

Analog IC Design

Course Code: EE809

Course Description:

Analog circuits are crucial for modern ICs, SOCs, MEMS and NEMS. For instance, they act as an interface between the real world and digital systems. Likewise, they are required in analog to digital conversion and vice versa and, are utilized in amplification and filtering processes. This is a founding course on analog integrated circuits. It reviews the fundamentals of semiconductor devices, introduces the CMOS fabrication technology and discusses the fundamental analog circuit topologies, concepts and ICs layout. The course includes Virtuoso-Cadence based design oriented assignments/projects to prepare the students for the analog ICs design. Since modern ICs are mostly based on CMOS technology, this course shall mainly focus on CMOS analog ICs. The course shall act as a foundation for advanced courses on analog and mixed signal IC design.

Text Book:

1. Design of Analog CMOS Integrated Circuits, B. Razavi, 2nd Edition, McGraw Hill.

Reference Book:

2. Analysis and Design of Analog Integrated Circuits, Gray, Hurst, Lewis, Meyer, 5th Edition, John Wiley & Sons, 2009.
3. Microelectronics Circuits, 6th Edition, Sedra & Smith, Oxford University Press.
4. Fundamentals of Microelectronics by Behzad Razavi, John Wiley & Sons Inc.
5. Semiconductor Physics and Devices, 4th edition, Donald A Neamen, McGraw-Hill.

ASSESSMENT SYSTEM

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| Quizzes | 10% |
| Assignments | 20% |
| Mid Terms | 30% |
| ESE | 40% |

Teaching Plan

| Week No. | Topics |
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| 1 | Introduction to Analog Design <ul style="list-style-type: none"> Analog electronics, integrated circuits and CMOS technology |
| 2 | MOS Device Physics <ul style="list-style-type: none"> MOSFET and IV characteristics, second order effects, models and FinFETs |
| 3 | CMOS Processing Technology <ul style="list-style-type: none"> Fabrication processes, sequence and structures |
| 4 | Single-stage amplifiers <ul style="list-style-type: none"> Common source, source follower, common gate and cascode stages |
| 5 | Layout <ul style="list-style-type: none"> Design rules and layout techniques |
| 6-7 | Differential Amplifiers <ul style="list-style-type: none"> Differential pair, common mode response, differential pair with MOS loads |
| 8 | Current Mirrors and Biasing Techniques <ul style="list-style-type: none"> Basics, cascode and active current mirrors Biasing of CS, CG, source follower and differential pair |
| 9 | Mid Semester Exam |
| 10 | Frequency Response of Amplifiers <ul style="list-style-type: none"> Frequency response of analog circuit topologies |
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| 11 | Noise <ul style="list-style-type: none"> Characteristics, types and noise in amplifier circuits |
| 12 | Feedback <ul style="list-style-type: none"> Feedback circuits, topologies, and Bode's analysis |
| 13 | Operational Amplifiers <ul style="list-style-type: none"> Introduction, one stage and two stage OPAMPS |
| 14-15 | Bandgap References <ul style="list-style-type: none"> Supply-Independent Biasing, Temperature-Independent References and PTAT Current Generation |
| 16-17 | Switched Capacitor Circuits <ul style="list-style-type: none"> Sampling switches and switched capacitor amplifiers |
| 18 | End Semester Exam |