

课程大纲

COURSE SYLLABUS

1.	课程代码/名称 Course Code/Title	SME5016/电源管理集成电路设计 SME5016/Power Management IC Design
2.	课程性质 Compulsory/Elective	选修课/Elective
3.	课程学分/学时 Course Credit/Hours	3/64
4.	授课语言 Teaching Language	英文/ English
5.	授课教师 Instructor(s)	詹陈长副教授/ Dr. Chenchang Zhan, Associate Professor
6.	先修要求 Pre-requisites	模拟电子技术基础、信号与系统、集成电路设计
7.	教学目标 Course Objectives	<p>本课程传授电源管理集成电路设计的相关原理和技巧。课程首先介绍电源管理 IC 设计基本概念，然后系统复习无源元件、半导体器件、环路稳定性分析等基础知识，接着重点讲授低压差稳压器（LDO）设计，包括带片外电容 LDO、全集成 LDO、数字控制 LDO，以及参考电压源，包括带隙基准电压源、非带隙 CMOS 参考电压源，最后将简要介绍其他先进电源转换器的基本概念。将兼顾电源管理 IC 设计的基础知识、原理以及最新进展，并结合主流 EDA 工具传授设计技术。</p> <p>This course is to introduce the principles and design techniques of power management integrated circuits. An overview of the power management IC design basic concepts will be carried out first. Then, a systematic review on the basics of passive components, semiconductor devices, and loop stability analysis will be discussed. After that, the focus will be on the topics of low-dropout regulators (LDO) design, including the regular LDOs with external capacitors, the fully-integrated LDOs, and digital control LDOs, as well as the voltage references (VRs) design, including bandgap voltage references and the non-bandgap CMOS voltage references. Finally, a brief introduction of the other advanced power converters will be presented. The aspects of fundamentals, design principles, and state-of-the-art development of power management IC will all be comprehensively emphasized. Furthermore, the course will employ the industry-standard EDA tool to deliver the design techniques.</p>
8.	教学方法 Teaching Methods	<p>(1) The lectures will be intuition-rich and yet rigorous in delivering the fundamentals of power management integrated circuits.</p> <p>(2) In-class discussions and student involvements will be highly encouraged and carried out.</p> <p>(3) In-class quiz will be designed to help students grasp the knowledge in a short time.</p> <p>(4) Application oriented projects will be designed for students to apply the course contents.</p> <p>(5) Industry-standard EDA tools will be employed throughout the course delivery as well as during the course projects.</p>
9.	教学内容 Course Contents	<p>Section 1 Overview of power management IC design (2 hours)</p>

Section 2	Review of passive components R, C and L (2 hours)
Section 3	Review of semiconductor components D, Q and M (2 hours)
Section 4	Review of small-signal analysis, loop gain, and frequency compensation (2 hours)
Section 5	Low-dropout (LDO) regulators with external capacitors (6 hours)
Section 6	LDO regulators with fully-on-chip implementations (6 hours)
Section 7	Digital control LDO regulators (4 hours)
Section 8	Bandgap voltage references (4 hours)
Section 9	CMOS voltage references (2 hours)
Section 10	Brief introduction of advanced power converters (2 hours)
Lab Part	<p>Lab 1: EDA Setup (2 hours)</p> <p>Lab 2: Basic Circuit Components (4 hours)</p> <p>Lab 3: MOSFET Studies, including I-V curve simulations, Key parameter estimations (8 hours)</p> <p>Lab 4: LDO Simulations (8 hours)</p> <p>Project: Open topic of PMIC Designs (10 hours)</p>

**10. 课程考核
Course Assessment**

请再此注明：①考查/考试；②分数构成。

考查，包括：

出勤(Attendance): 15%

随堂测验(Quiz): 25%;

实验简报(Lab): 20%;

课程项目(Projects): 40%

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

教材：课程讲义

参考书：

P. R. Gray, P. J. Hurst, S. H. Lewis, and R. G. Meyer, "Analysis and design of analog integrated circuits," 4th edition, John Wiley & Sons, Inc., 2001, 高等教育出版社, 英文影印本, 2003.

B. Razavi, "Design of analog CMOS integrated circuits," 2nd edition, 英文影印本, 清华大学出版社, 2005.

T. C. Carusone, D. A. Johns, and K. W. Martin, "Analog integrated circuit design," 2nd edition, John

Wiley & Sons, Inc., 2011.

S. M. Sze and K. K. Ng, "Physics of semiconductor devices," 3rd edition, John Wiley & Sons, Inc., 2007.

R. W. Erickson and D. Maksimovic, "Fundamentals of power electronics," 2nd edition, Springer, 2001.