Spring 2002

EEE598D: Analog Filter & Signal Processing Circuits

Instructor:

Dr. Hongjiang Song

Department of Electrical Engineering

Arizona State University

Contact Information

- Instructor: Dr. Hongjiang Song
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  - Adjunct Professor at ASU

- Office: ECG239 (965-0595)

- Office Hour: T, Th. 9:00am - 9:50am

  or by appointment

Course Information

- Class Rooms:
  - SCOB101-Studio (965-4487)
  - Remote Sites
- Class hours: T, Th. 7:40am - 8:55am
- Credits: 3 hours
- Prerequisites:
  - EEE 433 Analog Design
  - EEE 523 Analog Circuits
  - or equivalent with instructor's approval

- Reference books:
  - Analog Circuits, by Geregorian and Temes
  - Design of analog Filters, R. Schaumann, M. V. Valkenburg, Oxford, 2000

- Class notes

- Reading assignments

General Instruction for TV class

- **(Tape)**

# Teaching/Learning Methodology

- ## Course Lectures
  - Basic concepts
  - Design techniques

- ## Reading Assignments
  - Reference books
  - Papers

- ## Homework/Computer Lab Assignments
  - Design practices
  - Computer Modeling

- ## Project
  - Team work

Grading Policy

- Homework Assignments (15%)
  - Weekly or (Bi-weekly)
  - Due a week from the assigned date
- 2 Midterm Exam   (40%)
  - Closed book
- Final Exam   (25%)
  - Closed book
- Group Project   (20%)
  - Group project with 3-4 student/per group
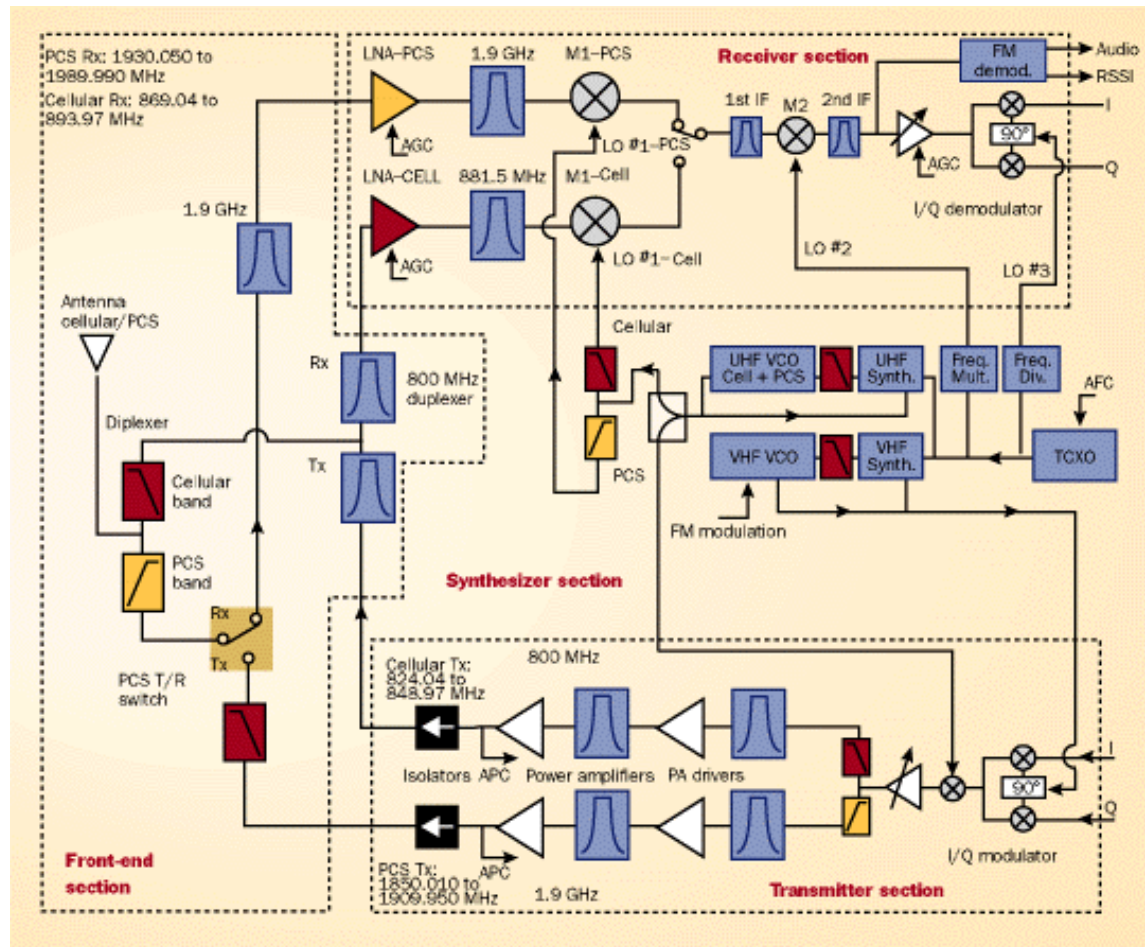- NO LATE homework/Project will accepted and it will be count as zero point!

