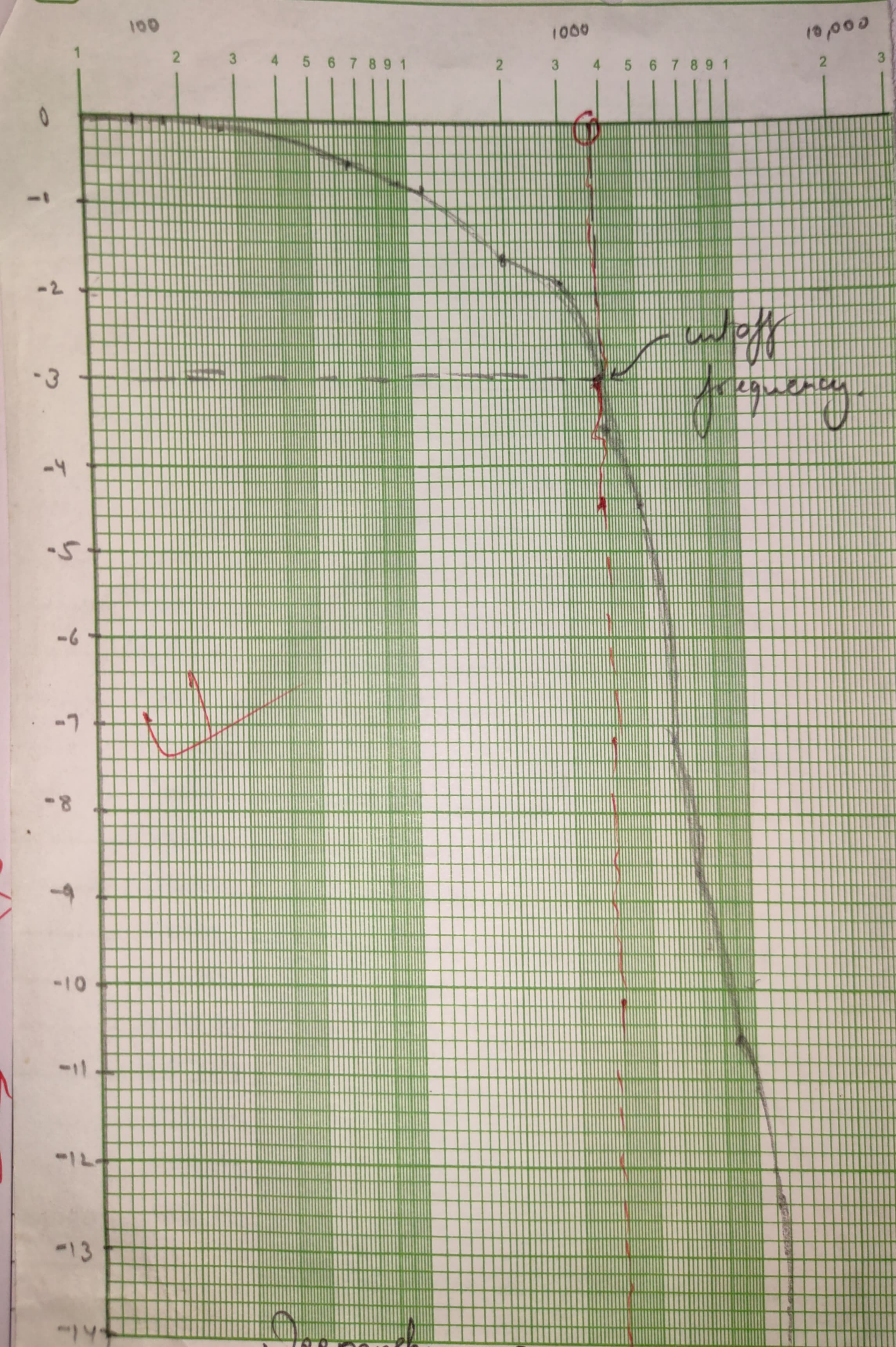
1. **Circuit Diagram:**

RC Integrator Circuit	RC Differentiator Circuit
	

2. Chosen R = 1000 Ω, C = 10^{-7} F, τ (theoretical) = 10^{-4} sec

3. **Time Response:** Paste the traced response for a given square wave of ±5V.

RC Integrator Circuit		
T << τ	**T ≈ τ**	**T >> τ**
		
RC Differentiator Circuit		
T << τ	**T ≈ τ**	**T >> τ**
		



100
1000
10,000
1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9 1 2 3
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
cutoff frequency.

4. Frequency Response of low pass filter:

Frequency (in Hz)	Input Voltage, V_i (in V)	Output Voltage, V_o (in V)	Voltage Gain (in dB)
30.6 KHz	5V	0.88V	-15.09
28.6 KHz	5V	1V	-13.98
19.4 KHz	5V	1.28V	-12.04
14.7 KHz	8V	1.27V	-11.91
11.8 KHz	5V	1.3V	-11.70
10 KHz	5V	1.38V	-11.37
9 KHz	5V	1.5V	-10.46
8 KHz	5V	1.8V	-8.87
7KHz	5V	2V	-7.96
6KHz	5V	2.2V	-7.13
5KHz	5V	3V	-4.44
4KHz	5V	3.2V	-3.87
3KHz	5V	4V	-1.93
2KHz	5V	4.1V	-1.73
1.1KHz	5V	4.6V	-0.72
970 Hz	5V	4.68V	-0.63
907 Hz	5V	4.7V	-0.54
674 Hz	5V	4.8V	-0.35
289 Hz	5V	4.93V	-0.125
108 Hz	5V	5V	0

5. **Plot Gain (in dB) vs Frequency:** (Attach the plot drawn on semi-log graph paper)

6. **Results:** Discuss the results obtained in the experiment.

