

集成电路系统设计课程教学大纲

Integrated Electronic Systems Design Subject Syllabus

一、课程信息 Subject Information

课程编号: Subject ID	41033	开课学期: Semester	2
课程分类: Category	专业教育 PA	所属课群: Section	专业基础 MF
课程学分: Credit Points	2.5	总学时/周: Total Hours/Weeks	40
理论学时: LECT. Hours	28	实验学时: EXP. Hours	8
PBL 学时: PBL Hours	4	实践学时/周: PRAC. Hours/Weeks	0
开课学院: College	东北大学 悉尼智能科技学院	适用专业: Stream	通信工程 CE
课程属性: Pattern	必修 Compulsory	课程模式: Mode	互认 EQV
课程协调人: Coordinator	黄彩梅 HUANG Caimei	成绩记载方式: Result Type	百分制 Marks
先修课程: Requisites	高等数学建模, 电气电子工程 Mathematical Modelling , Electrical and Electronic Engineering		
英文参考教材: EN Textbooks	Robert L. Boylestad, Louis Nashelsky. Electronic Devices and Circuit Theory, Eleventh Edition, Publishing House of Electronics Industry, 2016		
中文参考教材: CN Textbooks	ALLAN R. HAMBLEY, 模拟电子技术(第二版), 电子工业出版社, 2016		
教学资源: Resources	童诗白,华成英.《模拟电子技术基础》, 高等教育出版社, 第五版		
课程负责人(撰写人): Subject Director	黄彩梅	提交日期: Submitted Date	单击或点击此处输入日期。
任课教师(含负责人): Taught by	宋爱娟, 黄彩梅, 李梅梅		
审核人: Checked by	韩鹏	批准人: Approved by	史闻博
		批准日期: Approved Date	单击或点击此处输入日期。

二、教学目标 Subject Learning Objectives (SLOs)

注：毕业要求及指标点可参照悉尼学院本科生培养方案，可根据实际情况增减行数

Note: GA and index can be referred from undergraduate program in SSTC website. Please add/reduce lines based on subject.

整体目标: Overall Objective	学生应了解集成电子系统的应用领域。具有一定的电子电路基础知识和技能，能够分析、设计和解决一些实际电子系统的思维和能力。 Students should understand the applied field of Integrated electronic system, master the basic knowledge and skills of electronic circuitry, be able to analyze, design and solve some electronic system problems of thinking and ability.	
(1) 专业目标: Professional Ability	1-1	掌握电子系统的发展过程和基本的电子元器件特性 Master the development process of electronic system and basic characteristics of electronic components
	1-2	将电子技术理论应用于基本的电子单元电路的分析和设计 Apply electronic technique theories to the analysis and design of basic electronic unit circuits.
	1-3	掌握电子电路的分析方法,并能够解决简单的电子系统设计问题。培养初步的工程思维和创新的能力 Master the basic methods of electronic circuit analysis, and be able to solve simple electronic system design problems. Cultivate preliminary engineering thinking and innovation ability.
	1-4	使用基本的实验软件设计、构建电子系统电路,并对电子系统进行故障排除 Using the basic experimental software to design and construct the electronic system circuit, and the electronic system troubleshooting
(2) 德育目标: Essential Quality	2-1	具有良好的团队协作意识和能力、较强的表达能力和人际交往能力 A strong sense and capability of teamwork, strong expression and interpersonal skills.
	2-2	具有良好的跨文化、跨领域沟通能力,能够在本专业相关领域进行有效的技术沟通和交流 Good cross-cultural and cross-field communication skills, able to carry out effective technical communication and exchange in the relevant field of the major.
课程教学目标与毕业要求的对应关系 Matrix of GA & SLOs		
毕业要求 GA	指标点 GA Index	教学目标 SLOs
1、工程知识：能够将数学、自然科学、工程基础和专业用于解决复杂工程问题。	指标点 1-1：掌握数学、自然科学、工程基础和专业，并使用其建立正确的数学、物理学等模型以解释复杂工程问题	1-1,1-2,1-3