Why Analog Filters?
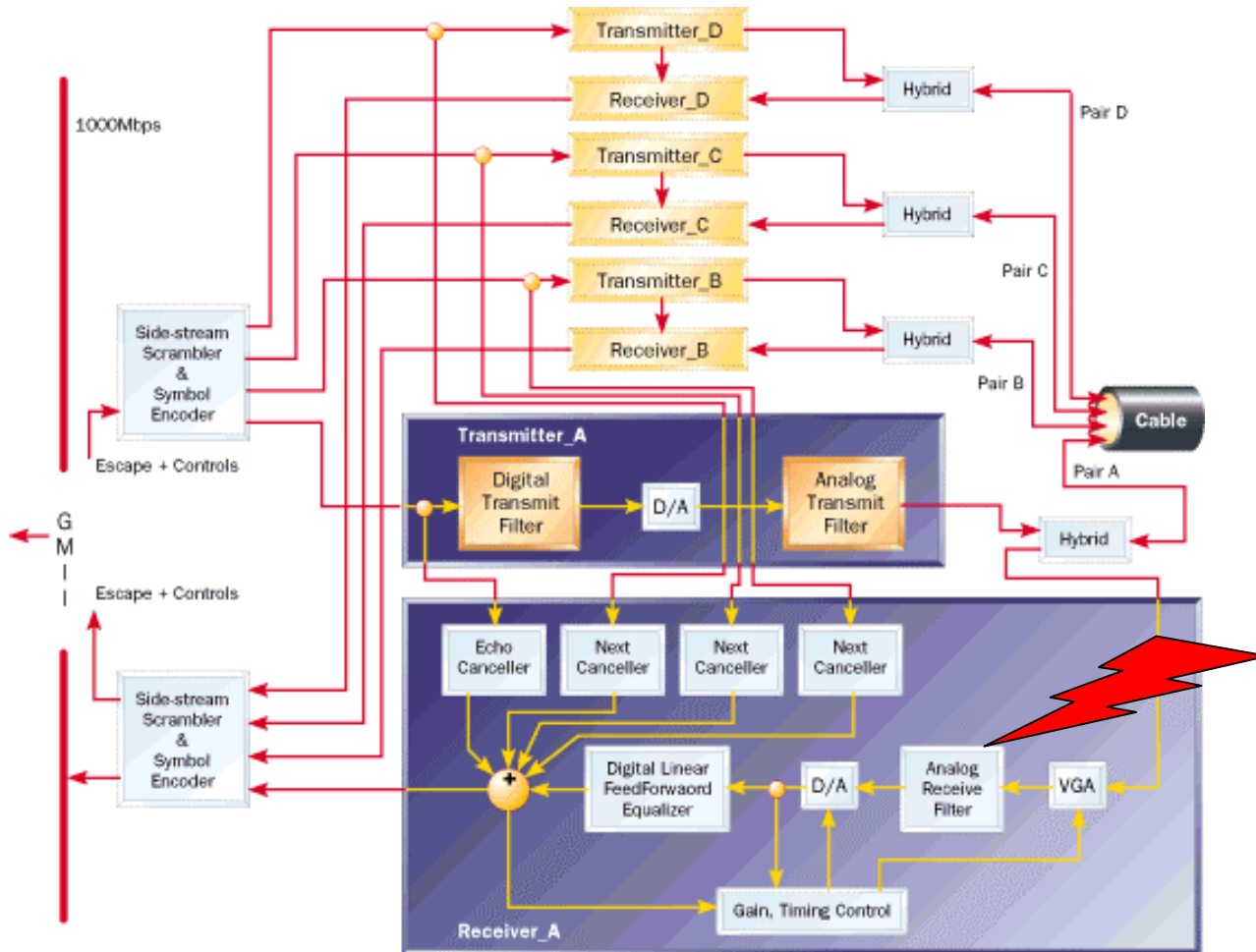
Example: Gigabit Ethernet over Copper
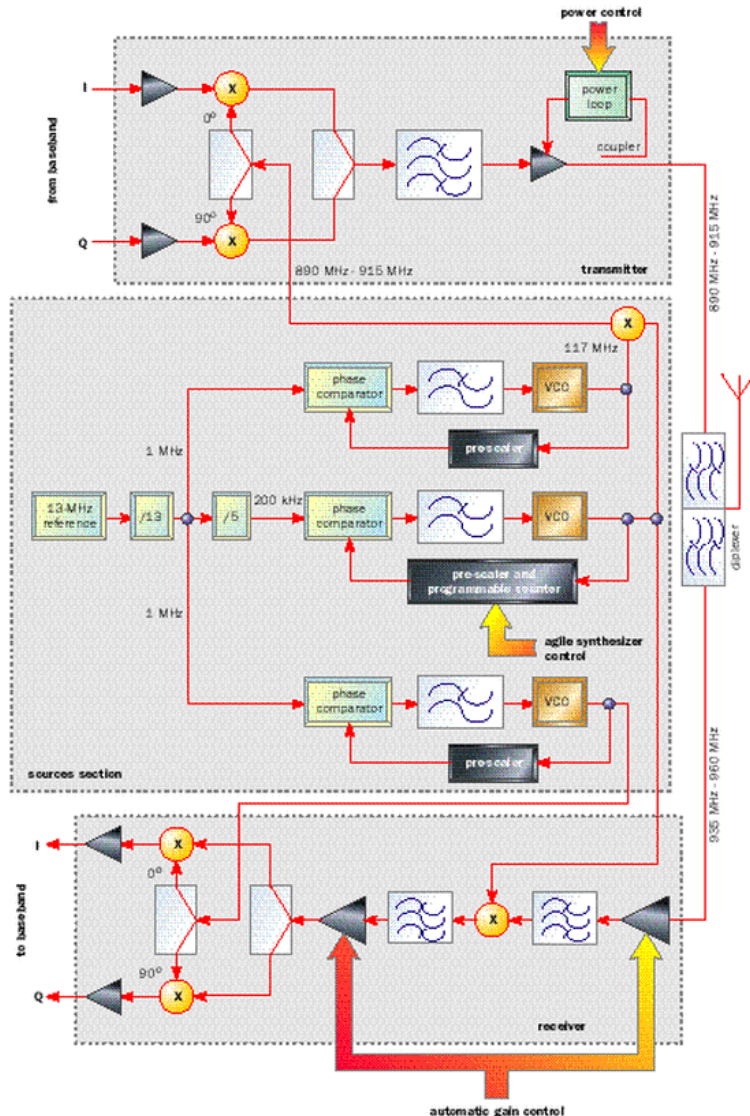
Source: *Communication Systems Design*

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Why Analog Filters?

Example: Generic Dual-band TDMA Handset

Source: *Communication Systems Design*

Why Analog Filters?

