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**	电子技术基础 Electronic Circuit Principles and Design
2.	**授课院系** **Originating Department**	系统设计与智能制造学院 School of System Design and Intelligent Manufacturing
3.	**课程编号** **Course Code**	SDM244
4.	**课程学分 Credit Value**	4
5.	**课程类别** **Course Type**	专业基础课 Major Foundational Courses
6.	**授课学期** **Semester**	秋季 Fall
7.	**授课语言** **Teaching Language**	中英双语 English & 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）**	付敏跃 教授 系统设计与智能制造学院, 邮箱：fumy@sustech.edu.cn Minyue FU School of System Design and Intelligent Manufacturing Email: fumy@sustech.edu.cn
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）**	

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	48	0	32		80

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	PHY105大学物理（下）; EE104电路基础 PHY105 College Physics II; EE104 Fundamental of Electric Circuits
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

本课程是电子技术的基础课程，涉及自动化工程专业本科生在电子技术方面必备的知识。课程分为模拟电子电路和数字电子电路两部份，主要内容包括：

1. 半导体基础知识：二极管、双极型晶体管和结型场效应晶体管
2. 放大器：共射极、共集极、共基极放大器和电压和电流放大器
3. 运算放大器：理想运算放大器、倒相与非倒相放大器及应用
4. 滤波器：被动和有源滤波器、一阶和二阶滤波器、半波和全波整流器
5. 二进制数系统基础：二进制运算与转换、基本逻辑门、真值表、布尔代数
6. 组合逻辑电路：加法器、比较器、编码器/译码器、复用器/解复用器、卡诺图
7. 时序逻辑电路：锁存器、触发器、计数器、寄存器、有限状态机、状态图、状态表

This is a foundational course in electronic technology, covering the essential knowledge that undergraduate students majoring in automation engineering need in electronic technology. The course is divided into two parts: analog electronic circuits and digital electronic circuits, with the main content including:

1. Semiconductor fundamentals: diodes, bipolar junction transistors, and junction field-effect transistors.
2. Amplifiers: common emitter, common collector, common base amplifiers, and voltage and current amplifiers.
3. Operational amplifiers: ideal operational amplifiers, inverting and non-inverting amplifiers and their applications.
4. Filters: passive and active filters, first-order and second-order filters, half-wave and full-wave rectifiers.
5. Fundamentals of the binary number system: binary arithmetic and conversion, basic logic gates, truth tables, Boolean algebra.
6. Combinational logic circuits: adders, comparators, encoders/decoders, multiplexers/demultiplexers, Karnaugh map.
7. Sequential logic circuits: latches, flip-flops, counters, registers, finite-state machines, state diagrams, state tables.

16. 预达学习成果 Learning Outcomes

使学生获得模拟和数字电子技术方面的基础知识，为后续自动化专业课程的学习及日后从事工程技术工作和科学研究奠定坚实基础。通过这门课程的学习，学生能够

1. 掌握主要放大电子器件的特性和工作原理

2. 掌握基本放大电路的组成、特性和分析方法
3. 运用电子电路的构思方法，可以根据需求设计放大电路
4. 分析和识别常用集成运算放大电路的各级电路
5. 掌握可用于分析和设计数字电路的技术和方法，包括数制/数码、逻辑简化和最小化，状态表，状态图等
6. 掌握基本组合逻辑和时序逻辑模块的设计和运作方式
7. 分析由基本组合逻辑和时序逻辑模块组成的电路

The course aims to provide students with a solid foundation in both analog and digital electronic technology, which will be beneficial for their future studies in automation engineering and their future careers in engineering and scientific research. By taking this course, students will be able to:

1. Understand the characteristics and operating principles of basic electronic amplification devices.
2. Understand the composition, characteristics, and analysis methods of basic amplification circuits.
3. Use the conceptual approach of electronic circuits to design amplification circuits.
4. Analyze and identify various stages of commonly used integrated operational amplification circuits.
5. Understand the techniques and methods used to analyze and design digital circuits, including number systems/digits, logic simplification and minimization, state tables, and state diagrams.
6. Understand the design and operating modes of basic combinational logic and sequential logic modules.
7. Analyze circuits composed of basic combinational and sequential logic modules.

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.)

理论教学大纲 Lectures (48 credit hours)

周 1：信号与放大器 Weeks 1: Signals and Amplifiers

信号：连续/离散/数字信号、信号频谱；放大器：电压/电流/功率放大器、放大器等效电路、放大器频率相应

Signals: continuous-time/discrete-time/digital signals, signal spectrum; Amplifiers: voltage/current/power amplifiers, equivalent circuits, frequency response of amplifiers.

周 2-3：运算放大器电路 Weeks 2-3: Operational Amplifier Circuits

理想运算放大器、倒相与非倒相放大器及应用；差分放大器、积分器、微分器；被动和有源滤波器、一阶和二阶滤波器；

Ideal operational amplifier, inverting and non-inverting amplifiers and their applications; passive and active filters, first and second order filters.

周 4-6：二极管和晶体管 Weeks 4-6: Diodes and Transistors

PN 结、二极管模型、正向和反向偏置、二极管特性、基本二极管电流、半波和全波整流器；双极晶体管（BJT）工作原理、偏置和小信号模型；MOS 场效应晶体管（MOS-FET）工作原理、偏置和小信号模型

PN junction, diode model, forward and reverse bias, diode characteristics, basic diode circuits, half-wave and full-wave rectifiers; Bipolar Junction Transistor (BJT), biasing and small signal model; MOS Field Effect

Transistor (MOS-FET), biasing and small signal model.

