EE 112 Analog Integrated Circuits I

Spring, 2019

Instructor: Haoyu Wang, wanghy.shanghaitech@gmail.com

Class Hours: Tuesdays and Thursdays 15:00am-16:40am; Location: 1B106, SIST Bldg.

Office Hours: Fridays 3:00pm-5:00pm@1D301C, SIST Bldg., or via individual appointment

Course Website: http://pearl.shanghaitech.edu.cn/2019spring/EE112/

Forum: https://piazza.com/shanghaitech.edu.cn/spring2019/ee112

TA: Bo Xue, xuebo@shanghaitech.edu.cn

TA Office Hours:Tuesday, 19:00-21:00, 1D-304 SIST Bldg.

Course Description: This course will focus on analog VLSI circuit design and attempt to cover a wide range of circuit configurations that are useful for analog signal processing/computation beyond simple amplification and filtering.

Prerequisite(s): Circuits Theory; Analog and Digital Circuits

Credit Hours: 4

Required Text:

P. R. Gray, P. J. Hurst, R. G. Meyer, and S. H. Lewis, *Analysis and Design of Analog Integrated Circuits*, 5th Edition, John Wiley & Sons, 2009. ISBN-13: 978-0470245996

Recommended Texts:

The following recommended texts will provide background for the course.

P. E. Allen, and D. R. Holberg, *CMOS Analog Circuit Design*, 3rd Edition, Oxford University Press, 2011. ISBN-13: 978-0199765072

Razavi Behzad, *Design of Analog CMOS Integrated Circuits*, 2nd Edition, McGraw-Hill Education, 2017. ISBN-13: 978-9387067844

Course Contents:

1. Review of semiconductor basis, pn-junction, and MOSFETs (above and below threshold operation)
2. Review of small signal analysis of simple transistor amplifiers, differential pairs, current mirrors
3. Common second-order effects: Miller-capacitance, Early effect, W/L ratio, short-channel phenomenon.
4. Current-mode approaches: the translinear principle
5. Analysis of circuit variants: cascoding, active replacement elements
6. Feedback circuits, frequency response and compensation
7. Nonlinear circuits: peak/envelope detectors, rectifiers
8. Aggregate computations: normalization, winner-take-all, centroid
9. Floating-gates, hot-electron injection, tunneling
10. Basic noise analysis

Course Material: Most of the course material will be delivered within the lecture. Supplementary material, such as homework and course announcement, will be updated on the class website at http://pearl.shanghaitech.edu.cn/2019spring/EE112/ and/or via direct email to students in the class. In case of email notification, I will send it to your @shanghaitech.edu.cn email by default. All class announcements will be mirrored onto the class website as an alternative means of retrieving updated information.

Homework: Homework will be given roughly every other week. They will be distributed from the webpage. Homework will typically be due in class one week after it is posted and will be collected by the TA. The remainder of the semester will focus on an individual design project.

Late Policy: Late homework is allowed five days maximum after its due date, but its weight will be deducted by 10% per day.

Exams: Your exam score in the class will be based on two equally-weighted exams. The exact dates of the exams will be determined later and announced in class at least one and a half weeks in advance. Exam questions will be based on the lecture notes and homework.

Project: Students are also responsible for projects, where you will work individually to analyze an existing circuit from the literature, then design and simulate a novel analog or analog/digital mixed signal circuit that improves or creates a new solution for a challenging analog processing application. Project should be limited in scope (i.e. N transistors) where $10 < N < 100$. Students will be required to submit a written report, as well as give an oral presentation, describing the project in detail. Details of the project will be provided later.

Grading: Grading will be based on: homework (15%), notes(5%), mid-term exam (25%), final project (30%), final exam (25%). Scores will be translated into final grades at the end of the semester with a grading scale that will likely be: $0 - 30\% = F, 30\% - 60\% = C, 60\% - 80\% = B, 80\% - 100\% = A$.

Academic Dishonesty: Academic dishonesty will not be tolerated. The following acts of academic dishonesty are absolutely prohibited: cheating, fabrication, facilitating academic dishonesty, and plagiarism. Academic dishonesty in this course includes copying of homework or deliberately taking unfair advantage of the other students. Once been found, it can lead one to a FAIL in this class and will be referred to the academic committee in the School of Information Science and Technology.