Example:
GSM Handset

Source: *Communication Systems Design*
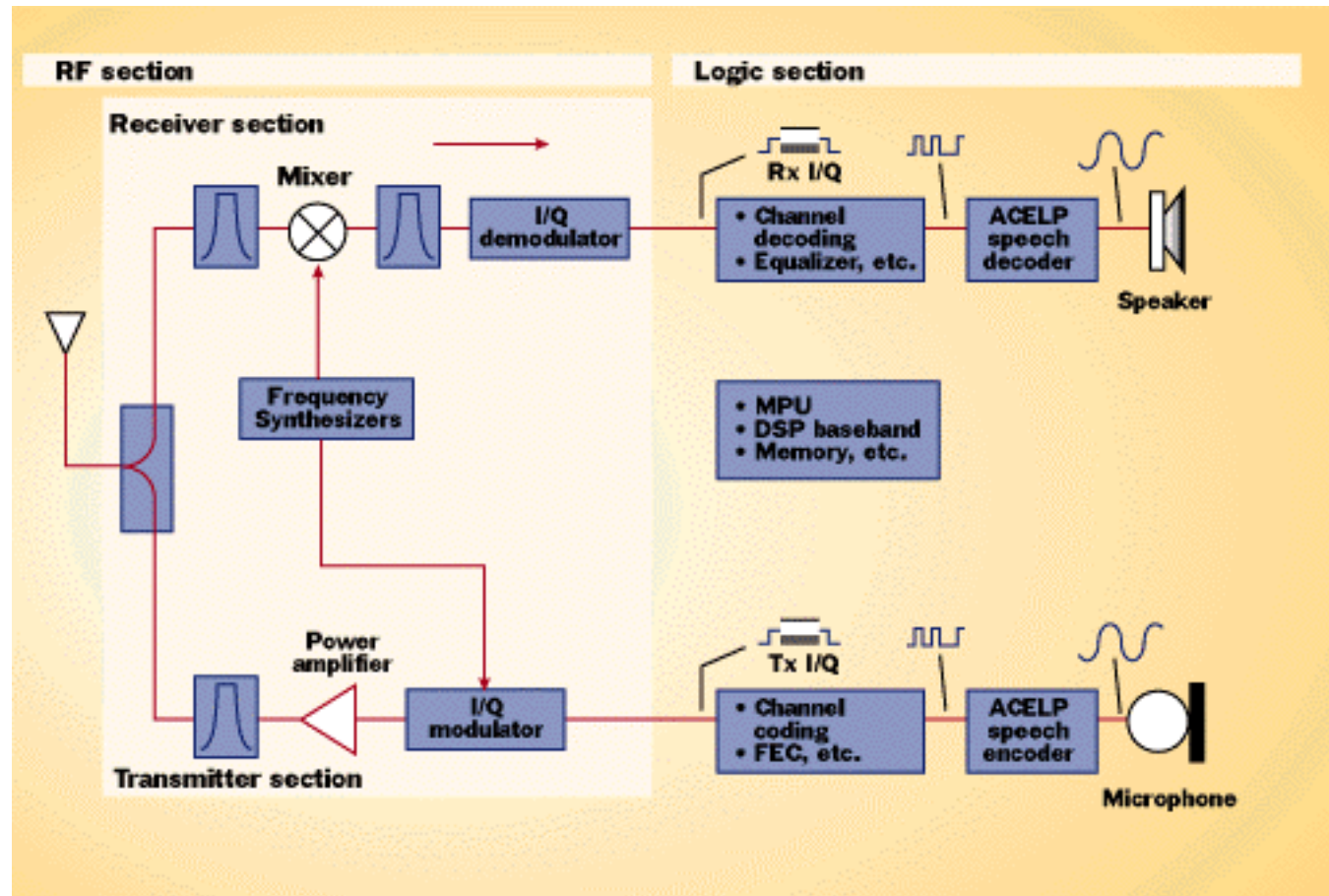
Why Analog Filters?

