南方科技大学 SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	**课程名称 Course Title**	**模拟集成电路设计 Analog Integrated Circuit Design**
2.	**授课院系 Originating Department**	电子与电气工程系 Department of Electrical and Electronics Engineering
3.	**课程编号 Course Code**	EE337
4.	**课程学分 Credit Value**	3
5.	**课程类别 Course Type**	专业选修课 Major Elective Courses
6.	**授课学期 Semester**	秋季 Fall
7.	**授课语言 Teaching Language**	中英双语 English & Chinese （English with detailed explanations in Chinese）
8.	**授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） Instructor(s), Affiliation& Contact （For team teaching, please list all instructors）**	潘权 助理教授、电子系、panq@sustc.edu.cn Quan Pan Assistant Professor, EEE Dept.
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	待公布 To be announced
10.	**选课人数限额(可不填) Maximum Enrolment （Optional）**	50

11.	授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other（Please specify）	总学时 Total
	学时数 Credit Hours	32		32		64

12.	先修课程、其它学习要求 **Pre-requisites or Other Academic Requirements**	半导体器件导论 Introduction to Semiconductor Devices EE204 模拟电路 Analog Circuits EE201-17
13.	后续课程、其它学习规划 **Courses for which this course is a pre-requisite**	
14.	其它要求修读本课程的学系 **Cross-listing Dept.**	

教学大纲及教学日历 SYLLABUS

15. **教学目标 Course Objectives**

This course introduces the fundamentals of analog integrated circuits analysis and design. Topics covered include the motivation on analog IC design, the basics of MOS device physics, and a variety of analog circuit blocks such as single-stage and differential amplifiers, voltage and current references, operational amplifiers, and state-of-art industry analog circuit blocks. Intuitions, concepts, and rigorous analysis are presented to help the students master the design skills of analog integrated circuits, which are also intensified through the practical designs delivered in the lab sessions.

本课程主要讲授模拟 CMOS 集成电路设计的相关原理，包括基本器件物理、单级放大器、差分放大器、放大器频率响应、噪声、反馈、运算放大器、稳定性及频率补偿等；将讲授模拟集成电路设计的最新进展，并结合主流 EDA 工具传授设计技术和实验课程。

16. **预达学习成果 Learning Outcomes**

After completing this course, the students will be able to

1. Understand the fundamentals of circuit-design oriented device physics.

2. Develop the basic understanding on the operation principles of various analog IC blocks.

3. Acquire the rigorous analysis and design skills of analog IC circuits.

1.理解以电路设计为导向的器件基础知识；

2.掌握各类模拟电路模块的工作原理；

3.学习模拟集成电路严格的分析和设计技能。

17. **课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）**
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

理论课主要内容：

Course Content:

□模拟电路设计绪论 Introduction to analog design（2 hours）

介绍模拟电路的背景知识和本学科的科学意义，以及通用概念的介绍 Introduction of analog circuits' background and its purpose.

□MOS 器件物理基础 Basic MOS device physics（3 hours）

介绍 MOS 器件的工作原理和基础知识，包括 MOS I/V 特性、模型等 Introduction of basic MOS device working principle and physics, including MOS I/V characterization and device modeling

□单级放大器 Single-stage amplifiers（3 hours）

分析 3 种不同的单机放大器的工作原理，包括共源、源极跟随器、共栅电路 Explain 3 different types of single-stage amplifier and their working principle, including CS, source follower, and CG stages.