3、设计/开发解决方案：能够设计针对复杂工程问题的解决方案，设计满足特定需求的系统、单元或流程，并能够在设计环节中体现创新意识，考虑社会、健康、安全、法律、文化以及环境等因素。	指标点 3-1：能够设计针对本专业相关复杂工程问题的解决方案，能够设计和开发实现特定功能、满足特定需求的信息传输、信号处理或网络通信系统	1-1,1-2,1-3
		1-1,1-2,1-3
4、研究：能够基于科学原理并采用科学方法对复杂工程问题进行研究，包括设计实验、分析与解释数据、并通过信息综合得到合理有效的结论。	指标点 4-1：能够基于科学原理并采用科学方法，在本专业相关理论指导下对复杂工程问题设计实验进行研究	1-4
	指标点 4-2：能够结合本专业知识对实验数据进行分析与解释，设计并优化实验方案，并通过信息综合得到合理有效的结论；	1-4
5、使用现代工具：能够针对复杂工程问题，开发、选择与使用恰当的技术、资源、现代工程工具和信息技术工具，包括对复杂工程问题的预测与模拟，并能够理解其局限性	指标点 5-2：熟悉解决本专业相关复杂工程问题所需的技术和资源，能够运用现代信息技术进行文献检索和资料查询，获取专业解决方案；	1-2,1-3,1-4
		1-2,1-3,1-4
9、个人和团队：能够在多学科背景下的团队中承担个体、团队成员以及负责人的角色。	指标点 9-1：能够认识团队协作的重要性，具有强烈的团队协作意识和能力、卓越的组织管理能力、较强的表达能力和人际交往能力；	2-1,2-2
		2-1,2-2
10、沟通：能够就本专业复杂工程问题与业界同行及社会公众进行有效沟通和交流，包括撰写报告和设计文稿、陈述发言、清晰表达或回应指令。具备一定的国际视野，能够在跨文化背景下进行沟通和交流。	指标点 10-2：熟练掌握英语，能够在本专业相关领域进行有效的技术沟通和交流。	2-2

三、教学内容 Content (Topics)

注：以中英文填写，各部分内容的表格可根据实际知识单元数量进行复制、扩展或缩减

Note: Filled in both CN and EN, extend or reduce based on the actual numbers of knowledge unit

(1) 理论教学 Lecture

知识单元序号: Knowledge Unit No.	1	支撑教学目标: SLOs Supported	1-1
知识单元名称 Unit Title	电子系统概述, 半导体二极管 Overview of electronic system, Semiconductor Diodes		
知识点: Knowledge Delivery	电子系统的发展历程及现状 The development and present situation of electronic system		
	半导体材料, 杂质半导体 Semiconductor Materials, Impurity semiconductor		
	半导体二极管, 二极管的特性曲线 Semiconductor diode, characteristic curve of diode		
	半导体二极管的应用 Semiconductor Diodes Applications		
学习目标: Learning Objectives	了解: Recognize	电子元器件的发展过程, 载流子的概念, 二极管在电路中的应用 The development of electronic components, The concept of charged particles, Semiconductor Diodes Applications	
	理解: Understand	半导体材料的导电原理, 负载线分析电路的方法 The Principle of semiconductor materials conducts electricity, The method of analyzing circuit with load line	
	掌握: Master	二极管的特性曲线, 等效模型分析, 利用二极管等效电路分析串、并联二极管电路, 二极管整流、限幅电路 Characteristic curve of diode, Equivalent model analysis, The series and parallel diode circuits, rectifier and limiting circuit are analyzed by diode equivalent circuit, Diode rectifier and limiting circuit	
德育目标 Moral Objectives	具有良好的团队协作意识和能力、较强的表达能力和人际交往能力 A strong sense and capability of teamwork, strong expression and interpersonal skills. 具有良好的跨文化、跨领域沟通能力, 能够在本专业相关领域进行有效的技术沟通和交流 Good cross-cultural and cross-field communication skills, able to carry out effective technical communication and exchange in the relevant field of the major.		
重点: Key Points	半导体的导电原理, 二极管的工作特性, 二极管的等效模型, 整流限幅电路 Characteristic curve of diode, The Principle of semiconductor materials conducts electricity, Equivalent model analysis, Rectification, Clippers Circuit		
难点: Focal points	二极管的交流动态电阻, 限幅电路和钳位电路的输出响应 AC or Dynamic Resistance of diode, Output response of limiting		

	circuit
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知识单元序号: Knowledge Unit No.	2	支撑教学目标: SLOs Supported	1-1,
知识单元名称 Unit Title	双极性结型晶体管及其放大电路 Bipolar Junction Transistor and its amplifying circuit		
知识点: Knowledge Delivery	晶体管的结构和工作原理 Structure and working principle of transistor		
	晶体管放大原理, 三种组态放大电路 Transistor Amplifying Action, Three kinds of transistor configuration		
	BJT 电路直流偏置 DC Biasing—BJTs		
	BJT 交流分析 BJT AC Analysis		
学习目标: Learning Objectives	了解: Recognize	npn 和 pnp 晶体管的特性, 混合参数 Π 模型 Characteristics of NPN and PNP transistors, Mixed Π model	
	理解: Understand	晶体管的工作原理, 信号源内阻对放大器特性增益的影响 Operating principle of Transistor, Effect of Internal Resistance of signal source on characteristic gain of amplifier	
	掌握: Master	晶体管电路的直流分析 DC analysis of various transistor configuration circuits 使用等效模型分析晶体管放大电路的交流参数 Analysis of AC parameters of transistor amplifier circuit with equivalent model	
德育目标 Moral Objectives	具有良好的团队协作意识和能力、较强的表达能力和人际交往能力 A strong sense and capability of teamwork, strong expression and interpersonal skills. 具有良好的跨文化、跨领域沟通能力, 能够在本专业相关领域进行有效的技术沟通和交流 Good cross-cultural and cross-field communication skills, able to carry out effective technical communication and exchange in the relevant field of the major.		
重点: Key Points	晶体管的电流放大作用, 晶体管放大电路的直流偏置, 晶体管交流等效模型, 晶体管放大电路交流参数求解 The current amplifying function of transistor, the DC bias of transistor amplifying circuit, the AC equivalent model of transistor, the solution of AC parameters of transistor amplifying circuit		
难点: Focal points	晶体管电路的直流分析, 绘制等效模型, 利用等效模型分析放大器的交流参数		