Example: TDMA Cellular/PCS Handset

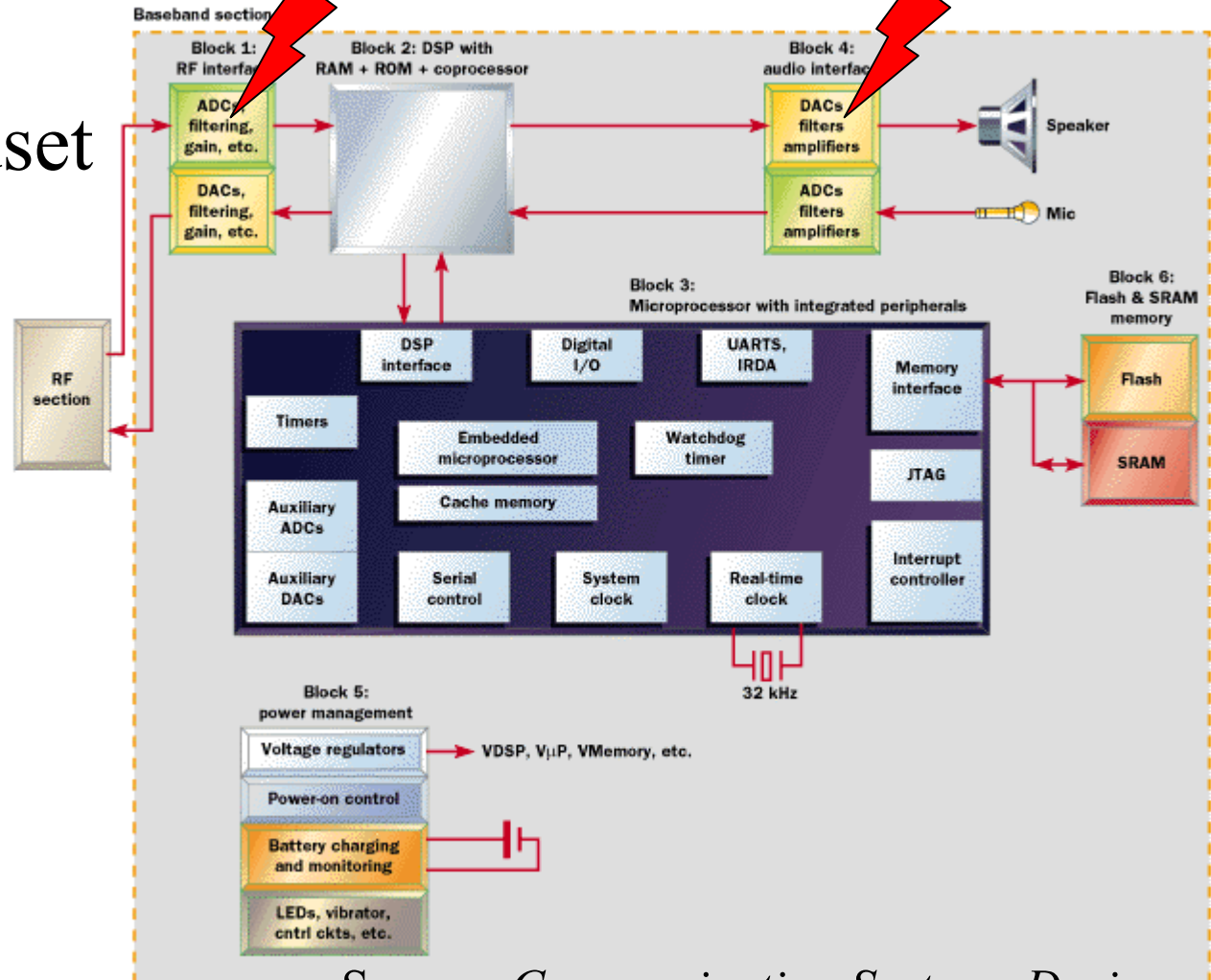Source: *Communication Systems Design*

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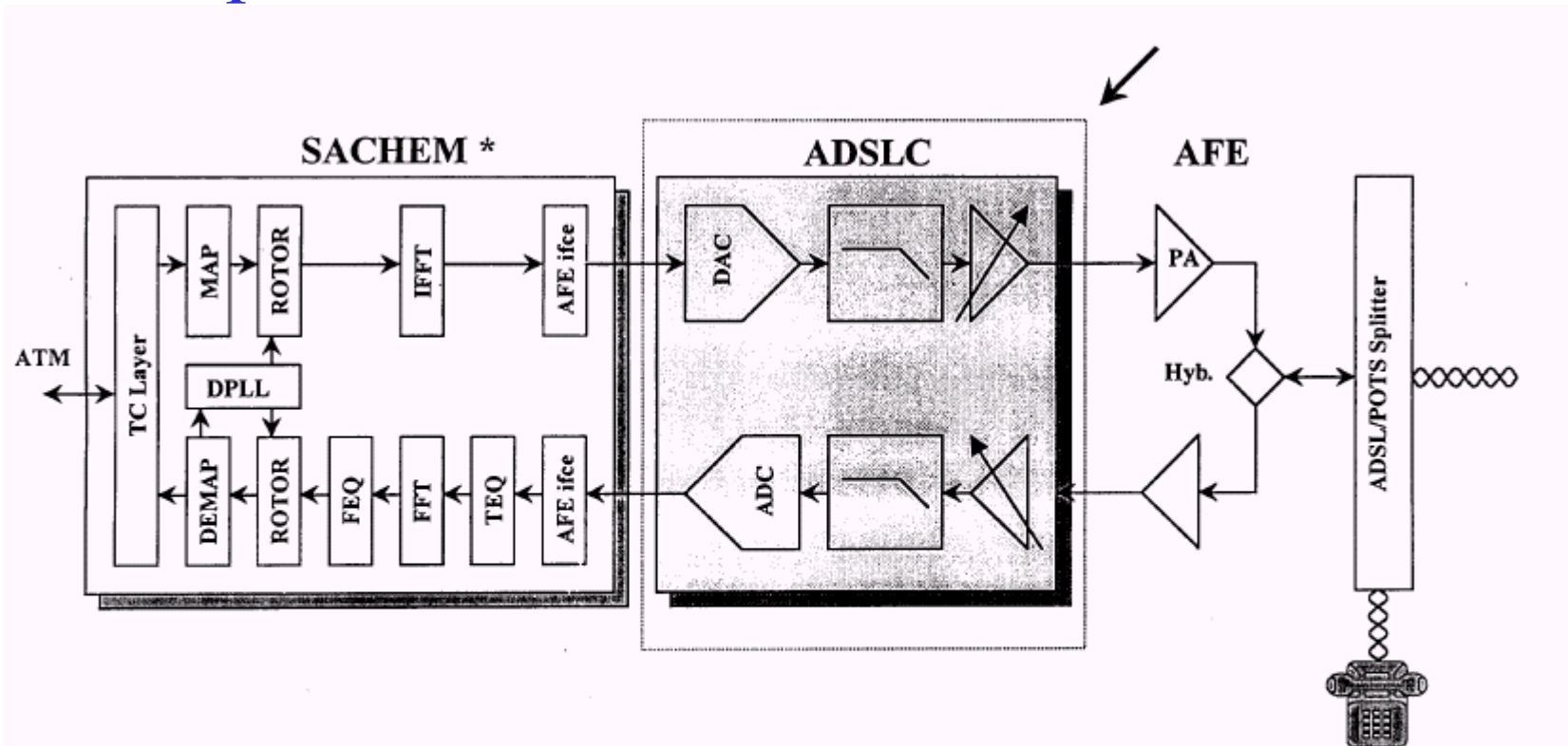
Why Analog Filters?

