

# OVERVIEW OF FOCUSED ANALOG IC DESIGN

## Overview of How to Design in CMOS/BiCMOS Technology:

- Who is the developer and presenter?
- What is this course about?
- Where is the course used?
- Why should I be interested in this course?
- When did this course develop?
- How should I use this course?

## What will I learn?

- How to design an analog circuit in CMOS/BiCMOS technology
- How to design and simulate a circuit to meet a given specification

Dr. Phillip Allen

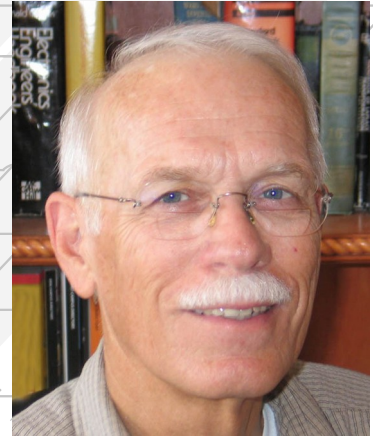
Prof. Emeritus, ECE, Georgia Tech

Version 181029

## Developer and Presenter

### Prof. Phillip Allen

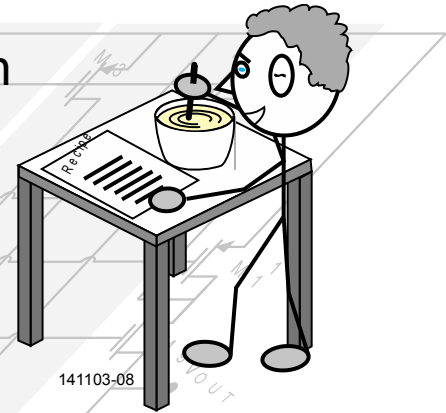
- 35 years teaching and research in analog IC design
- 15 years teaching new and experienced designers in industry
- Co-author of *CMOS Analog Circuit Design* (3<sup>rd</sup> edition)
- Developer and presenter of over 130 short courses worldwide to over 3000 students and professionals
- Passion for understanding and teaching analog IC design



# Course Description

## What is the course about?

- Provides a structured approach to analog IC design
- Uses design procedures (recipes)
  - A step-by-step procedure to create a design from a specification
  - Examples are given to illustrate the procedure
- Design procedure gives a first cut design
- Designer can then modify design if specifications are not met
- Laboratories with design tools are available to the designer
- Test benches determine whether or not the design meets specs
- Designer can modify the design to attempt to meet specs



# Course Content

## Module 1 - How to Design in CMOS/BiCMOS Technology

1. Influence of technology
2. How to select  $W$  and  $L$
3. XFAB 350nm technology

## Module 2 - How to Design Bias Circuits

4. How to design common mode bias circuits independent of  $V_{DD}$
5. How to design startup circuits
6. How to design cascode bias circuits independent of  $V_{DD}$
7. How to design bias circuits independent of  $V_{DD}$  and process
8. Lab01 – Bias Design

## Module 3 - How to Design Bandgap Circuits

9. How to design bias circuits independent of  $V_{DD}$  and temperature
10. How to design trimming circuits
11. How to design ultra-stable temperature independent bias circuits
12. Lab02 – Bandgap Design

# Course Content - Continued

## **Module 4 - How to Design Op Amps**

1. How to design single stage op amps
2. How to measure and simulate op amps
3. How to design two-stage op amps
4. *Lab03 - Op Amp Design*

## **Module 5 - How to Design Specialized Op Amps**

5. *How to design enhanced gain op amps*
6. *How to design low noise op amps*
7. *Lab04 - Low Noise Op Amp Design*
8. *How to design low power op amps*
9. *Lab05 - Low Power Op Amp Design*

## **Module 6 - How to Design Comparators**

10. *How to design open loop comparator design*
11. *How to design regenerative comparator design*
12. *How to design high speed comparator design*
13. *Lab06 - Comparator Design*

Italicized courses  
are under development

# Course Content - Continued

## **Module 7 - How to Design DACs**

- 1How to design serial DACs
- 2How to design parallel DACs
- 3How to design high resolution DACs
- 4How to design high speed DACs
- 5Lab07 - DAC Design
- 6How to design sigma delta DACs

