



苏州工业园区 2018 年度政府补贴紧缺推荐性项目- 高阶模拟集成电路设计技术

1. 课程时长： 5 天（9:00-17:00）

上课日期： 8 月 24 日、25 日、26 日、27 日、28 日共计 5 天

上课地点：苏州工业园区金鸡湖大道 1355 号国际科技园二期 E401

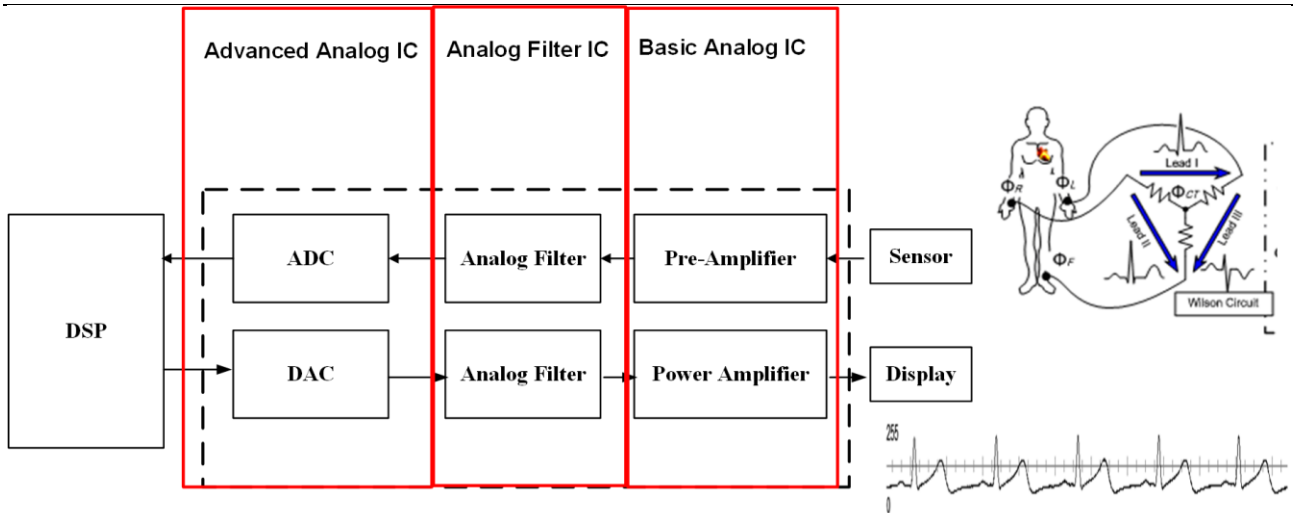
课程费用：

- 4200 元/人（含听课、讲义、午餐等费用），满 35 人开班，[缴纳苏州工业园区公积金的学员（园区公积金会员）享受政府补贴后费用为 2100 元/人。](#)

- 本课程有课后测验，合格者将由苏州市集成电路行业协会颁发结业证书。

课 程 名 称：高阶模拟集成电路设计技术(共四个单元)

课程说明：模拟讯号处理集成电路为模拟讯号处理(如前置放大器、模拟/数字与数字/模拟转换器、滤波器、锁相回路)与射频集成电路(如 LNA、Mixer、VCO、Frequency Synthesizer)之先修设计课程。本课程主要介绍模拟集成电路相关之基本电路单元与原理(如单级放大器、频率响应)，模拟讯号处理基本组件(如比较器、交换电容电路)，模拟与数字界面电路与系统(如 DAC、ADC)、噪声处理电路与系统(如滤波器)。透过模拟集成电路组件特性的分析、进而熟悉各种模拟集成电路与系统(如 Amplifier、Switched-Capacitor Circuits、Analog Filter、DAC/ADC)之设计技术及藉由系统架构分析与电路设计的训练，了解模拟讯号处理集成电路设计的技巧与建立模拟讯号处理集成电路设计的能力，如前置放大器、模拟滤波器、数据转换器。在整个课程中，讲师将会以深入浅出的方式讲授课程，让学员能在最有效时间内学习此领域专业知识，并确实能够实际运用于工作中，以提升学员未来在职场上的竞争力。