Example: EDGE Handset

Source: *Communication Systems Design*
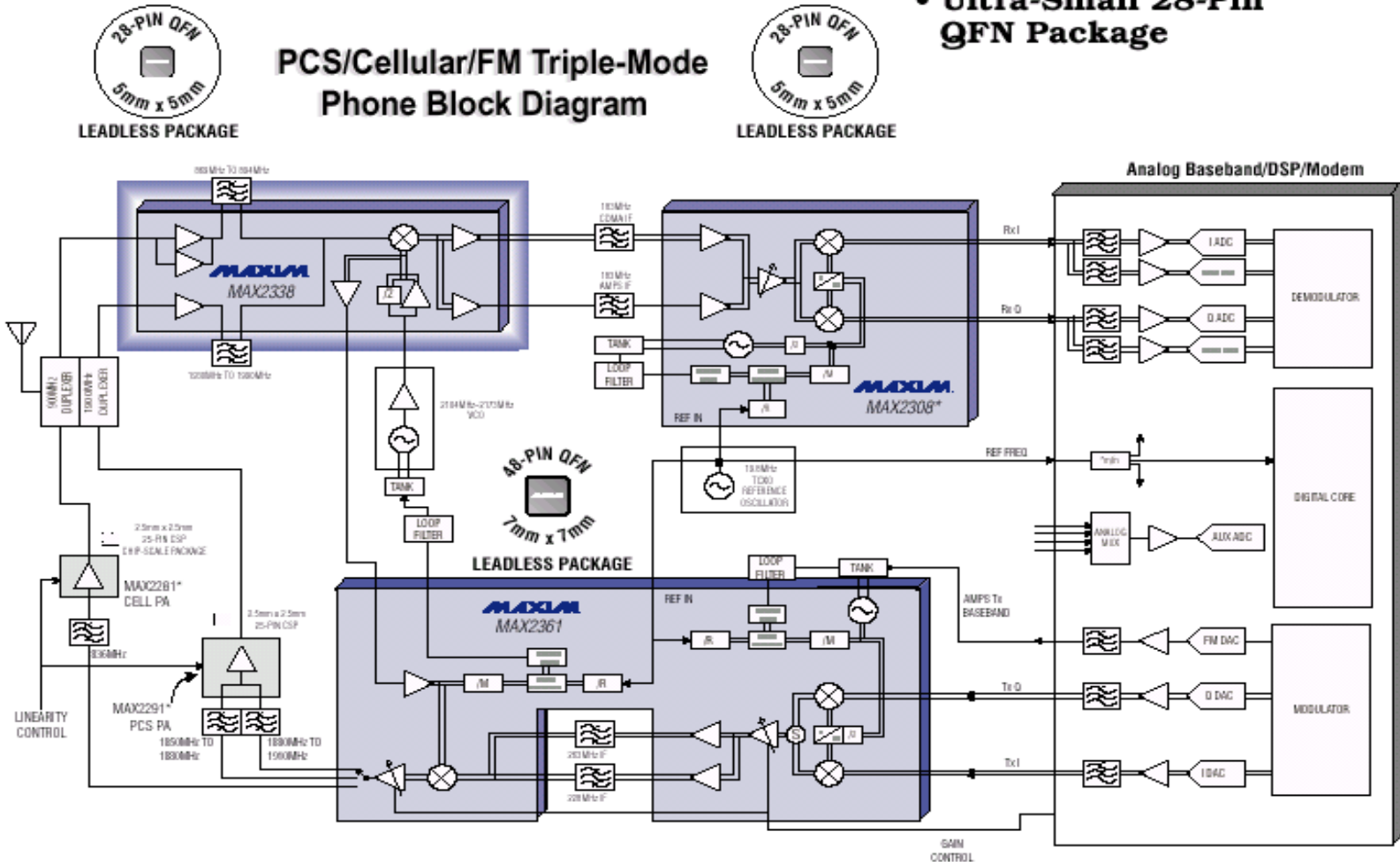
Why Analog Filters?

Example: Modem

* L. Kiss, K. Adriaensen, M. Huysmans, E. Hanssens, C. Gendarme, F. Van Beylen, H. Van De Weghe,
«Sachem, a versatile DMT-based modem transceiver for ADSL»,
11th Annual IEEE Internztional ASIC conference, Sep. 13-16, Rochester, NY
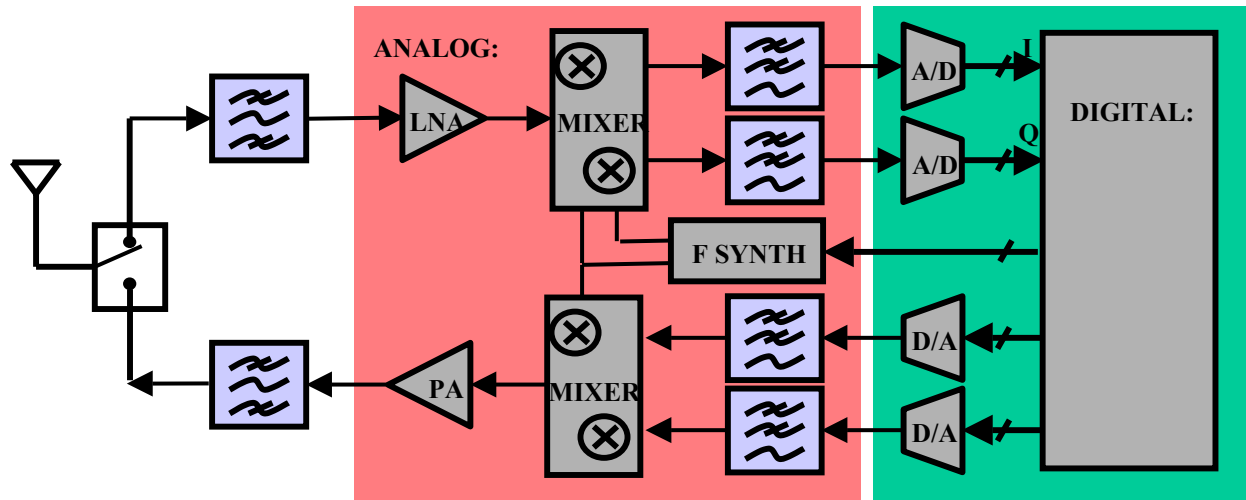
Why Analog Filters?

• **Example:CDMA Cellular Radio**

PCS/Cellular/FM Triple-Mode Phone Block Diagram

• Ultra-Small 28-Pin QFN Package

Why Analog Filters?
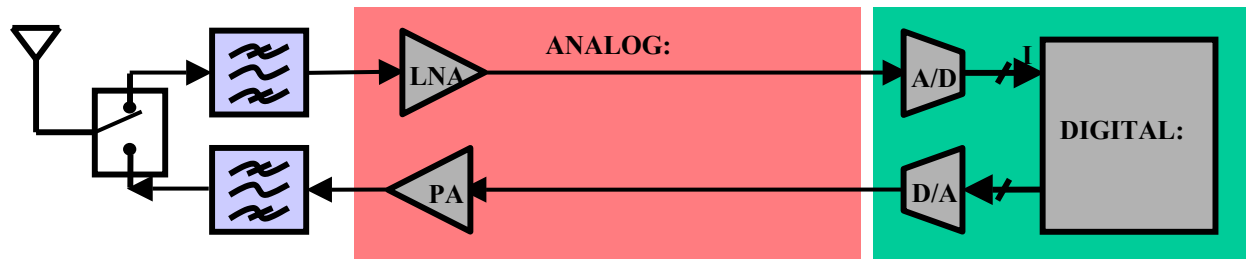
- ## Example: Narrowband Transceiver

A "Mostly Digital" Radio:

Why Analog Filters?