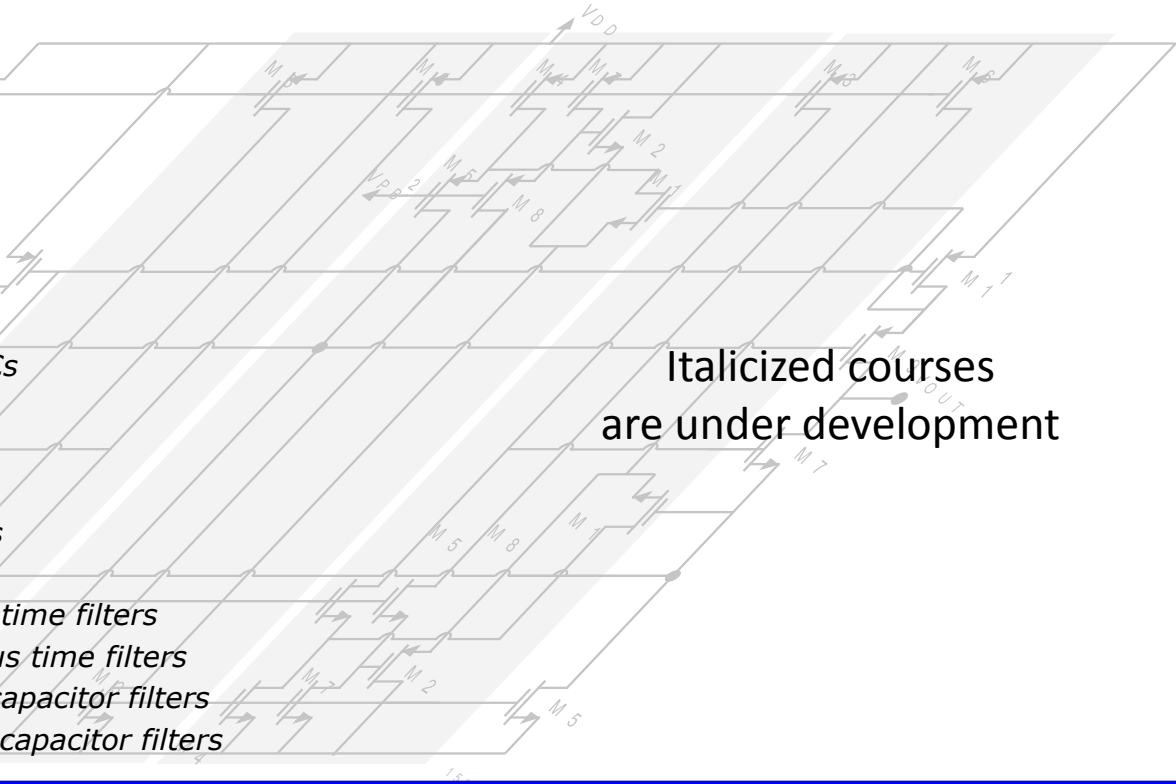
## **Module 8 - How to Design ADCs**

- 7How to design serial ADCs
- 8How to design moderate speed ADCs
- 9How to design high speed ADCs
- 10Lab08 - ADC Design
- 11How to design sigma delta ADCs
- 12How to design high resolution ADCs

## **Module 9 - How to Design Filters**

- How to design low-order continuous time filters
- 1How to design high-order continuous time filters
- 11How to design low-order switched capacitor filters
- 12How to design high-order switched capacitor filters
- 13How to design variable filters

Lab09 - Filter Design



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# Application of the Course

## Where is the course used?

- Can be used to prepare to use eFabless resources to design an analog IC
- Can provide the training to make the transition from analysis to design
- Can be used internal to a design company
- Can be used by anyone with an internet connection
- Course is useful to anyone wanting to do analog IC design in a 350 nm CMOS or BiCMOS technology

# Benefit of the Course

## Why should I take this course?

- To learn structured approach to analog IC design
- To sharpen your skills in analog IC design
- To gain experience using a 350nm technology to do design
- To find a solution to a particular design problem
  - How to design curvature corrected bandgaps
  - How to minimize process dependence on a design
- To gain certification of a level of design expertise
  - When a laboratory design is completed with all specifications satisfied, you will receive certification

# Course Development

## When did this course develop?

- This course was developed in 2018
- Based on teaching analog design in industry to new designers and experienced designers
- It is part of the eFabless training curriculum for analog IC design
- It resulted from the desire to associate the lectures with an experience to design and simulate a circuit given a set of specifications
- It is being continually updated
- All laboratories use eFabless tools

# Course Approach

## How is this course work?

- Prerequisites
  - You should have a good background in analog IC design – the short course “CMOS Analog Circuit Design” available on this website would be a good example of the required background
- You can use this course to do a general study of structured analog IC design or focused topic design
- Course modules typically contain three to six 20-25 minute video lectures along with hardcopy
- Course modules contain one or more laboratories
- Modules build on each other

# Summary

## Overview of Focused Analog IC Design

- Who – Prof. Phillip Allen
- What – A structured approach to analog IC design
- Where – Can be used by anyone with access to the internet
- Why – Will learn analog IC design and make the transition from analysis to design
- When – Developed in 2018 and continues to develop
- How – Focused design procedures along with laboratories to design an analog circuit to meet a given set of specifications