Design of a Two Stage Operational Amplifier with Miller Compensation

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***Abstract*—Many analog and mixed-signal circuits use CMOS operational amplifiers, which are one of the most fundamental, flexible, and vital building components. They are employed in a variety of applications, including comparators, differentiators, Phase Locked Loops, etc. In this hackathon, a single ended two stage operational amplifier with Miller compensation is to be constructed in 28 nm CMOS technology node to meet particular design specifications.**

I. Introduction

Two-stage operational amplifiers are the most commonly used multistage amplifier because it can provide high gain and high output swing [1]. However, an uncompensated two-stage operational amplifier has a two-pole transfer function, and these are located below the unity gain frequency. Therefore, a frequency compensation circuitry must be implemented to ensure stability.

A. Implementation

- Found NMOS and PMOS parameters for μ_p, μ_n, V_{tp}, V_{tn}
- Calculated aspect ratio of all the transistors, C_c in Fig. 2, for particular specifications
- Simulated Fig. 2 with the obtained aspect ratio of all the transistors, for gain.

II. Reference Circuit Design

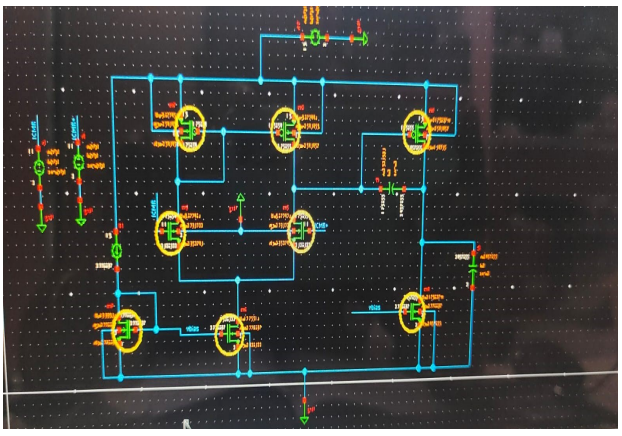

Fig. 1. Schematic of a two-stage operational amplifier with Miller compensation

III. Reference Waveforms

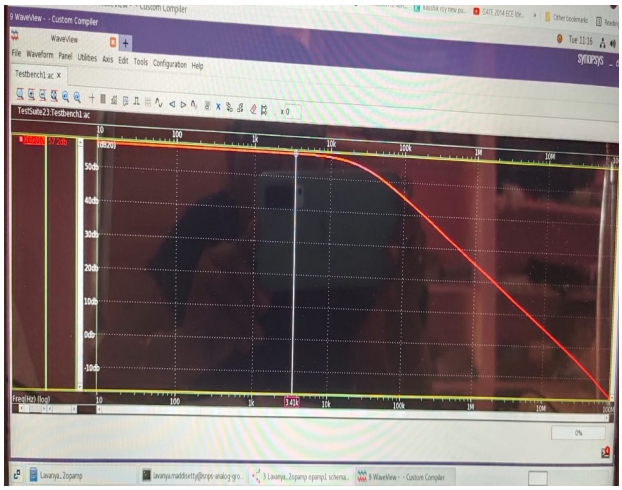

Fig. 2. Bode Plot of Frequency response

IV. Conclusion

The two stage opamp design is done for the gain bandwidth product of 60dB. Practically when the circuit is simulated in custom compiler©, the gain obtained is 57.2dB.

V. Acknowledgements

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References

[1] Behzad Razavi, "Design of Analog CMOS Integrated Circuits," 2nd Edition, Tata McGraw-Hill.
[2] Phillip E. Allen, "CMOS Analog Circuit Design," The Oxford Series in Electrical and Computer Engineering.