- Example: Read Channel Building Blocks
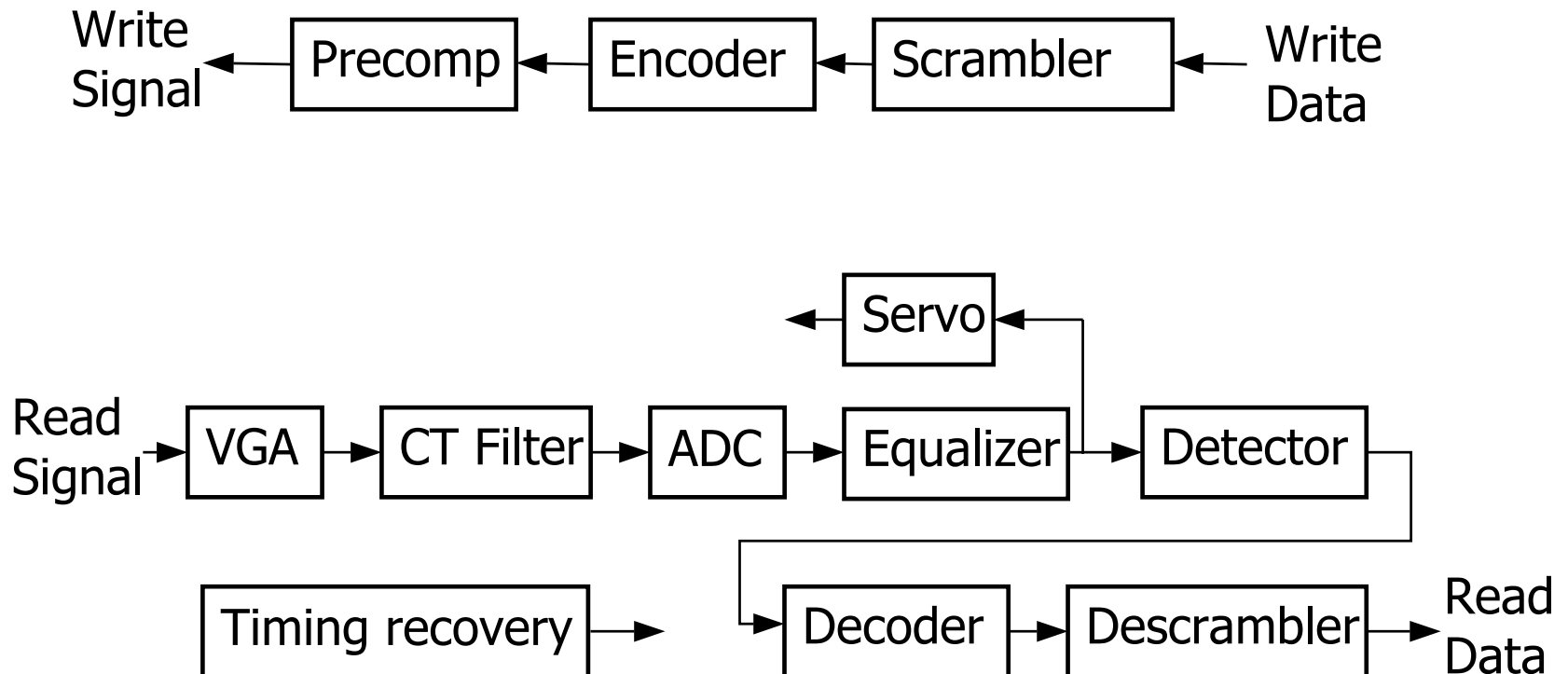
Write Signal ← Precomp ← Encoder ← Scrambler ← Write Data
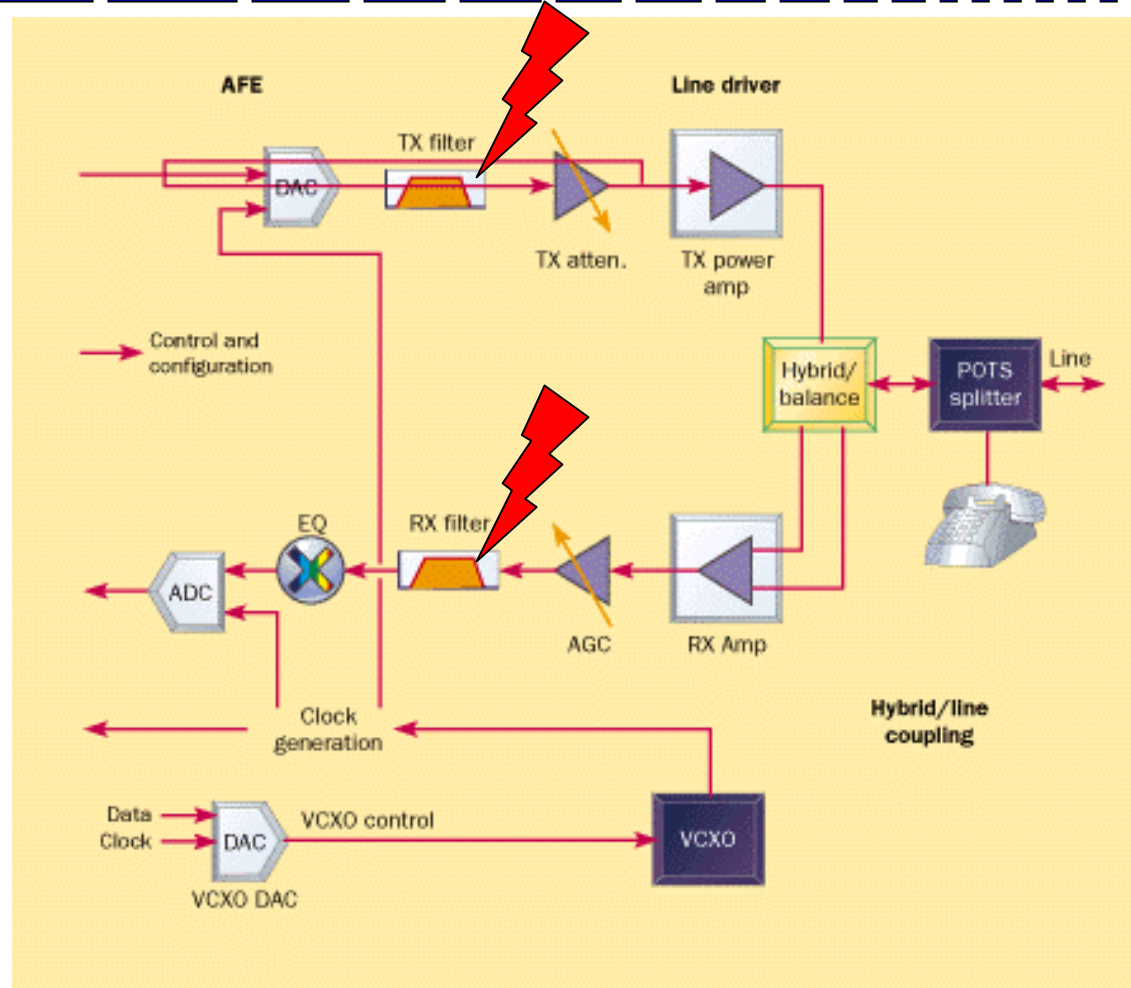
Read Signal → VGA → CT Filter → ADC → Equalizer → Detector