	DC analysis of various transistor circuits, Draw the equivalent model, Analysis of AC parameters of amplifier by equivalent mode
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知识单元序号: Knowledge Unit No.	3	支撑教学目标: SLOs Supported	1-1,1-3
知识单元名称 Unit Title	场效应晶体管及其放大电路 Field-Effect Transistors and its amplifying circuit		
知识点: Knowledge Delivery	场效应管的构造和特性 Structure and characteristics of FET		
	场效应管的偏置 FET Biasing		
	场效应管放大器 FET Amplifiers		
学习目标: Learning Objectives	了解: Recognize	场效应管的工作原理 Working principle of field effect transistor	
	理解: Understand	场效应管的类型 Types of FET	
	掌握: Master	转移特性曲线, FET 负载线的分析, JFET、MOSFET 电路的直流分析, 场效应管的小信号模型, 电路交流分析 Transfer Characteristics, Analysis of load line, Direct current analysis of JFET, MOSFET circuit, JFET Small-Signal Model, Circuit AC analysis	
德育目标 Moral Objectives	具有良好的团队协作意识和能力、较强的表达能力和人际交往能力 A strong sense and capability of teamwork, strong expression and interpersonal skills. 具有良好的跨文化、跨领域沟通能力, 能够在本专业相关领域进行有效的技术沟通和交流 Good cross-cultural and cross-field communication skills, able to carry out effective technical communication and exchange in the relevant field of the major.		
重点: Key Points	绘制转移特性曲线, 典型偏置电路的分析计算, 电路交流分析 Draw Transfer Characteristics, Analysis and calculation of typical bias circuit, Circuit AC analysis		
难点: Focal points	分压偏置电路, 场效应管的小信号等效模型 Voltage-Divider Biasing, JFET Small-Signal Model		

知识单元序号: Knowledge Unit No.	4	支撑教学目标: SLOs Supported	1-1,1-3
知识单元名称 Unit Title	BJT 和 FET 频率响应 BJT and FET Frequency Response		
知识点: Knowledge Delivery	频率响应的幅频特性和相频特性 Amplitude frequency and phase frequency characteristics of frequency		

	response	
	低频响应、高频响应 Low-Frequency response, High-Frequency response	
	多级放大电路的频率响应 Frequency response of multistage amplifier	
学习目标: Learning Objectives	掌握: Master	上限截止频率和下限截止频率 Upper and lower cut-off frequencies 单级放大电路的频率响应 Frequency response of single stage amplifier 多级放大电路的频率响应 Frequency response of multistage amplifier
德育目标 Moral Objectives	具有良好的团队协作意识和能力、较强的表达能力和人际交往能力 A strong sense and capability of teamwork, strong expression and interpersonal skills. 具有良好的跨文化、跨领域沟通能力，能够在本专业相关领域进行有效的技术沟通和交流 Good cross-cultural and cross-field communication skills, able to carry out effective technical communication and exchange in the relevant field of the major.	
重点: Key Points	上限截止频率和下限截止频率 Upper and lower cut-off frequencies	
难点: Focal points	上限截止频率和下限截止频率 Upper and lower cut-off frequencies	

知识单元序号: Knowledge Unit No.	5	支撑教学目标: SLOs Supported	1-1,1-2,1-3
知识单元名称 Unit Title	运算放大器 Operational amplifier		
知识点: Knowledge Delivery	运算放大器的组成 Composition of operational amplifier		
	差分放大电路 Differential amplifier		
	运算放大器基础 Operational amplifier Basics		
学习目标: Learning Objectives	掌握: Master	运算放大器的组成 Composition of operational amplifier 共模信号、差模信号、共模抑制比 Common mode signal, Differential mode signal, C Common mode rejection ratio 差分放大电路的组成和分析 Composition and analysis of differential amplifier circuit	