第一单元：模拟电路设计基础

(Basic Analog Integrated Circuits Design)

授课老师：Dr. Louis Lee

授课对象：半导体产业暨相关系统业者之在职人士或有相关技术需求者。

课程时长：8 课时/天

课程说明:

本课程将从混合讯号集成电路之基本组件开始介绍,如运算放大器(Operational Amplifier)、交换电容电路(Switched-Capacitor Circuits)、比较器(Comparator)、能隙基准电压电路与低压差线性稳压器(Bandgap References (BGR)), 其课程目标主要为介绍模拟芯片相关之基本电路单元,以作为混合讯号电路与系统设计之基础。

课程大纲：

➤ Basic MOS Device Physics

- Introduction to Analog Design
- Study with the structure of MOS transistors
- Derive MOS I/V characteristics
- Describe second-order effects such as body effect, channel length modulation, and subthreshold conduction
- Identify the parasitic capacitances of MOSFETs, derive a small-signal model, and a simple SPICE model

➤ Single-Stage Amplifiers

- Study the low-frequency behavior of single-stage CMOS amplifier
- Common-source amplifier
- Common-gate amplifier
- Source followers amplifier
- Cascode amplifier

➤ Differential Amplifiers

- Review single-ended and differential operation
- Analyze both large-signal and small-signal behavior
- Describe the common-mode rejection
- Study differential pairs with diode-connected and current-source loads

➤ Passive and Active Current Mirror

- Deals with the design of current mirrors
- Study cascode mirror operation
- Analyze active current mirrors
- Describe the properties of differential pair

➤ Frequency Response of Amplifiers

- Frequency response of single-stage and differential amplifiers
- High-frequency behavior of CS, CG and source followers
- High-frequency behavior of cascode and differential amplifiers
- The effect of active current mirrors on the frequency response of differential pairs

➤ Feedback

- A general view of feedback
- Four feedback topologies and their properties
- The effects of loading in feedback amplifiers



第二单元：模拟集成电路设计

(Analog Integrated Circuits Design)

授 课 老 师：Dr. Louis Lee

授 课 对 象：半导体产业暨相关系统业者之在职人士或有相关技术需求者。

课 程 时 长：8 课时/天

课程说明:

本课程将从混合讯号集成电路之器件开始介绍,如比较器(Comparator)、能隙基准电压电路與低压差线性稳压器(Bandgap References (BGR) and low dropout regulator (LDO)),进而介绍各种模拟数字转换器/数字模拟转换器(ADC/DAC)之架构,以及振荡器与锁相环电路,使学员不但具有讯号处理所需之模拟数字接口电路概念,并能熟习振荡器与锁相环之集成电路设计

➤ Operational Amplifiers

- Describe simple op amps such as telescopic and folded cascode topologies
- Study two-stage and gain-boosting configurations and problem of common-mode feedback
- Introduce the concept of slew rate and analyze the effect of supply rejection

➤ Stability and Frequency Compensation

- Stability criteria and the concept of phase margin
- Frequency compensation techniques for different op amp topologies
- The impact of frequency compensation on the slew rate of two-stage op amps

➤ OPAMP Design Example

- Two-stage CMOS opamp
- Feedback and opamp compensation
- Folded-cascode OPAMP

➤ Switched-Capacitor Circuits

- Basic building blocks and analysis

- First-order and biquad filters
- Charge injection
- Switched-capacitor gain circuits
- Correlated double-sampling techniques
- Comparator
 - Examine a simplistic approach of an open-loop opamp for a comparator
 - Describe other approaches : multiple-stage comparators, positive-feedback track-and-latch comparators, and fully differential comparators
- Bandgap References (BGR)
 - Study supply-independent biasing and the problem of start-up
 - Describe temperature-independent references and examine the effect of offset voltages
 - Present constant- G_m biasing
 - Study an example of state-of-the-art bandgap references

第三单元：前沿模拟集成电路设计

(Advance Analog Integrated Circuits Design)