Servo

Timing recovery →

Decoder → Descrambler → Read Data

Why Analog Filters?

Example: ADSL

Source: *Communication Systems Design*

Why Analog Filters?

Echo cancellation

Upstream

Downstream

POTS

Frequency

1 MHz

Example: ADSL

Source: *Communication Systems Design*

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Why Analog Filters?

Example: ADSL

Source: *Communication Systems Design*

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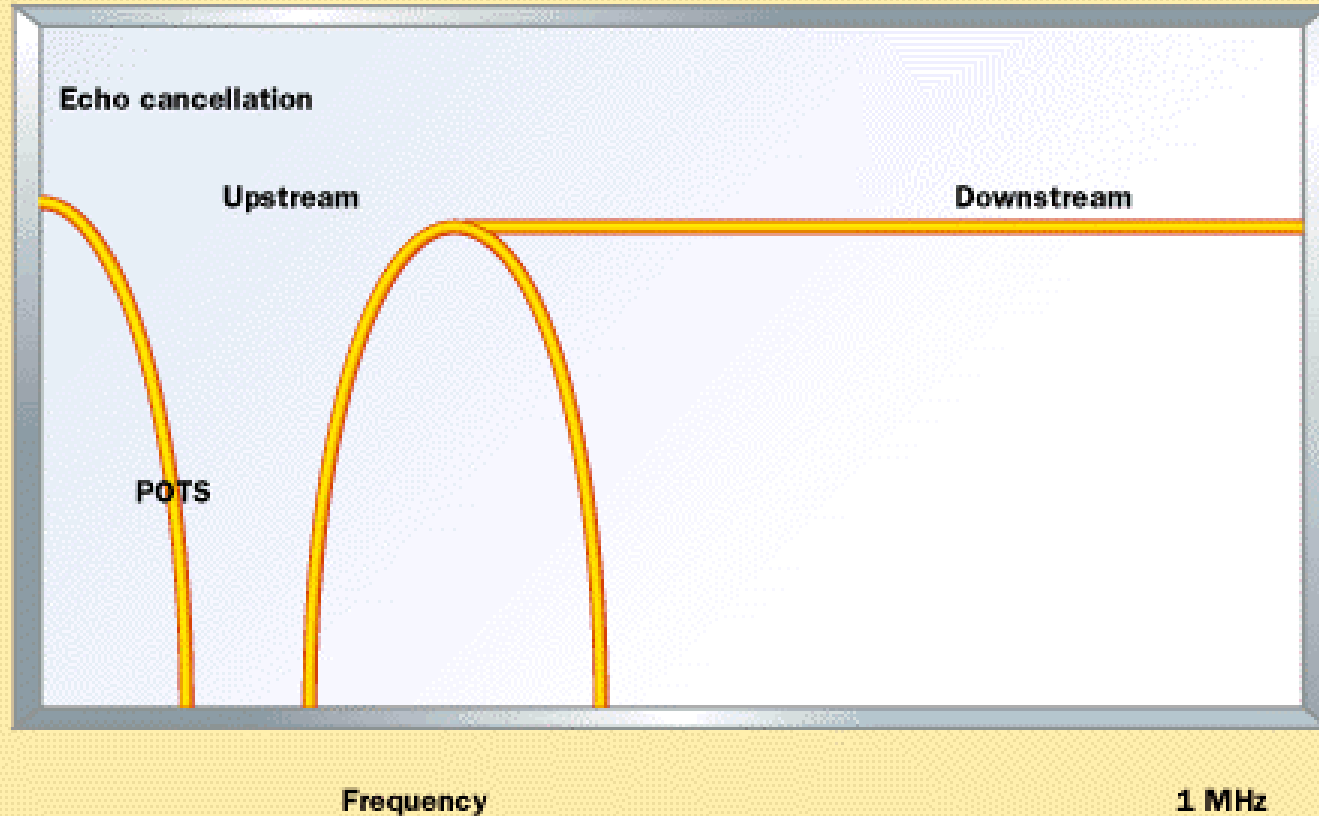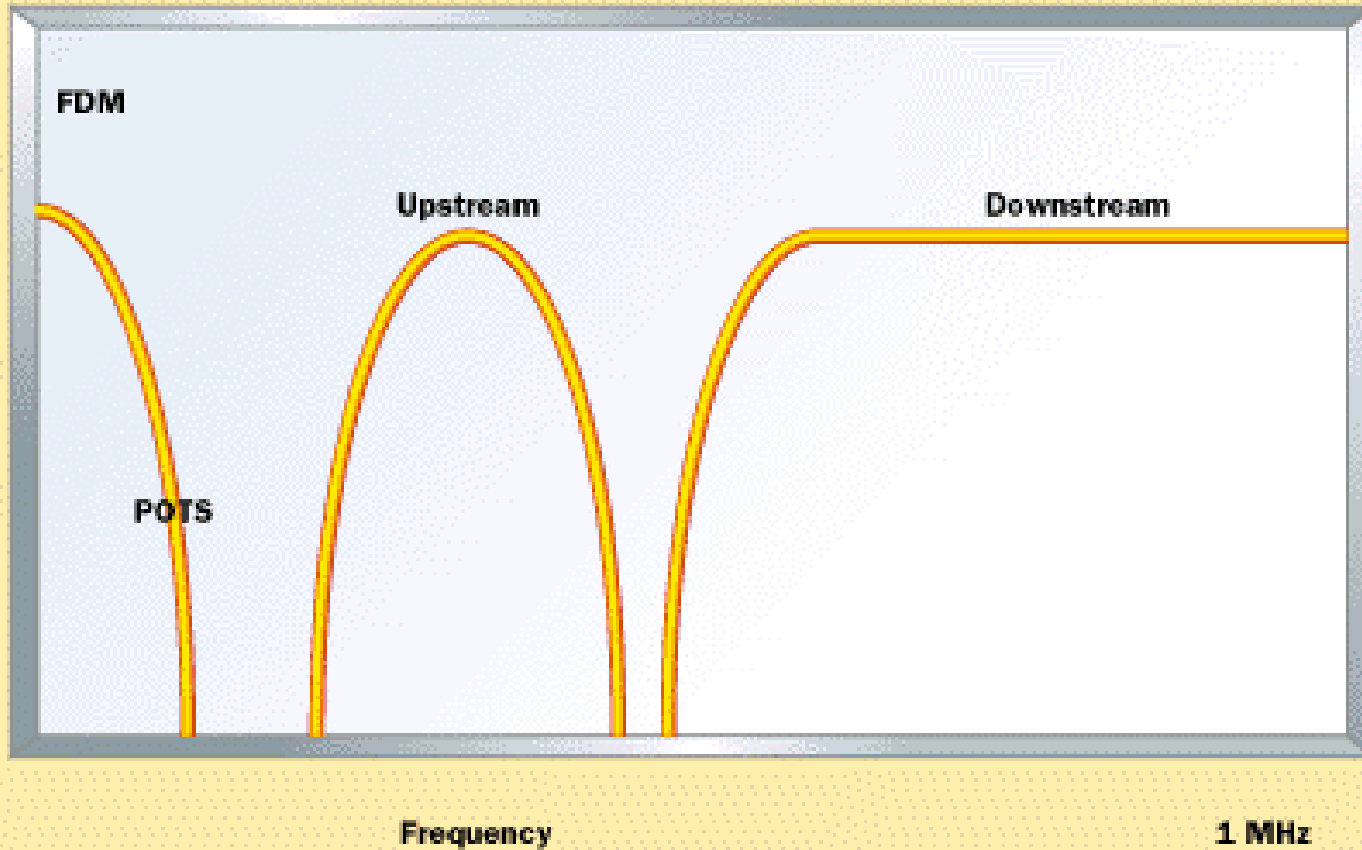
VLSI Analog Filter & Circuit Design