周 7-9：基本放大电路. Weeks 7-9: Basic Amplifier Circuits

共射极、共集极、共基极放大器；电压和电流放大器；场效应管放大电路

Common emitter, common collector, common base amplifier; voltage and current amplifiers; FET amplifier circuits.

周 10-11：二进制数系统基础. Weeks 10-11: Basics of Binary Number System

二进制运算与转换；基本逻辑门；真值表、布尔代数

Binary arithmetic and conversion; basic logic gates; truth tables, Boolean algebra.

周 12-13：组合逻辑电路 Weeks 12-13: Combinational Logic Circuits

加法器、比较器；编码器/译码器；复用器/解复用器；卡诺图

Adders, comparators; encoders/decoders; multiplexers/demultiplexers; Karnaugh maps.

周 14-16：时序逻辑电路. Weeks 14-16: Sequential Logic Circuits

锁存器、触发器、计数器；寄存器、有限状态机；状态图、状态表

Latches, flip-flops, counters; registers, finite-state machines; state diagrams, state tables.

常规实验部份 8 Labs （16 credit hours）

1. 绪论（2学时）：介绍本门课程实验构成、实验注意事项、课程评价方式、主要实验仪器的使用。

   Introduction (2 credit hours): Introduction of the labs, grading policy and how to use the testing instruments in the lab.

2. 二极管电路的应用（2学时）：验证二极管的单向导电性；二极管在稳压、限幅和箝位电路中的应用和工作原理。

   Application Circuits of Diodes (2 credit hours): Applications of diodes in voltage regulators, clipping circuits and clamping circuits.

3. 共射极单管放大电路研究（2学时）：分析共射极放大电路的性能，加深对共射极放大电路放大特性的理解；学习共射极放大电路静态工作点的调试方法，分析静态工作点对放大器性能的影响；掌握放大器电压放大倍数、输入电阻、输出电阻及最大不失真输出电压的测试方法。

   Common-emitter BJT Amplifiers (2 credit hours): Analysis techniques of the common-emitter BJT amplifier circuits, the DC and AC equivalent circuits, Q-point and the dynamic performances of the amplifiers, adjusting methods of the Q-point, saturation and cutoff distortions, dynamic performance parameters of the amplifiers including voltage gain, input and output resistances, dynamic range and frequency response.

4. 运算放大器的应用I（2学时）：掌握用运算放大器组成比例、求和、积分、微分及波形产生电路的特点及性能；掌握各电路的工作原理、测试和分析方法。

   Op-Amp Application Circuits I (2 credit hours): Summing, subtraction and inverting amplifiers, integrators and differentiators.

5. 门电路逻辑功能及测试（2学时）：熟悉与门、非门、或门等逻辑门的使用方法；掌握数字示波器的使用。

   TTL Logic Gates (2 credit hours): Familiarization with some basic 74 series TTL logic gates including AND,

OR, NAND, NOR, XOR and the conversions between them. Learn to use the digital storage oscilloscope.

6. CMOS门电路测试（2学时）：掌握CMOS门的功能测试方法；学会外特性的测试；比较CMOS门与TTL门的差异。

   CMOS Logic Gates (2 credit hours): Testing of functions and performances of CMOS logic gates, comparison between the TTL gates and CMOS gates.

7. 组合逻辑电路（2学时）：掌握半加器、全加器、译码器、数据选择器等组合逻辑电路的原理及逻辑测试方法，了解它们的应用。

   Combinatorial Logic Circuits (2 credit hours): Principles and applications of half-adders, adders, decoders, encoders, multiplexers, de-multiplexers.

8. 触发器（R-S、D、J-K）（2学时）：熟悉并掌握R-S、D、J-K触发器的构成、工作原理和功能测试方法；学会正确使用触发器集成芯片；了解不同逻辑功能触发器相互转换的方法。

   Flip-Flops (R-S, D, J-K) (2 credit hours): Principles and applications of different kinds of flip-flops and the conversions between them.

DIY 实践部分（16学时） DIY Project (16 credit hours)

根据学生自己的兴趣，组成3-8人的 Project Team，小组成员围绕模拟或数字电路主题共同拟定项目的题目，制定项目的技术路线、实现方案以及经济预算，实施项目的分工，控制项目的时间进度，在教师的协助和指导下自行采购所需的实验耗材，最终完成整个项目作品的设计和制作，并撰写项目报告。DIY 实践部分从作品的创新性、完整性、可靠性、团队协作及项目报告五个维度进行评价。

A project team typically comprises three to eight members, with one student serving as the team leader. The teams are tasked with completing a project related to circuit theory, wherein they must apply their knowledge of analog and digital circuit theory as well as experimental skills to design an electronic gadget. Working under the guidance of their instructors, each team is responsible for creating a time schedule, conducting cost evaluations, and allocating the budget accordingly. The projects are evaluated based on five criteria: innovation, reliability, integrity, presentations, and reports, as well as teamwork.

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

(一) 教材 Textbooks

Microelectronic circuits, 7th edition, Sedra Smith, Oxford University Press, 2015

Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, Digital Systems: Principles and Applications, 11/e - Pearson

(二) 主要参考书 References

童诗白 华成英 编,《模拟电子技术基础》(第五版)，高教出版社,2015 年

阎石主编，《数字电子技术基础》（第六版），高等教育出版社，2016 年

康华光编,《电子技术基础》(第五版), 高教出版社,2005 年

Wakerly John F, Digital Design: Principles and Practices, Pearson Prentice-Hall, 4th edition, 2007

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				
课堂表现 Class Performance				

小测验 **Quiz**				
课程项目 **Projects**		20		
平时作业 **Assignments**		15		
期中考试 **Mid-Term Test**		25		
期末考试 **Final Exam**		40		
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