□差动放大器 Differential amplifiers（2 hours）

分析基本的差动放大器的工作原理， 包括基础知识、共模响应等 Analysis of basic differential amplifiers' working principle, including basic differential pair and common-mode response

□无源与有源电流镜 Passive and active current mirrors（2 hours）

分析各类电流镜及优缺点，包括基础/Cascode/有源等架构 Analysis of different types of passive and active current mirrors, including basic/cascode/active topologies

□放大器的频率特性 Frequency response of amplifiers（3 hours）

零极点分析及分析放大器的频率特性和设计方法 Analysis of zeros/poles and the frequency response of 5 different amplifiers and design method

□噪声 Noise （3 hours）

分析噪声的来源，分类及消除方法 Analysis of different noise sources/types and reduction method

□反馈 Feedback（4 hours）

分析各类反馈电路及其应用 Analysis of different types of feedback circuits and their applications

□运算放大器 Operational amplifiers（2 hours）

分析运算放大器的工作原理及其应用 Analysis of operational amplifiers' working principle and their applications

□稳定性与频率补偿 Stability and frequency compensation（2 hours）

分析电路的稳定性、增益相位裕量其频率补偿方法 Analysis of circuits' stability, gain/phase margin, and methods for frequency compensation

□锁相环 Phase-locked loop（4 hours）

分析通用锁相环电路的原理、主要电路和难点 Analysis of working principle of phase-locked loop, and its main circuit

blocks and design difficulties.

□最新工业界模拟集成电路导论 Introduction to state-of-art industry analog circuits （2 hours）

介绍目前工业界最新的模拟/高速集成电路的架构、热点及方向 Introduction to state-of-art industry analog circuits, including latest architectures and research directions.

实验课主要内容：

Lab contents:

□UNIX 设置与 cadence 基础知识 UNIX setup and cadence basic (2 hours)

介绍 UNIX 仿真的设置和 cadence 的基础知识 Introduction of UNIX setup and cadence background knowledge

□电路图和仿真环境 Schematic and simulation environment (4 hours)

介绍电路图的建立、使用及 ADE 的使用 Introduction of schematic build-up and usage of ADE environment

□MOSFET I/V 曲线特性 MOSFET I/V curve characterization (2 hours)

介绍如何仿真 MOSFET I/V 的特性 Introduction of how to simulate the I/V curves of MOSFET

□单级放大器 Single-stage amplifiers (6 hours)

仿真三种不同的单级放大器的电路架构 Simulation of 3 different types of single-stage amplifier

□差动放大器 Differential amplifiers (2 hours)

仿真不同的差动放大器的电路架构 Simulation of different types of differential amplifiers

□电流镜 Current mirrors (2 hours)

仿真不同的电流镜 Simulation of different type of current mirrors

□电感/电阻/电容 Inductor/Resistor/Capacitor (2 hours)

学习如何仿真电感/电阻/电容 Learn how to simulate Inductor/Resistor/Capacitor

□放大器的频率特性 Frequency response of amplifiers (4 hours)

仿真放大器的增益带宽性能 Simulation of amplifiers' gain and bandwidth performance

无特殊注意事项 No special attention needed during the lab hours

□课程项目 Course project (8 hours)

课程考察项目的主要内容是设计一个含有 MOSFET、电流镜、电感、电阻、电容、差动放大器的单级或多级放大器。学生

需要根据学得的理论知识进行分析、计算，利用实验工具进行仿真，完成最终报告。

The main content of the final course project is to design a single-stage or multiple-stage amplifier including MOSFET, current mirror, inductor, resistor, capacitor and differential pair. Students need to analysis and calculation based on the theory, do simulation with experimental tools, and finish the final project report.

注意事项：

课程最后考察的项目内容与前面分阶段的培训密切相关。

Note:

The final project is related to each step of the whole lab content.

18. 教材及其它参考资料 Textbook and Supplementary Readings

Textbook:

Behzad Razavi, “Design of Analog CMOS Integrated Circuits,” McGraw-Hill, 2001.

Reference Books:

Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer, “Analysis and Design of Analog Integrated Circuits,” John Wiley & Sons, 2001.

课程评估 ASSESSMENT

19.

评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		10		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects		35		
平时作业 Assignments		15		
期中考试 Mid-Term Test		40		
期末考试 Final Exam				
期末报告 Final Presentation				

其它（可根据需要改写以上评估方式） **Others (The above may be modified as necessary)**				

20. 记分方式 **GRADING SYSTEM**

☑ A. 十三级等级制 **Letter Grading**
☐ B. 二级记分制（通过/不通过） **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority