

TEXAS A&M UNIVERSITY
ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT

ECEN 622 SYLLABUS
ACTIVE FILTER ANALYSIS AND DESIGN

Instructor: Edgar Sánchez-Sinencio **Fall 2009**
Office: 318E WERC **Time:** TR 11:10-12:25
Phone: 845-7498 **Location:** 128A Zachry
E-mail: sanchez@ece.tamu.edu
Office Hours: Tues, Thu, 2:00 to 3:00 PM

Textbook: *Design of Analog Filters*, R. Schaumann and M.E. Van Valkenburg, Oxford University Press, 2001.

References

- [1] *Passive and Active Network Analysis and Synthesis*, A. Budak, Houghton Mifflin Co., Boston, 1974. [A classical Book with solid basic principles.](#)
- [2] *MOS Switched-Capacitor and Continuous-Time Integrated Circuits and Systems*, R. Unbehauen and A. Cichocki, Springer-Verlag, Berlin, 1989. [Good cover in particular on SC filters.](#)
- [3] *The Circuits and Filters: Handbook*, Editor-in-Chief Wai-Kai Chen, CRC Press, 1995. [Good reference for a variety of related topics.](#)
- [4] *Analog Integrated Circuit Design*, David A. Johns, and Ken Martin, John Wiley & Sons, Inc., New York, 1997. [Good practical discussion.](#)
- [5] *Design with Operational Amplifiers and Analog Integrated Circuits*, S. Franco, McGraw Hill, New York, 1998. [Valuable for discrete component implementations.](#)
- [6] *Continuous-Time Active Filter Design*, T. Deliyanis, Y. Sun, and J. K. Fidler, 1999, CRC Press. [Good discussion on Gm-C filters.](#)
- [7] *Design of High Frequency Integrated Analogue Filters*, Y. Sun, IEE, London, 2002. [Good cover of several continuous-time circuits.](#)
- [8] *IEEE Trans. on Circuits and Systems I & II and IEEE J. Solid-State Circuits.*

OBJECTIVES: To analyze, understand and synthesize integrated CMOS active-filters. In Particular the design of practical filters for a host of practical applications, from very low frequency of less than 1Hz up to GHz range RF Filters. Several applications for data communication will be discussed. To learn how to apply design trade-offs and to mix theory, simulations and practice in filter designs.

Learning Outcomes

At the end of the course the student will be able to:

- 1) Conduct system level design and simulation of active filters based on basic block diagrams.
- 2) Estimate frequency and time response at the system level of analog filters.
- 3) Understand how to map a basic blocks diagram into a circuit implementation based on Op Amp or Transconductance Amplifier.
- 4) Synthesize into a mathematical expression the filter frequency response specifications.

- 5) Understand the practical design trade-offs of Continuous-Time and Discrete-Time (Switched-Capacitor) filters.

Grading Policy

Partial Exam 1	20%
Partial Exam 2	15%
Partial Exam 3	15%
Final Project	20%
Homework	25%
Quizzes	<u>5%</u>
	100%

Special Notes

Progress Report (Dec. 1, 2009) with discussion of the specifications; clearly define the problem, preliminary simulations and identification of the future work and a summary of the reported related publications in the literature. No more than 6 pages. This report is worth 10% of the final project. This (word document) report **must** have the following form:

Title

Statement of the problem.

Background, previous work.

Potential applications of your circuit. You must provide specific examples and references.

Basic idea of your solution. Preliminary Results.

Problems to be solved in the future.

References, a complete list of references must be included.

Final Written Report (Dec. 8, 2009). This final (word document) report must include:

1. Title
2. An abstract
3. Introduction
4. Background and a comparative table of previous results
5. Proposed Solution
 - Conceptual idea of solution
 - Circuit Diagram and explanation
 - Design Procedure, how to determine the (W/L)'s
 - Simulate the temperature, noise and process variation effects
 - Simulate the operation of your circuit around the corners of the technology.
6. A Comparative Table between Hand calculation and Simulation.
7. Discussion of Results with other reported results and suggested improvements
8. Layout of the Circuit
9. References

Oral Presentations in Power Point Form: Dec. 8, 2009.

- 1) No final exam will be given. Partial accumulate exams can be take-home or closed book (with only one page information possibly). Exams can be scheduled to be out of class.
- 2) There will be no make-up exams for individual cases, unless it is properly justified, e.g. medical or family emergency.
- 3) Quizzes will be given randomly.

- 4) Homework is due at the beginning of the class on the due date. Late homework is not accepted.
- 5) Knowledge of using MATHLAB, SPICE (CADENCE), SIMULINK and FIESTA II is strongly suggested.

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. <http://disability.tamu.edu>

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>

TENTATIVE COURSE SCHEDULE

Week	Week of	Topic	Chapter	Lab	Remarks
1	Sept. 1-3	Introduction			Historical Review
2	Sept. 8-10	Basic Block and Systems	1 [3]		Key Blocks
3	Sept. 15-17	Systems Fundamentals	3,4 [2]		Good Fundamentals
4	Sept. 22-24	Approximation	6		Find its Origin and where to access software related
5	Sept. 29-Oct. 1	Biquad Circuits	6		Study input signal injections
6	Oct. 6-8	RC-Active Filters	2,5,6		Exam 1
7	Oct. 13-15	RC-Active Filters	2,3,5,6		Summarize Design Approaches and Topologies
8	Oct. 20-22	RC-Oscillators	2,5,6, Notes		Project Assignment
9	Oct. 27-29	OTA-C Filters	Notes		Study Commercial OTA's
10	Nov. 3-5	OTA-C Filters			Exam 2
11	Nov. 10-12	OTA-Oscillators	Notes		
12	Nov. 17-19	Switched Capacitor Filters	7, 17 [1]		
13	Nov. 24-26*	Switched Capacitor Filters Basics	7, 17 [1]		Find Commercial SC Filters
14	Dec. 1-3	Switched Capacitor Oscillators			Exam 3
15	Dec. 8**	Oral Presentation			Last day Dec. 8

*Thanksgiving Holiday is Nov. 26 and 27.

** Last Day of Classes is Dec. 8.