– It IS a filter design course

– It IS NOT a filter design course

- Different from traditional filter design courses
- VLSI realizable filters only
- CMOS circuit implementation

– It IS a circuit design course

– It IS NOT a circuit design course

- Different coverage as the pre-required courses (such as OP design)

Course Outline

Part One: Review of Basic Filter Theory

- – Signal, System, and Transfer Functions
- – Laplace Transformation
- – Fourier Transformation
- – Z-Transformation
- – S- Z- Transformation
- – Frequency Scaling & Transformations
- – Approximation Techniques

Course Outline

Part Two: VLSI Circuit Techniques

- Active-RC & MOS-C Circuits
- Gm-C Circuits
- SC Circuits
- SI Circuits
- Ladder Circuits

Course Outline

Part Three: VLSI Filter Design

- – Active-RC & Gm-C Filters
- – MOS-C Filters
- – SC Filters
- – SI Filters
- – Ladder Filters

Lecture Topics and Schedule

Date	Topic	Date	Topic
1/15/2002, Tuesday	Introduction	3/7/2002, Thursday	Gm-C Filter Design
1/17/2002, Thursday	CT Filter Fundamental	3/19/2002, Tuesday	SC Filter Design
1/22/2002, Tuesday	CT Filter Fundamental	3/21/2002, Thursday	SC Filter Design
1/24/2002, Thursday	VLSI Active R-C and MOS-C Circuits	3/26/2002, Tuesday	SI Filter Design
1/29/2002, Tuesday	Gm-C Circuits	3/28/2002, Thursday	(Review)
1/31/2002, Thursday	Gm-C Circuits	4/2/2002, Tuesday	(Exam2)
2/5/2002, Tuesday	DT Filter fundamental	4/4/2002, Thursday	(Design Project Assignment)
2/7/2002, Thursday	S-Z Transformations	4/9/2002, Tuesday	Design Sensitivity & Analysis
2/12/2002, Tuesday	SC Circuits	4/11/2002, Thursday	Design Case (1):Ladder Filters
2/14/2002, Thursday	SC Circuits	4/16/2002, Tuesday	Design Case (2): Butterworth Filters
2/19/2002, Tuesday	SI Circuits	4/18/2002, Thursday	Design Case (3): Chebyshev Filters
2/26/2002, Tuesday	(Exam1)	4/23/2002, Tuesday	Design Case (4): Elliptic Filters
2/28/2002, Thursday	Frequncy Scaling & Tranformations	4/25/2002, Thursday	Design Case (5): Bessel Filters
3/5/2002, Tuesday	Active R-C & MOS-C Filter Design	4/30/2002, Thursday	(Review for Final Exam)

Note: There may be slight variations, based on the progress of the course

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