Devices and Circuits Laboratory
Experiment-5
MOS Differential Amplifier

Group : 1
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Objectives:

1. To characterize an NMOS current mirror circuit and a CMOS differential input to single ended output amplifier

NMOS CURRENT MIRROR

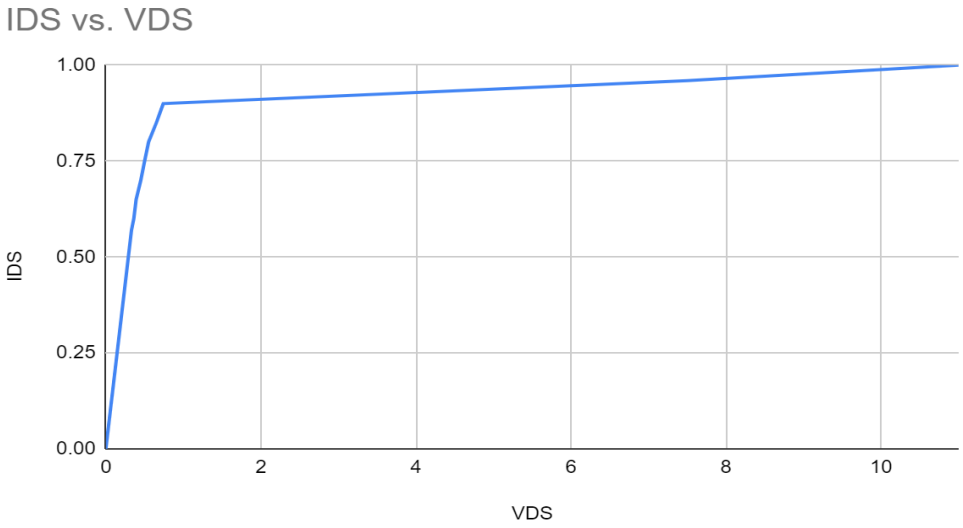
I_{ds}-V_{ds} characteristics of NMOS current mirror where current is in mA and voltage is in volts

Tabular Results:

V_{DS} (V)	I_{DS} (mA)
0	0
0.33	0.57
0.36	0.6
0.39	0.65
0.45	0.7
0.5	0.75
0.55	0.8
0.65	0.85
0.74	0.9
7.5	0.96
11	1

Graph of Ids vs Vds:

Ids is in mA.



Calculation of Output Impedance (R_{ds}):

$R_{ds} = V_d / I_d$

Hence, we can find the output Impedance from the slope of the graph.

Rds = 0.786 KOhm

Channel Length Modulation (λ):

The channel length modulation parameter (λ) can be found out as,

$\lambda = 1 / R_{out} I_d$

Hence we get,

$\lambda = 1.12V^{-1}$

CMOS differential amplifier

Question 2:

Formula : $f = \frac{1}{2\pi RC}$

Here the lower cutoff frequency of the design is f = 30Hz.