From this experiment, we find impedence $\left(X_c = \frac{1}{\omega C}\right)$ not the voltage.
We analysed the frequency response of a low pass filter circuit with $1K\Omega$ resistance and $10^{-7}F$ capacitor.
We get cut off frequency corresponding to -3dB voltage gain which is approximately 3.8 KHz. The circuit is most efficient in this bandwidth

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Laboratory Report

Experiment-5: Study of Normal and Zener Diode Characteristics,

Code Number of Diode: (i) Normal Diode: 9.(IN4003) Resistance: 1KΩ

(ii) Zener Diode: 9.(IN4728A)

A. Table-I: For Normal Diode

Applied Voltage (in V)	Current (in mA)
0.1V	0
0.2V	0
0.4V	0.01
0.6V	0.14
0.8V	0.32
1.3V	0.77
1.8V	1.26
2.0V	1.49
2.2V	1.63
2.6V	2.07
3.3V	2.75
3.9V	3.30
4.4V	3.84
5.2V	4.65
5.8V	5.19
6.6V	6.08
7.8V	7.21
8.3V	7.81
9.0V	8.49
9.8V	9.34
10.5V	10.02
11.2V	10.77
11.8V	11.37
12.4V	12.01
12.8V	12.42
13.5V	13.12
14.2V	13.88
15.0V	14.62

B. Table-II: For Zener Diode

Applied Voltage (in V)	Current (in A)
Forward: 0V	0
0.4V	0
0.5V	0
0.6V	0.02
0.9V	0.17
1.3V	0.59
1.9V	1.07
2.4V	1.57
3.0V	2.19
3.8V	2.97
4.5V	3.58
5.2V	4.37
6.0V	5.29
6.6V	5.83
7.3V	6.49
7.9V	7.18

8.9V	8.17
9.8V	9.05
10.7V	9.91
11.5V	10.71
12.4V	11.67
13.5V	12.80
14.4V	13.73
15.0V	14.32.
Reversebias:-	
1	0
2	0
3	0
4	0
5	0
6	0
6.8	0.01
7.4	0.13
7.9	0.58
8.4	1.04
9.0	1.62
9.7	2.4
10.7	3.34.
11.8	4.43
12.9	5.58
13.8	6.41
14.4	7.01
15.0	7.66.

Graphs: Plot *I-V* characteristics for both the diodes and estimate the required parameters.

Results: Table-III

Threshold voltage of Normal Diode (in V)	0.4V
Static resistance of Normal Diode (in Ω)	1.02kΩ
Dynamic resistance of Normal Diode (in Ω)	0.95kΩ
Threshold voltage of Zener diode (in V)	0.5V
Zener breakdown voltage (in V)	8V