授 课 老 师 : Dr. Louis Lee

授 课 对 象 : 半导体产业暨相关系统业者之在职人士或有相关技术需求者。

课 程 时 长 : 8 课时/天

课程说明:

本课程将从模拟与数字转换接口集成电路之原理开始介绍,如模拟数字转换器/数字模拟转换器(ADC/DAC)之基本概念,进而介绍各种模拟数字转换器/数字模拟转换器(ADC/DAC)之架构,其中并分别加入一 SAR ADC 与 Pipeline ADC 之设计与模拟例子,使学员不但具有讯号处理所需之模拟数字接口电路概念,并能熟习其关键零组件之集成电路设计。

➤ Data Converter Fundamental

- Ideal D/A converter

- Ideal A/D converter
- Quantization noise
- Performance limitations
- Digital-to-Analog Converter (DAC)
 - Decoder-based
 - Binary-weighted
 - Thermometer-code
 - Hybrid
- Analog-to-Digital Converter (ADC)
 - Integrating converters
 - Successive-approximation converters
 - Algorithmic (or Cyclic) A/D converters
 - Flash (or parallel) converters
 - Two-step A/D converters
 - Pipelined A/D converters
 - Time-interleaved A/D converters
- SAR ADC/Pipelined ADC Design Example

第四单元：模拟滤波器集成电路设计

(Analog Filter Integrated Circuits Design)

授 课 老 师：Dr. Louis Lee

授 课 对 象：半导体产业暨相关系统业者之在职人士或有相关技术需求者。

课 程 时 长：8 课时/天

课程说明:

本课程主要针对模拟滤波器原理、分析与设计进行介绍。首先将说明模拟滤波器的原理,再来会提到各种滤波器之近似方程序与合成方法。最后将介绍被动式滤波器的设计技巧,以及低通、高通、带通、带拒滤波器的转换与设计方法。此外介绍模拟滤波器集成电路、设计与实现方法,其中电路将包含连续时域与非连续时域的电路设计技巧。连续时域主要为 Gm-C

Filter,非连续时域则为 Switched-Capacitor Filter 的集成电路实现方法。目的为让初学者可很容易了解模拟滤波器设计方法。获得本课程模拟滤波器的原理与关键技术后,可应用在集成电路、通讯、消费电子、监控系统等产业公司之讯号传输、讯号检测、噪声防制之技术开发,建立讯号处理的能力。

➤ Fundamental of Filter

- Linear continuous time-invariant systems
- Type of filters

➤ Approximation

- Butterworth response
- Chebyshev response

➤ Passive Filter Design

- Realization of LC immittance functions
- Derivation of the twoport parameters of LC filters
- Realization of LC allpass circuits
- Realization of LC ladders

➤ Discrete-Time Switched-Capacitor Filters

- First-order transfer function
- Second-order transfer function
- Design example of high-order switched-capacitor filters

➤ Continuous-Time OTA-C Filters

- Gm-C integrator
- Gyrator-C active inductor
- Design example of high-order Gm-C filters



师资简介:

授课师资: 李老师 (台湾)

Education:

- 台湾成功大学电机工程博士

Experience:

- 台湾工业技术研究院计算机与通讯研究所
- 华邦电子消费性产品开发部
- 罗技电子制造工程部
- 美台电讯制造工程部
- 台湾中正大学电机工程学系教授
- 台湾南台科技大学集成电路设计中心主任
- Technical Program Chair (TPC) :
 - 2014 IEEE International Symposium on Bioelectronics and Bioinformatics
 - 2015 International Symposium on Bioelectronics and Bioinformatics
 - 2015 Taiwan and Japan Conference on Circuits and Systems (TJCAS 2015)

Co-General Chair:

- 2016 Taiwan and Japan Conference on Circuits and Systems (TJCAS 2016)

Specializations:

- Low-voltage Low-Power Analog Integrated Circuits
- RF Wireless Communication System
- RFIC circuits
- Mixed-signal circuit and system
- Biomedical circuits and system