

GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

ECE 4410

Analog Filters

Fall 2006

Instructor: R. K. Feeney

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Office Hours: 11:30 - 12:30 Monday; Wednesday and Friday: 8:30 - 9:30. Other times by appointment.

Text: *Analog Filters* (2nd edition) by K. Su

WWW URL: <http://users.ece.gatech.edu/~feeney/ece4410/ece4410.htm>

Course Objective: See attached outline.

Course Grading:	Quiz No. One	20.0%	20 Sept.
	Quiz No. Two	20.0%	25 Oct.
	Quiz No. Three	20.0%	22 Nov.
	Homework	8.0%	
	Final Exam	32.0%	
	Total	100.0%	

Quizzes and Exams: Quizzes and exams will be closed book and notes. Hand-held or lap-top computers may not be used on quizzes. Calculators may not be used in the programmable or "solve" modes. Grades on quizzes become final one week after they are returned in class.

Homework Problems: You will be given about ten sets of homework problems. These homework problems are designed to illustrate the current concept under study. The problems will be graded and skeleton solutions provided. No late homework will be accepted.

Practice Problems: A large number of optional practice problems with answers will be posted to the class www site. Work these problems to improve your understanding of the course material. They will not be collected and graded.

Class Absence: You are not required to attend class; however, you are responsible for all material presented and all announcements made in the lecture period. If you must miss a scheduled quiz or exam because of illness or other valid reason, you *must* contact the instructor prior to missing the quiz or exam. **Failure to do this will result in a zero grade with no possibility of makeup.**

ECE 4410 Analog Filters (3-0-3)

Prerequisite: ECE 3040

Course Objective: To introduce the student to the theory, design and application of analog passive, active and switched-capacitor filters.

TOPICAL OUTLINE

Introduction and definitions

- Normalization and denormalization
- Frequency scaling and impedance scaling

Standard Filter Characteristics

- Butterworth lowpass characteristics
- Chebyshev lowpass characteristics
- Elliptic-function lowpass characteristics
- Comparison of standard filter characteristics

Network Functions of Filters

- General procedure
- Network functions for standard filter characteristics
- Bessel-Thomson filter functions
- Delay equalization

Frequency Transformations

- Lowpass-to-highpass
- Lowpass-to-bandpass
- Lowpass-to-bandreject

Synthesis of Passive Networks

- Properties of lossless one-ports, two-ports
- Synthesis of LC ladder networks

Realization of singly-terminated passive filters

- Transmission zeroes and zero shifting
- Realization of filters by pole removing

Realization of doubly-terminated passive filters

- Transmission and reflection coefficients
- LC ladders with equal terminations, LC ladders with unequal terminations

Sensitivity

- Definitions and interpretations
- Calculations of various filter sensitivities
- Multiparameter and statistical sensitivities

Basics of Active Filters

- Properties of the op amp
- Basics of RC-op amp circuits

Biquad Circuits

- Sallen-Key biquads
- Infinite-gain multiple feedback biquads
- Two-integrator biquads

High-Order Active Filters

- The cascade of biquads
- The state-variable realization of filters
- Lowpass-to-bandpass transformation

Active Simulation of Passive Filters

- Simulation using generalized impedance converters
- Simulation using FDNR
- Functional simulation of passive filters

Switched-Capacitor Filters

- Simulation of resistors with switched capacitors
- Switched-capacitor biquads
- Switched-capacitor simulation of passive filters