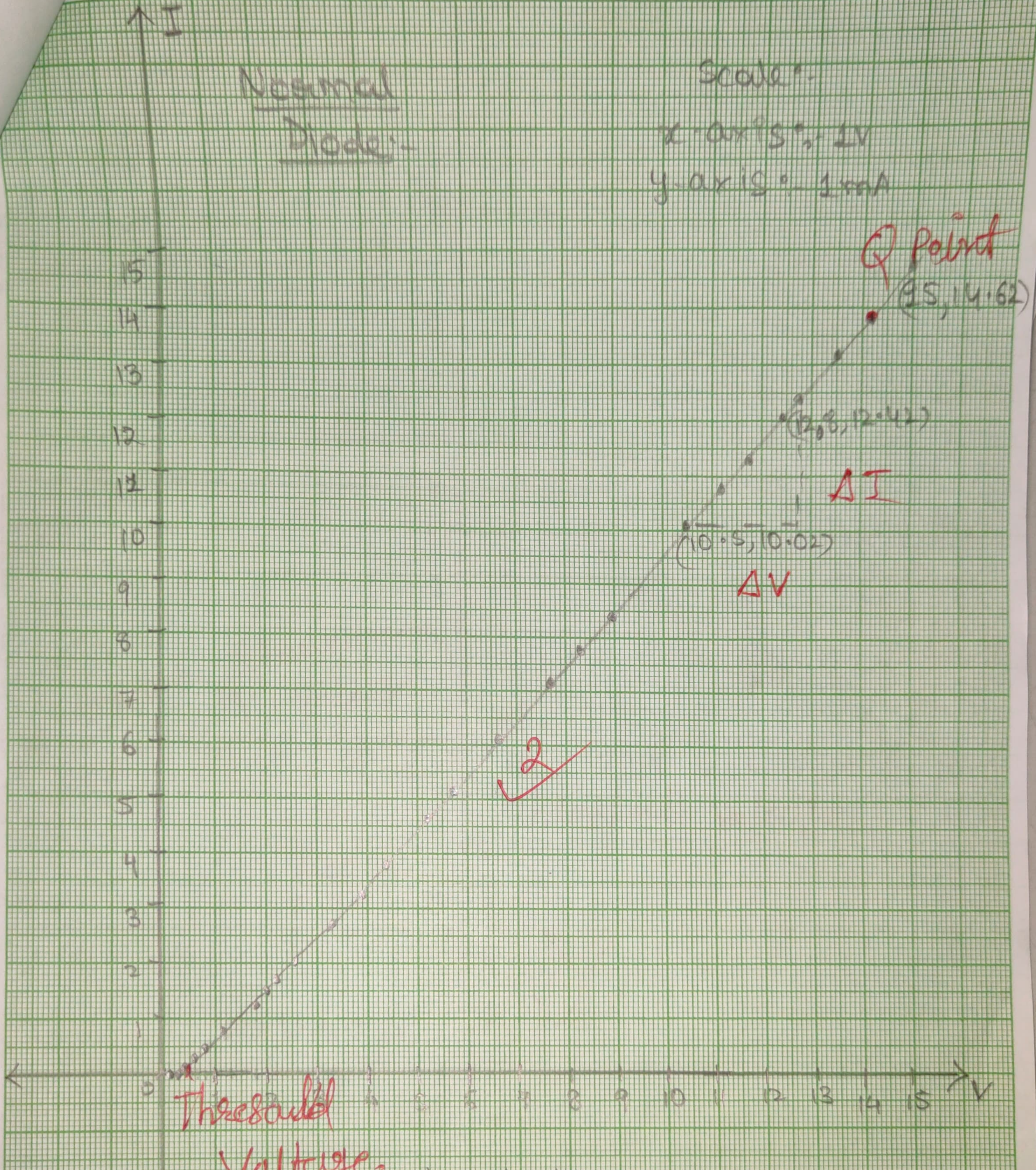
3

Normal Diode:-

Scale:-

x-axis :- 1V

y-axis :- 1mA

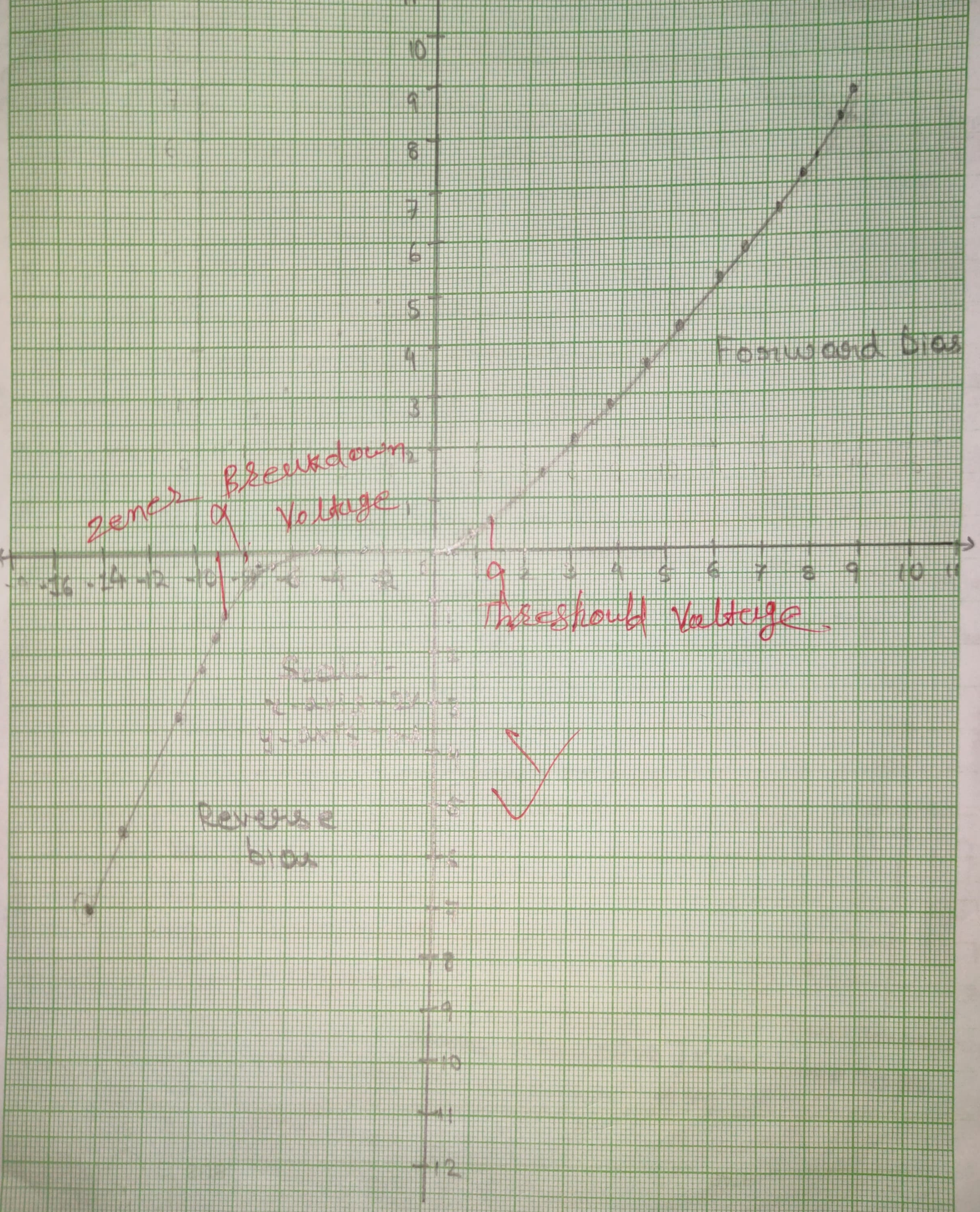


Threshold = 0.4V

Static R = $\frac{15}{14.62\,mA}$ = 1.02kΩ

Dynamic = $\frac{12.8-10.5}{12.42-10.02} = \frac{2.3}{2.4} = 0.95k\Omega$

Zener diode


Scale:-
x-axis - 1V
y-axis - 1mA
Forward bias
Zener Breakdown Voltage
Threshould Voltage
Reverse bias

Exp. 1: DESIGN OF REGULATED POWER SUPPLY

Ripple factor = $\frac{V_{rms}}{V_{dc}} = \frac{5.82}{12.06} = 0.48 \times 100 = \boxed{48\%}$

Observations:

$V_{rms} = 15V$; Frequency = 50 Hz

Volt/div = 20V Time/div = 10ms

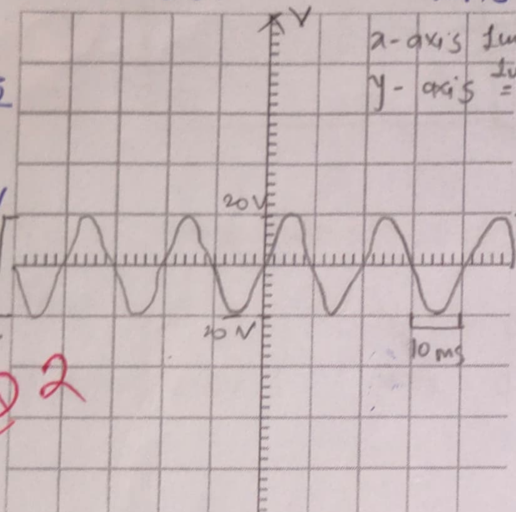
Volt/div = 20 V Time/div = 5 ms

$V_{peak} = V_{rms} \times \sqrt{2}$

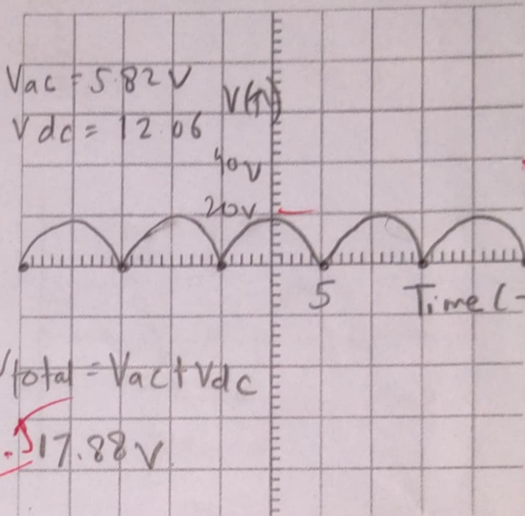
$V_{peak} = 21.15V$

40 V ← difference

good ① 2



Graph 1: Waveform at the secondary of the transformer



B 1.5

Graph 2: Waveform after rectification

Vpeak = ~~0.48~~ ~~x√2~~ = ~~0.6787~~

$V_{peak} = 5.82 \times \sqrt{2} = 8.22$

Volt/div = 0.2V Time/div = 10 m/s

Volt/div = 10 V Time/div = 2 m/s

$V_{rms} = 0.073$

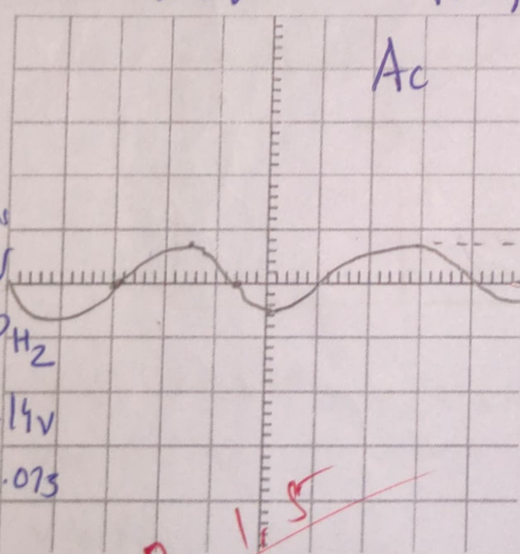
$V_{max} = \sqrt{2} \times V_{rms} = 0.102V$

freq = 100 Hz

$V_{dc} = 7.14V$

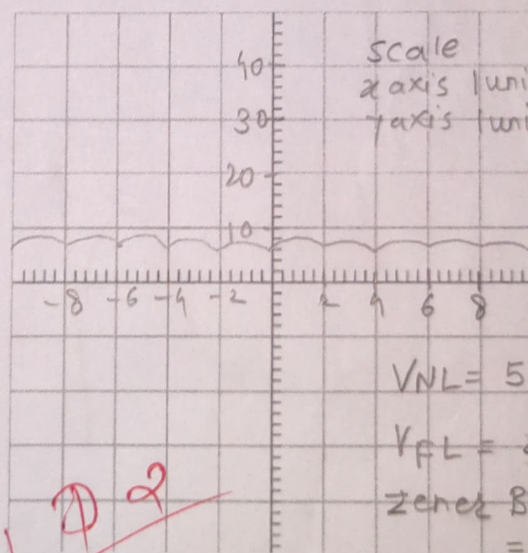
$V_{ac} = 0.073$

ripple = 0.01



B 1.5

Graph 3: Waveform after filter capacitor



$V_{NL} = 5.1$ V

~~$V_{FL} = 4.8$ V~~

~~Zener Breakdown~~ = 5.2

D 2

Graph 4: Regulated DC output

$[(V_{NL} - V_{FL})/V_{FL}] \times 100$

Load Regulation = $((V_{NL} - V_{FL})/V_{FL}) \times 100$ % = 6.25 %

~~V_{NL}~~ = Zener Breakdown = 5.2V

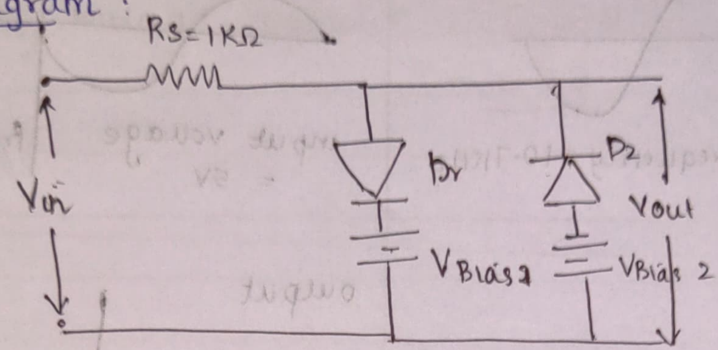
1

V_{NL}

clamping circuit & clipper circuit:

clamper circuit: To study +ve and -ve clipper circuits

circuit diagram:



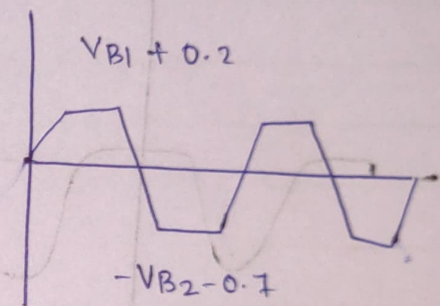
$V_{in} = \pm 10V$ (sine(2.2KHz))

$V_{Bias\,1} = 0.9V$

$V_{Bias\,2} = 3.6V$

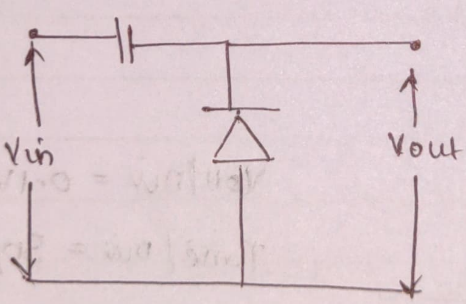
$V_{D1} = 0.7V$

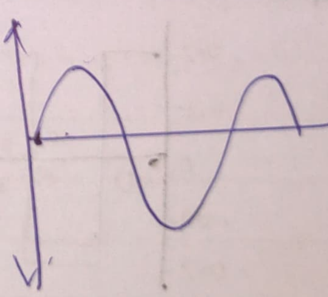
$V_{D2} = 0.7V$



(II) Aim: to study the +ve clamper circuit

circuit diagram:



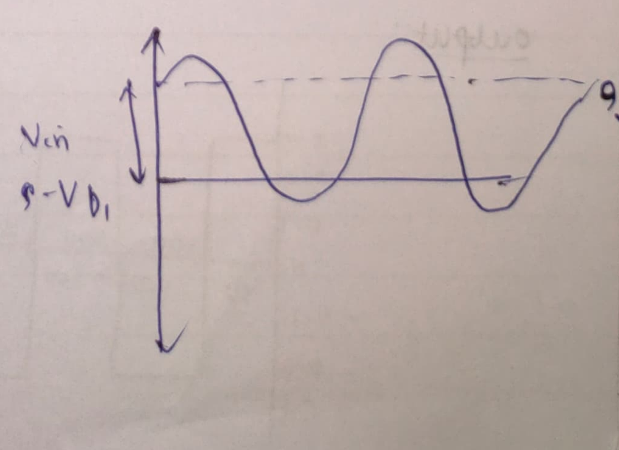


$V_{in} = \pm 10V$ (sine (2.8 KHz))

$V_{DT} = 0.7V$

$V(DC)\ in = -4.72V$

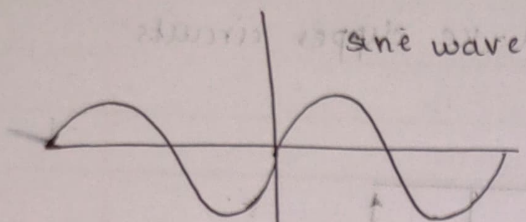
$V(DC)\ out = 4.58V$



Clipper circuit

Forward Bias

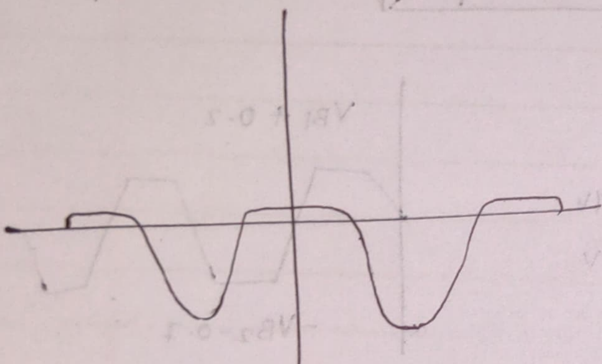
Sine wave



input voltage = 5V

Frequency = 10.7KHz

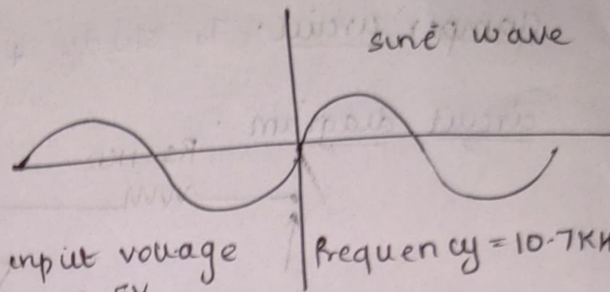
output



output voltage = 4V

Reverse Bias

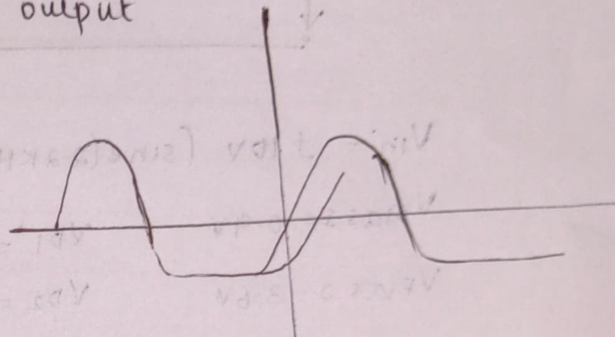
Sine wave



input voltage = 5V

Frequency = 10.7KHz

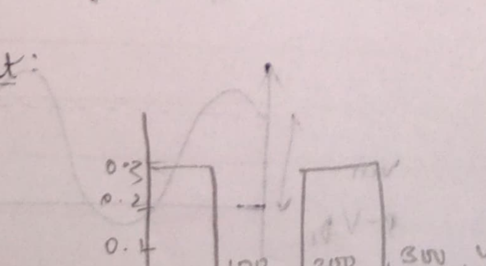
output



output voltage = 4V

Clamper circuit

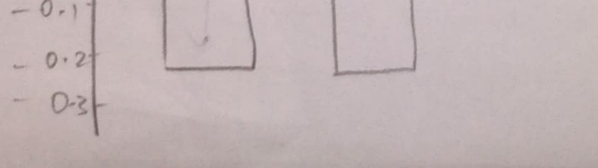
Input



Volt/Div = 0.1V

Time/Div = 50μs

output:



Volt/Div = 0.1V

Time/Div = 50μs

clamping voltage Diff :

Peak voltage before clamping $= 0.2V$

Peak voltage before clamping $= 0.3V$

clamping voltage difference $= 0.3 - 0.2$

$= \underline{0.1V}$

Aim :- To understand the characteristics of a Light Dependent Resistor (LDR) and use it to design a light dependent electronic switch.

A] Measurement of resistance of the given LDR :-

Resistance (in ohm) of LDR measured under following condn	
In Dark (placed within black box)	30.1×10^6
Under Laboratory Lighting	16.8×10^3
Under Solar Radiation	$276.075\ \Omega$

B] Study of the characteristics of the given LDR.

