

《数字集成电路设计实验》

课程实验教学大纲

1、课程基本信息

课程类型	<input checked="" type="checkbox"/> 独立设置的实验课 <input type="checkbox"/> 课内实验						
课程编码	7326101	学分	0.5	总学时	16	实验学时	16
课程名称	数字集成电路设计实验						
课程英文名称	Experiment of Digital Integrated Circuits Design						
适用专业	微电子科学与工程						
先修课程	(7069201)模拟电子技术、(7087611)数字电子技术、(7005321)半导体物理、(7119421)专用集成电路设计						
开课部门	信息学院电子工程系(微电子)						

2、实验的性质与任务

本大纲是信息学院电子工程系《数字集成电路设计》课程对应的实验课，为专业方向必修课。总学时 16 学时，实验 16 学时。为学生今后从事数字集成电路的设计、制造及应用研究等工作打下坚实的实践基础，目的是让学生熟悉数字集成电路设计用到的软件，掌握原理图、版图、网表等相关的基本知识，了解设计方法和流程以及数字集成电路设计中需要考虑的各种因素，培养学生数字集成电路方面的实践能力。

本实验教学是《数字集成电路设计》课程的重要组成部分，其任务是：

1. 掌握集成电路原理图和版图设计；
2. 掌握基本电路结构的网表分析；
3. 掌握简单数字系统的设计和仿真。

课程思政目标：根据课程的特点和育人要求，充分发挥课程所承载的育人功能，强化学生的学习体验和学习效果。坚定爱党爱国爱专业的理想信念、厚植爱国主义思想、加强品德修养，培育学生科学精神、创新精神、工匠精神。

3、实验教学内容与学时分配

序号	实验名称	学时	实验类型
1	软件工具的使用与简单器件版图的设计	4	验证性实验
2	MOS 反向器版图及静/动态特性分析	4	设计性实验
3	MOS 与非门/或非门静/动态特性分析	4	设计性实验

4	四位全加器电路设计及特性仿真	4	综合性实验
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4、实验安排与要求

1. 软件工具的使用与简单器件版图的设计（验证性，4 学时）
掌握 Tanner 软件基本电路图和版图绘制方法，进行电路和版图的绘制。
2. MOS 反向器版图及静/动态特性分析（设计性，4 学时）
掌握反相器工作原理以及版图绘制和网表的编程，进行反相器版图绘制和电路特性分析和仿真。
3. MOS 与非门/或非门静/动态特性分析（设计性，4 学时）
掌握与非门/或非门工作原理以及版图绘制和网表的编程，进行与非门/或非门版图绘制和电路特性分析和仿真。
4. 四位全加器电路设计及特性仿真（综合性，4 学时）
掌握加法器的工作原理，设计一个四位加法器并对其进行性能仿真。

5、实验教学与其它相关课程的联系与分工

本课程的先修课程：模拟电子技术、数字电子技术、半导体物理、专用集成电路设计。在学习本课程之前，应熟练掌握模拟电子技术、数字电子技术、半导体物理等课程的主要知识点，并且对半导体器件和电路的主要特性理解要深刻。

本课程的后续课程：毕业设计。本课程是微电子科学与工程专业设计类必修课，通过本课程的学习，为学生后续的毕业设计、就业以及考研打下坚实的理论和实践基础。

6、实验教学设计与教学组织

教学设计：本实验课程采用集成电路测试实验教学平台，以各类集成电路和器件的测试实例、测试数据库、测试模型的形式充分展示集成电路和器件的基本测试原理、测试方法和流程。采用实验室开放手段，在完成课内实验基础上可以在课外对实验内容进行拓展深入，结合实际测试项目，培养学生集成电路和器件测试的实践动手能力。

教学组织：在实验课程开展之前，应该做好相关知识和工具的预习准备工作，掌握集成电路测试实验教学平台的使用和特性。

7、实验教材、实验指导书及教学参考资料

1. 实验教材

TannerPro 集成电路设计与布局实战指导，廖裕评，科学出版社，2011 年，

ISBN: 9787030190499

2. 实验指导书

TannerPro 集成电路设计与布局实战指导, 廖裕评, 科学出版社, 2011 年, ISBN: 9787030190499

3. 参考资料

《模拟电路版图的艺术》, (美)黑斯廷斯, 电子工业出版社, 2007 年 04 月, ISBN: 9787121040047

8、实验考核方法及成绩评定标准

要求学生每次实验前要进行预习, 认真阅读实验指导书, 了解实验目的和要求。根据实验要求, 学生到实验室了解和熟悉本次实验所用测试工具和设备, 在规定时间内独立完成实验。

实验总成绩以百分制计算, 其中实验操作占 30%, 实验报告占 70%。

实验报告应包含实验目的、要求、实验获得的数据、分析和结论。

9、大纲制(修)订说明

制定大纲需要阅读与课程相关的参考文献和专著, 并熟悉相关软件的使用。

大纲执笔人: 杨兵

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制(修)订日期: 2022 年 2 月

Experiment of Digital Integrated Circuits Design

Experimental syllabus

1、 Basic Information of Course

Course Type	<input checked="" type="checkbox"/> Independent laboratory Course <input type="checkbox"/> In-class Experiment						
Course Code	7326101	Course credits	0.5	Course hours	16	Experiment hours	16
Course Name	数字集成电路设计实验						
Course Title	Experiment of Digital Integrated Circuits Design						
Applicable Speciality	Microelectronics Science and Engineering						
Prerequisites	(7069201) Analog Electronics、 (7087611) Digital Electronics、 (7005321) Semiconductor Physics、 (7119421) Application Specific Integrated Circuits Design						
Department	Department of Electronic Engineering, School of Information						

2、 Description and Learning Outcomes

This outline is suitable for the principle of testing system for integrated circuits course opened by the department of electronic engineering of information college. This course is a major elective. The total class time is 32 hours, including 16 hours for teaching and 16 hours for experiment.