R_1=1 Kohm

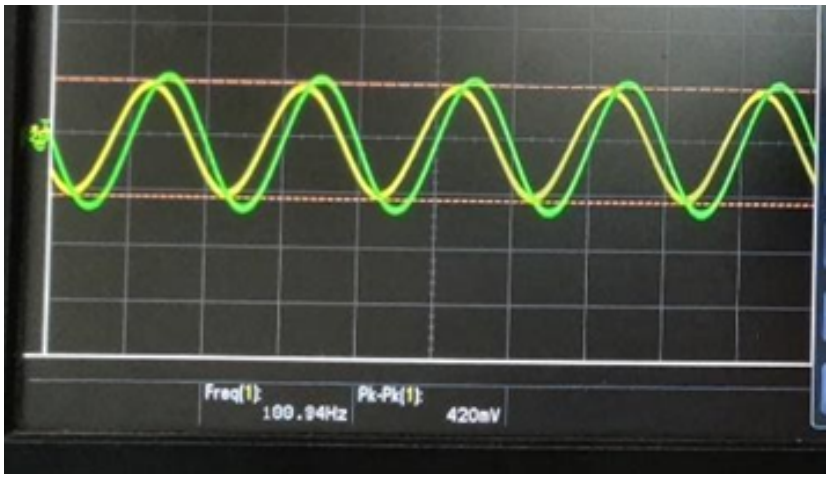
C = 4.7 µF

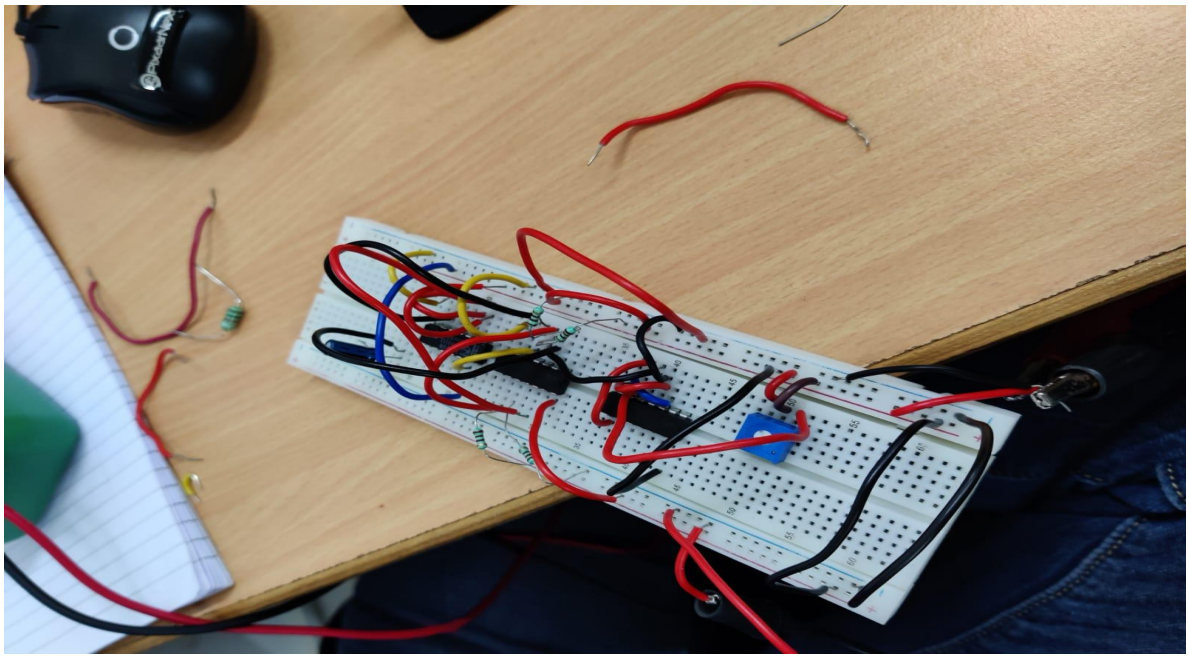
Question 5:

When the input signal was applied to the circuit, we got the gain of the amplifier to be around 3.2 when using the resistance values.

When the input signal was applied to the circuit, we got the gain of the amplifier to be around 27-29 when using the inductor, capacitor and 1M ohm resistor.

Question 6:

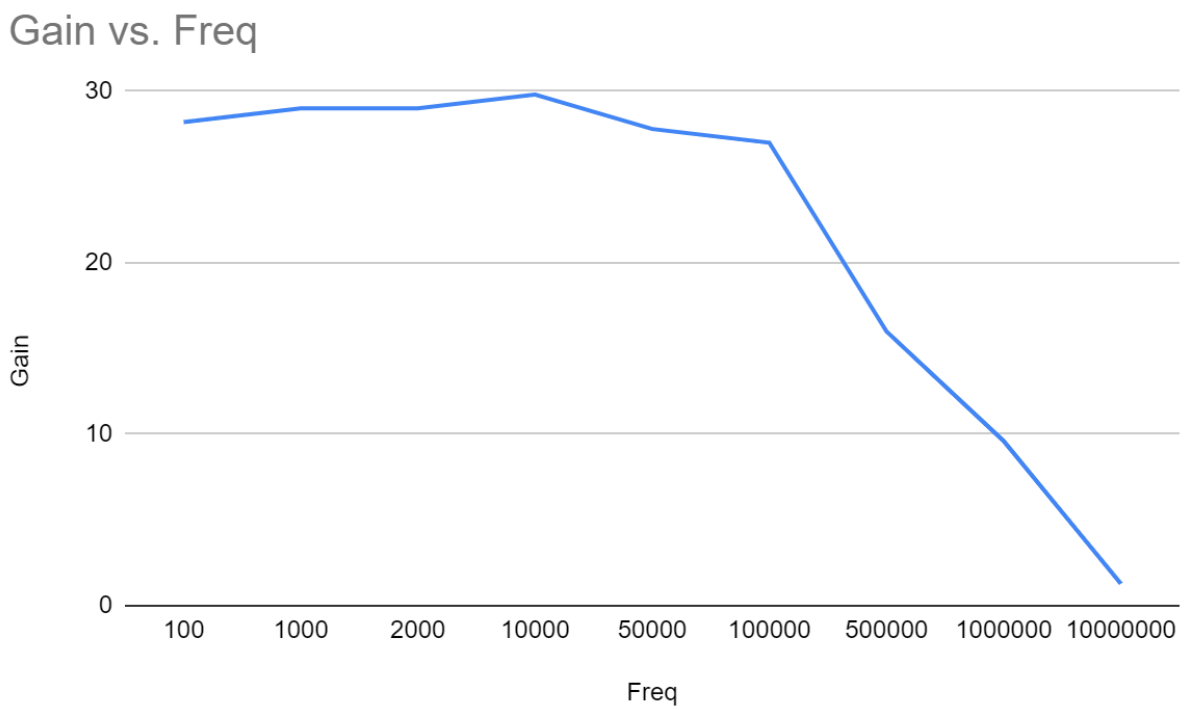




Question 7:

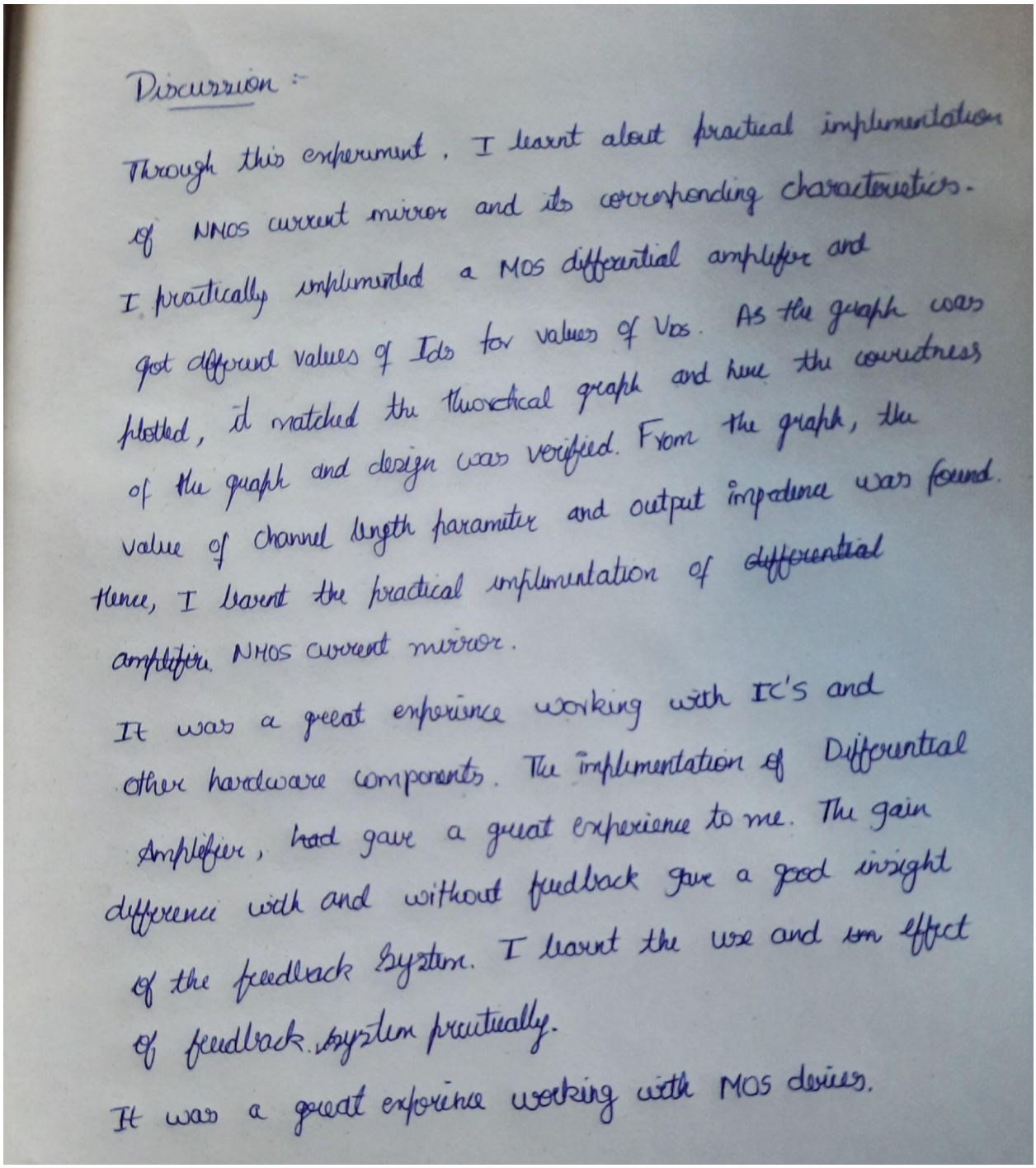
Freq	V_ip-p(V)	V_op-p(V)	Gain	Phase Diff(deg)
100	0.05	1.41	28.2	180
1000	0.05	1.45	29	40
2000	0.05	1.45	29	0
10000	0.05	1.49	29.8	-5
50000	0.05	1.39	27.8	-5
100000	0.05	1.35	27	-3
500000	0.05	0.8	16	-15
1000000	0.05	0.48	9.6	-15
10000000	0.05	0.064	1.28	-20

Plot of Gain vs Frequency Response



Results and Discussions:

Aditya Kalyani



Discussion :-

Through this experiment, I learnt about practical implimentation of NMOS current mirror and its corresponding characteristics. I practically implimented a MOS differential amplifier and got different values of Ids for values of Vds. As the graph was plotted, it matched the theoretical graph and hence the correctness of the graph and design was verified. From the graph, the value of channel length parameter and output impedance was found. Hence, I learnt the practical implimentation of differential amplifier. NMOS current mirror.

It was a great experience working with IC's and other hardware components. The implimentation of Differential Amplifier, had gave a great experience to me. The gain difference with and without feedback gave a good insight of the feedback System. I learnt the use and im effect of feedback system practically.

It was a great experience working with MOS devices.

Tanish H Talapaneni

Discussion :-

This experiment involved more hardware and helped me to understand the implementation of the CMOS differential amplifier. First, we tested the basic I_{DS} vs V_{DS} characteristics of the NMOS gate. We understood about the output impedance and channel length modulation.

After calculating the required values of resistances, we implemented the amplifier & observed the gains & the phase differences. It was a great experience to learn more about the CMOS gates.