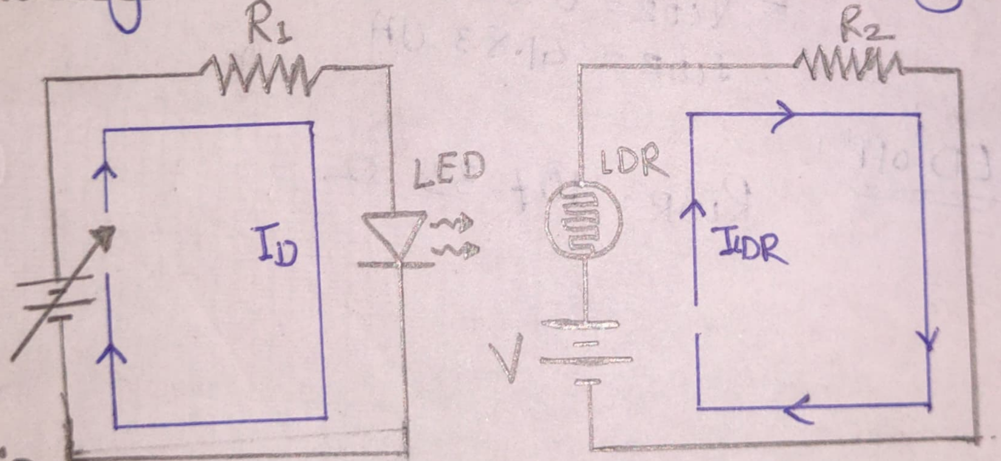


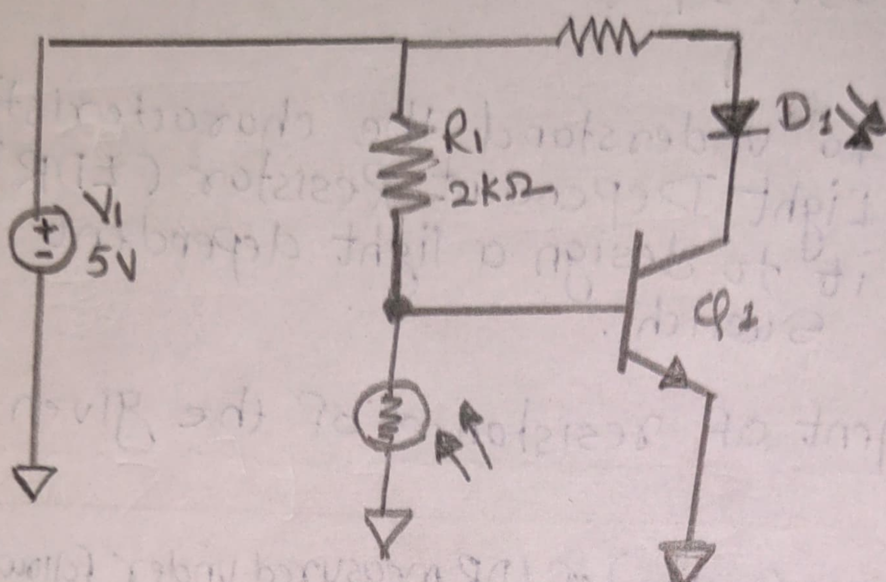
Fig. Circuit design to study the characteristics of LDR.

Result:-

Voltage	I_{LDR} (mA)	I_D (mA)
2.7	0.35	0.0685
3	0.484	0.2065
3.5	0.68	0.4465
4	0.829	0.681
4.2	0.887	0.7805
4.5	0.960	0.9345
4.7	0.992	1.019
5	1.068	1.182

C] Application of LDR : Design and analyze light dependent electronic switches

circuit dia :-



Application of LDR as light sensor to design an electronic switch

Readings :- LED ON :

$$R_{LDR} = \frac{V_{LDR}}{I_{LDR}}$$

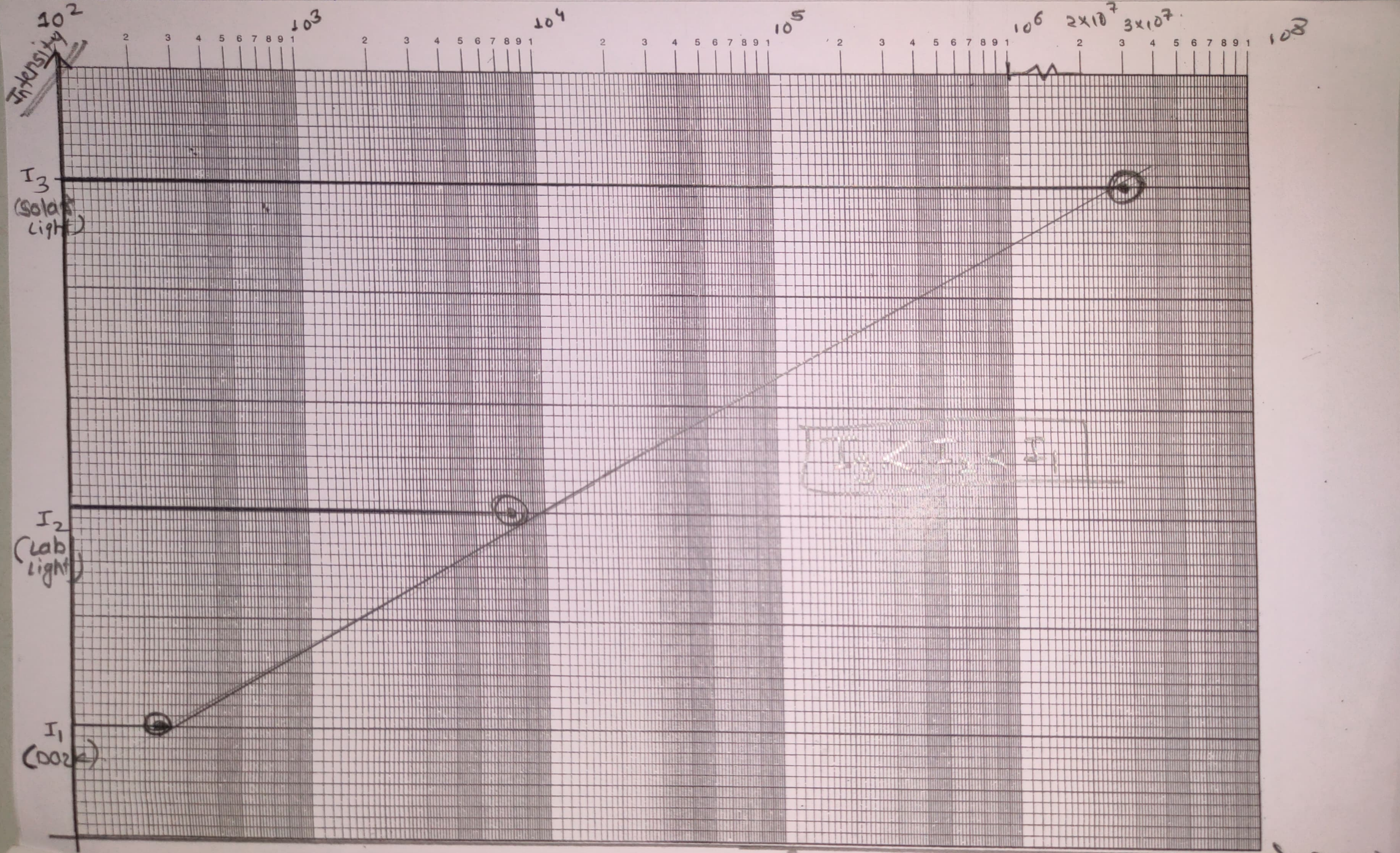
$R_{LDR} = 20.75\ k\Omega$

$V_{LDR} = 0.868\ V$

$I_{LDR} = 41.83\ \mu A$

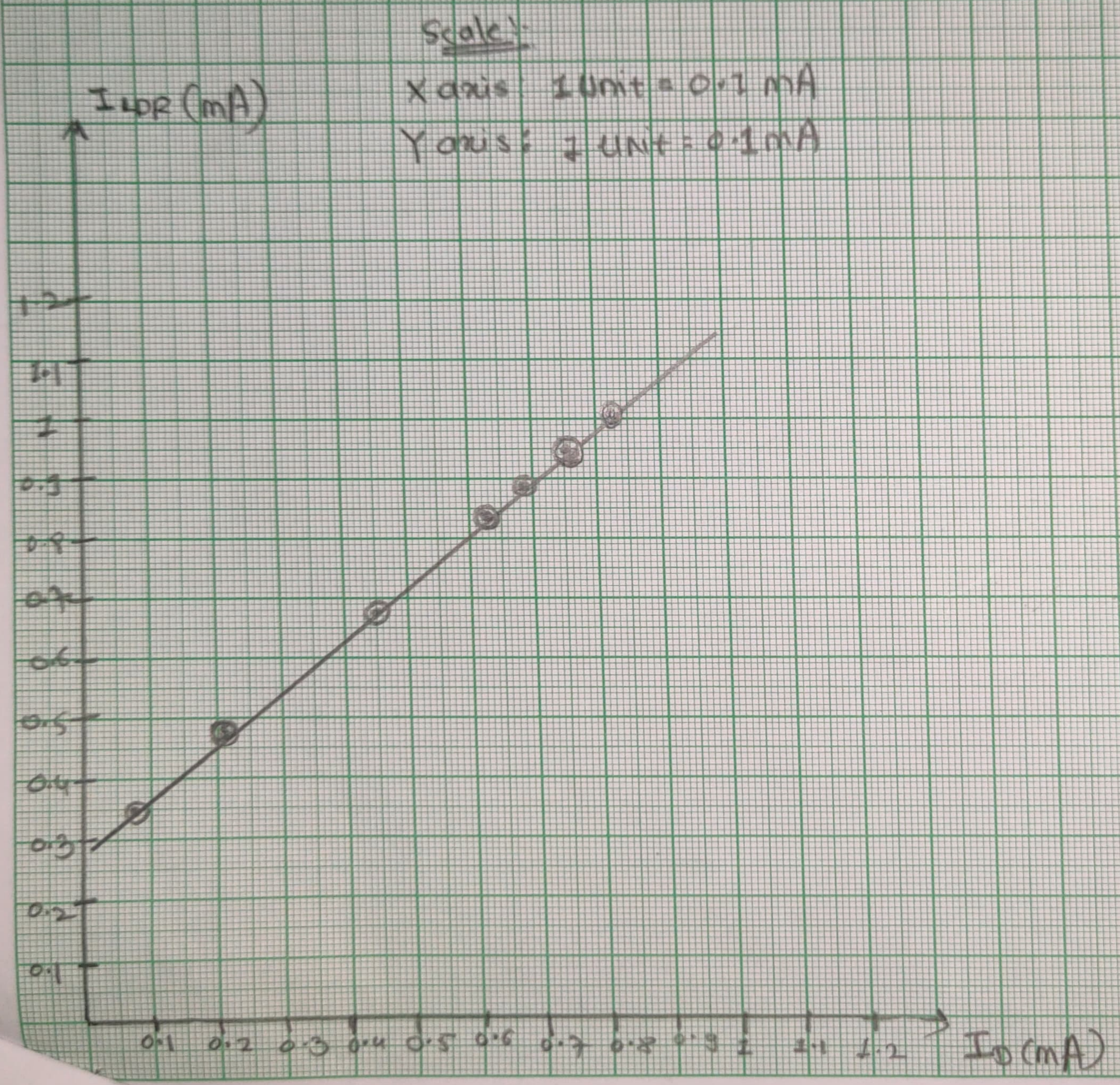
LED off :

$R_{LDR} = 107.33\ \Omega$



Kailas Rathod

SEMI-LOG PAPER (5 CYCLES X 1/10")


Scale:
X axis: 1 Unit = 0.1 mA
Y axis: 1 Unit = 0.1 mA
I_{LDR} (mA)
I_D (mA)
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2

Laboratory Report

Experiment-08: (*i*) To design a Common-Emitter Transistor (*n-p-n*) Amplifier Circuit. (*ii*) To obtain the frequency response curve of the amplifier and to determine the mid-frequency gain, A_{mid}, lower and higher cut-off frequency of the amplifier circuit.

value 1 → value from ideal resistors

Observations:

(30kΩ) (4.6kΩ) (4.4kΩ) (1kΩ)

β = 100, R_1 = 27kΩ, R_2 = 5kΩ; R_C = 4kΩ, R_E = 1kΩ, R_L = ...,

value 2 → value from actual given resistors

3

C_1 = 1uF, C_2 = 1uF, C_E = 100uF.

