**ECEN 607** **SPRING 2015**
**Tu Th 9:35 AM – 10:50 AM**
**ETB 1035**

# ADVANCED ANALOG CIRCUIT DESIGN TECHNIQUES

Instructor: **Edgar Sánchez-Sinencio**
Office: 318-E, Wisenbaker Engineering Building (WEB)
Telephone/email: 845-7498/ sanchez@ece.tamu.edu
Office Hours: 4:00-5:00 p.m., Tuesday and Thursday
Prerequisites: ELEN 474 (or approval of instructor)
Textbook: Textbook, ref 1.
TA: Judy Amanour-Boadu <jaydi4real@gmail.com>

References:

[1] **Analog Integrated Circuits Design, T.Chan Carusone, D.A. Johns and K. Martin, John Wiley & Sons ,Inc. Second Edition, 2012**
[2] *CMOS Analog Circuit Design*, P.E. Allen, D.R. Holberg, Oxford University Press, 3rd Edition, 2012.
[3] *Analysis and Design of Analog Integrated Circuits*, Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, John Wiley & Sons, Inc., 5th Edition, 2009.
[4] *Design of Analog Integrated Circuits*, Behzad Razavi, McGraw-Hill, 2000.
[5] *Low-Voltage Low Power Integrated Circuits*, E. Sánchez-Sinencio, A. Andreou, IEEE Press, 1999.
[6] *Design of Analog Integrated Circuits & Systems*, K.R. Laker, W.M.C. Sansen, McGraw-Hill, New York, 1994.
[7] *MOS Switched-Capacitor and Continuous-Time Integrated Circuits and Systems*, R. Unbehauen, A. Cichocki, Spring-Verlag, Berlin, 1989.
[8] *Analog MOS Integrated Circuits for Signal Processing*, R. Gregorian, G. Temes, Wiley, 1986.
[9] *Macromodeling with SPICE*, J.A. Conelly, P. Choi, Prentice Hall, Englewood Cliffs, New Jersey, 1997
[10] Selected copies of Journal Papers and notes.

Objective: To understand, design, and test IC analog components, and building blocks in CMOS technology. To grasp the relationships between devices, circuits and systems. Emphasize the design of practical amplifiers, small systems and their design parameter trade-offs. Discussion at the system level design. To identify practical applications. The lab will provide layout and experimental practical experience.

*GRADING POLICY*
Laboratory 20%
Unannounced Quizzes 5%
*Exams 35%
Homework 15%
Final Project 25% including Oral Presentation using Power Point

This course requires that you are familiar with conventional nodal analysis (writing nodal equations by inspection) as well as the uses of circuit simulators. SPECTRE, CADENCE, and MATLAB. You also need to become familiar in obtaining high quality plots from CADENCE. Homework's and report *should not include figures directly from* CADENCE since they are difficult to read. **Exams could be given in a different class date.*

# ELEN 607
# TENTATIVE COURSE SCHEDULE
# ADVANCED ANALOG CIRCUIT DESIGN TECHNIQUES

| WEEK | DATE | TOPIC | REFERENCES |
|---|---|---|---|
| 1 | Jan. 20 & Jan. 22 | Overall view of the course. Review of basic Op Amps and OTA Architectures Conventional Op Amps. | [1-3, 7] |
| 2 | Jan. 27 & Jan. 29 | Nested and Reversed Gm-C Op Amplifiers. | [10] |
| 3 | Feb. 3 & Feb. 5 | Enhanced Gm-C Amp for Large capacitive load. Line Driver Amplifiers. | [10] |
| 4 | Feb. 10& Feb. 12 | Bulk-driven and Floating Gate Techniques | [1,4,5] |
| 5 | Feb. 17 & Feb. 19 | LDO Fundamentals | [1], notes |
| 6 | Feb. 24 & Feb. 26 | P-N Rail to Rail Stages and Low Voltage Cells (Exam 1) | [2-3] |
| 7 | March 3 & March 5 | Voltage References | [1-5] |
| 8 | Mar.10 Mar. 12 | Common-Mode Feedback & Feedforward: Theory and Practice | [4,5] |
| 9 | Mar. 17& Mar. 19* | SPRING BREAK (MARCH 16-20) | |
| 10 | Mar. 24& Mar. 26 | Non-linearity issues and Noise Considerations | [1-5], [10] |
| 11 | Mar. 31 & Apr. 2 | Class-D Amplifiers | [11] |
| 12 | Apr. 7 & Apr. 9 | Multipliers: Power, linearity and area tradeoffs | [2],[6],[7], [10] |
| 13 | Apr.14 & Apr. 16 | Linearized OTA and Fully-Differential OTA: CMFB control techniques. Negative resistors and capacitors. (Exam 2) | [5-9, 10] |
| 14 | Apr. 21 & Apr. 23 | LV Switched-Capacitor Techniques, Comparators & Sample and Hold | [1, 5, 7] |
| 15 | Apr. 28 & Apr. 30 | Negative Capacitor and Resistor Implementations PowerPoint final Presentations | [10] |
| 16 | May 5 | PowerPoint final Presentations | |

***** *Spring Break, March 16-20.*

**Americans with Disabilities Act (ADA) Policy Statement**

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities, in Room 126 of the Koldus Building or call 845-1637.

**Academic Integrity Statement**

"An Aggie does not lie, cheat, or steal or tolerate those who do."

Honor Council Rules and Procedures are on the web http://www.tamu.edu/aggiehonor