This experiment teaching is an important part of the principle of testing system for integrated circuits course. This experiment is an in-class experiment, and its tasks are:

1. Deepen students' understanding of integrated circuits and device testing theory, testing method, testing process;
2. Mastering the basic device testing method, training students' practical ability test basic components;
3. Mastering the mixed signal integrated circuits testing method, train students' practical ability of testing mixed signal integrated circuits.

This outline is an experimental course corresponding to the course 《Digital integrated circuit design》 in the Department of electronic engineering of the school of information. It is a compulsory course for professional direction. 16 class hours in total and 16 class hours in experiment. Lay a solid practical foundation for students to engage in the design, manufacturing and Application Research of digital integrated circuits in the future. The purpose is to make students familiar with the software used in digital integrated circuit design, master the basic knowledge of schematic diagram, layout, netlist and other related knowledge, and understand the design methods and processes and various factors to be considered in digital integrated circuit design, Cultivate students' practical ability in digital integrated circuits.

This experimental teaching is an important part of the course of 《Digital integrated circuit design》. Its tasks are:

1. Master IC schematic diagram and layout design;
2. Master the netlist analysis of basic circuit structure;
3. Master the design and Simulation of simple digital system.

Ideological and political objectives of the course: according to the characteristics and educational requirements of the course, give full play to the educational function carried by the course, and strengthen students' learning experience and learning effect. Strengthen the ideals and beliefs of loving the party, the country and the profession, cultivate patriotism, strengthen moral cultivation, and cultivate students' scientific spirit, innovative spirit and craftsman spirit.

3、Contents and Time Allocation

Number	Contents	Lecture	Type
1	The use of software tools and the design of simple device layout	4	Confirmatory
2	Layout and static / dynamic characteristics analysis of MOS inverter	4	Design
3	Static / dynamic characteristic analysis of MOS NAND gate and / or not gate	4	Design
4	Circuit design and characteristic simulation of four bit full adder	4	Comprehensive

4、Arrangement and Requirements

1. Use of software tools and design of simple device layout (Confirmatory, 4

class hours)

Master the basic circuit diagram and layout drawing method of Tanner software, and draw the circuit and layout.

2. Layout and static / dynamic characteristic analysis of MOS inverter (Design, 4 class hours)

Master the working principle of inverter and the programming of layout drawing and netlist, and carry out inverter layout drawing and Circuit characteristic analysis and simulation.

3. Static / dynamic characteristic analysis of MOS NAND gate / or NAND gate (Design, 8 class hours)

Master the working principle of NAND gate / or NAND gate, layout drawing and netlist programming, and carry out NAND gate / or Non gate layout drawing and circuit characteristic analysis and simulation.

4. Circuit design and characteristic simulation of four bit full adder (Comprehensive, 4 class hours)

Master the working principle of adder, design a four bit adder and simulate its performance.

5、 Relations with Other Courses

Prerequisite courses of this course: analog electronic technology, digital electronic technology, semiconductor physics, application specific integrated circuit design. Before learning this course, you should master the main knowledge points of analog electronic technology, digital electronic technology, semiconductor physics and other courses, and have a deep understanding of the main characteristics of semiconductor devices and circuits.

The follow-up course of this course: graduation design. This course is a compulsory course for the design of microelectronics science and engineering. Through the study of this course, it will lay a solid theoretical and practical foundation for students' subsequent graduation design, employment and postgraduate entrance examination.

6、 Teaching Design and Organization

Teaching design: this experimental course adopts the integrated circuit test experimental teaching platform to fully display the basic test principles, test methods and processes of integrated circuits and devices in the form of test examples, test

databases and test models of various integrated circuits and devices. By means of laboratory opening, on the basis of completing the experiment in class, we can expand and deepen the experimental content outside class, and cultivate students' practical ability of integrated circuit and device testing in combination with actual test projects.

Teaching organization: before the experimental course is carried out, we should prepare for the preview of relevant knowledge and tools, and master the use and characteristics of the integrated circuit test experimental teaching platform.

7、 Experimental textbook, Instruction book and Reference

1. Experimental textbook

《Tannerpro integrated circuit design and layout practical guidance》, Liao Yuping, Science Press, 2011, ISBN: 9787030190499

2. Instruction book

《Tannerpro integrated circuit design and layout practical guidance》, Liao Yuping, Science Press, 2011, ISBN: 9787030190499

3. Reference

《The art of analog layout》, Alan Hastings, Electronic industry press, 2007, ISBN: 7502581316

8、 Assessment methods and evaluation criteria

Students are required to preview before each experiment, carefully read the experimental instruction and understand the purpose and requirements of the experiment. According to the experimental requirements, students go to the laboratory to understand and be familiar with the test tools and equipment used in this experiment, and complete the experiment independently within the specified time.

The total score of the experiment is calculated in the percentage system, in which the experimental operation accounts for 30% and the experimental report accounts for 70%.

The experimental report shall include the purpose, requirements, data, analysis and conclusion of the experiment.

9、 Explanation

To make the outline, you need to read the references and monographs related to the course, and be familiar with the use of relevant software.

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