Table-I: D.C. Analysis of the circuit (For V_{CC} = 12V)

Parameter	Computed Value (Theoretical)	Observed Value (Experimental)
V_B (in V)	1.94 (1.6)	1.5V
V_E (in V)	1.24 (0.9)	0.8V
I_C~I_E (in mA)	1.24 (0.9)	0.8 mA
V_{CE} (in V)	5.8 (7.85)	7.9V

2

Q point
when no input signal is applied then, I_C & V_{CE} should be measured

DC Q-point is at (7.9 V, 0.8 mA)

Table-II: A.C. Analysis of the circuit.

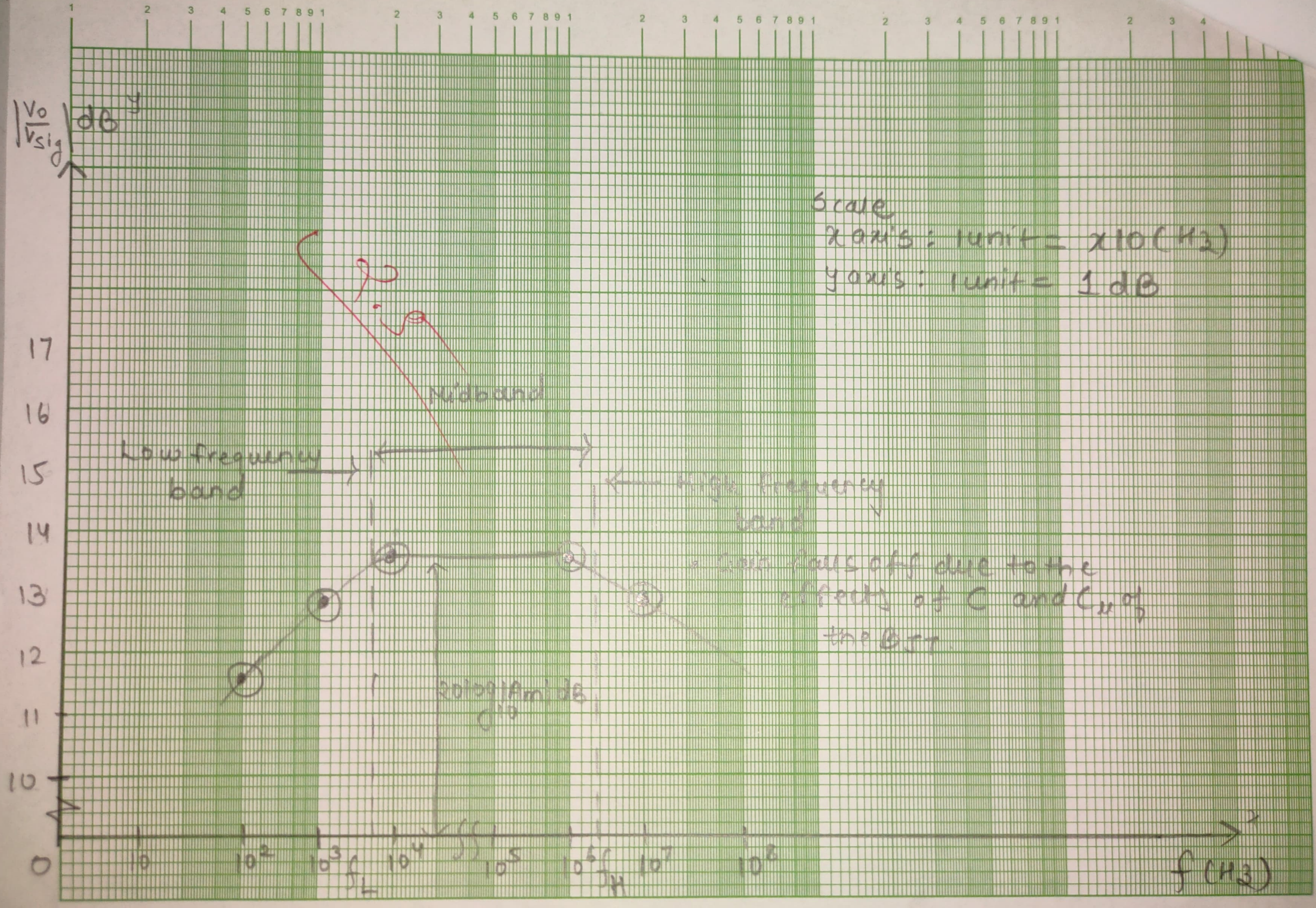
Parameter	Computed Value (Theoretical)	Observed Value (Experimental)
r_e' (in Ω)		
$Z_{in(base)}$ (in Ω)		
$Z_{in(stage)}$ (in Ω)		
r_c (in Ω))		
A_V		

$$Gain = 20\log_{10}\left|\frac{V_o}{V_{in}}\right| dB$$

Table-II: Frequency response: $V_{i(pp)}$ =....40........mV

S. No	Frequency, f (in Hz)	$V_{o(pp)}$ (V)	Gain, $A_V=V_{o(pp)}/V_{i(pp)}$	Gain (in dB)
1.	100	0.15	3.75	11.4
2.	120	0.15	3.75	11.4
3.	150	0.16	4.0	12.0
4.	200	0.16	4.0	12.0
5.	500	0.17	4.25	12.6
6.	10^3	0.18	4.5	13
7.	1.2×10^3	0.19	4.7	13.5
8	1.5×10^3	0.19	4.7	13.5
9.	5×10^3	0.19	4.7	13.5
10	10^4	0.20	5.0	14
11.	20×10^3	0.24	6.0	15.6
12.	50×10^3	0.245	6.2	15.8
13.	10^5	0.22	5.5	14.8
14.	500×10^3	0.19	4.75	13.5
15.	10^6	0.19	4.75	13.5
16.	2×10^6	0.18	4.5	13
17.	5×10^6	0.18	4.5	13
18.	10×10^6	0.18	4.5	13

2



|Vo/Vsig| dB
y
Scale
x axis : 1 unit = x10 (Hz)
y axis : 1 unit = 1 dB
17
16
15
14
13
12
11
10
0
Midband
Low frequency band
High frequency band
Gain falls off due to the effects of C and Cu of the BJT
20log|Amid| dB
10
10^2
10^3
f_L
10^4
10^5
10^6
f_H
10^7
10^8
f (Hz)
x