德育目标 Moral Objectives	<p>具有良好的团队协作意识和能力、较强的表达能力和人际交往能力</p> <p>A strong sense and capability of teamwork, strong expression and interpersonal skills.</p> <p>具有良好的跨文化、跨领域沟通能力，能够在本专业相关领域进行有效的技术沟通和交流</p> <p>Good cross-cultural and cross-field communication skills, able to carry out effective technical communication and exchange in the relevant field of the major.</p>
重点: Key Points	<p>运算放大器的组成和特点</p> <p>Composition and characteristics of operational amplifier</p> <p>差分放大电路的组成和分析</p> <p>Composition and analysis of differential amplifier circuit</p>
难点: Focal points	<p>差分放大电路的组成和分析</p> <p>Composition and analysis of differential amplifier circuit</p>

知识单元序号: Knowledge Unit No.	6	支撑教学目标: SLOs Supported	1-1,1-2,1-3
知识单元名称 Unit Title	反馈电路 Feedback circuit		
知识点: Knowledge Delivery	<p>反馈的概念</p> <p>The concept of feedback</p> <p>反馈组态的判断</p> <p>Judgment of feedback configuration</p> <p>负反馈对放大电路性能的影响</p> <p>Influence of negative feedback on the performance of amplifier circuit</p>		
学习目标: Learning Objectives	掌握: Master	<p>瞬时极性法</p> <p>Instantaneous polarity method</p> <p>反馈组态的判断</p> <p>Judgment of feedback configuration</p> <p>负反馈放大电路的放大倍数、输入输出电阻的分析</p> <p>Analysis of amplification factor, input and output resistance of negative feedback amplifier circuit</p>	
德育目标 Moral Objectives	<p>具有良好的团队协作意识和能力、较强的表达能力和人际交往能力</p> <p>A strong sense and capability of teamwork, strong expression and interpersonal skills.</p> <p>具有良好的跨文化、跨领域沟通能力，能够在本专业相关领域进行有效的技术沟通和交流</p> <p>Good cross-cultural and cross-field communication skills, able to carry out effective technical communication and exchange in the relevant field of the major.</p>		

重点: Key Points	瞬时极性法、反馈组态的判断 Instantaneous polarity method, Judgment of feedback configuration
	负反馈对放大电路性能的影响 Influence of negative feedback on the performance of amplifier circuit
难点: Focal points	负反馈放大电路的放大倍数、输入输出电阻的分析 Analysis of amplification factor, input and output resistance of negative feedback amplifier circuit

知识单元序号: Knowledge Unit No.	7	支撑教学目标: SLOs Supported	1-1,1-2,1-3
知识单元名称 Unit Title	运算放大器的应用 Op-Amp Applications		
	运算电路 Operation circuit		
	有源滤波 Active filters		
	比较器、施密特触发器 Comparator operation, Schmitt Trigger		
学习目标: Learning Objectives	掌握: Master	虚短路、虚断路 Virtual short circuit、 Virtual circuit breaker	
		有源滤波 Active filters	
		电压传输特性 Voltage transmission characteristics	
德育目标 Moral Objectives	具有良好的团队协作意识和能力、较强的表达能力和人际交往能力 A strong sense and capability of teamwork, strong expression and interpersonal skills. 具有良好的跨文化、跨领域沟通能力,能够在本专业相关领域进行有效的技术沟通和交流 Good cross-cultural and cross-field communication skills, able to carry out effective technical communication and exchange in the relevant field of the major.		
重点: Key Points	虚短路、虚断路 Virtual short circuit、 Virtual circuit breaker		
	电压传输特性 Voltage transmission characteristics		
难点: Focal points	有源滤波、施密特触发器 Active filters, Schmitt Trigger		

知识单元序号: Knowledge Unit No.	8	支撑教学目标: SLOs Supported	1-1,1-2,1-3
知识单元名称	正弦波振荡电路		

Unit Title	Sinusoidal Oscillator	
知识点: Knowledge Delivery	正弦波振荡电路的电路组成、幅值条件和相位条件 The circuit composition, amplitude condition and phase condition of sine wave oscillation circuit	
	RC 正弦波振荡电路、LC 正弦波振荡电路 RC sine wave oscillation circuit, LC sine wave oscillation circuit	
	石英晶体振荡电路 Quartz crystal oscillator circuit	
学习目标: Learning Objectives	掌握: Master	正弦波振荡电路的组成 Composition of sine wave oscillation circuit
		RC、LC 正弦波振荡电路产生正弦波振荡的判断 Judgment of RC and LC sine wave oscillation circuit producing sine wave oscillation
		振荡频率 Oscillation frequency
德育目标 Moral Objectives	具有良好的团队协作意识和能力、较强的表达能力和人际交往能力 A strong sense and capability of teamwork, strong expression and interpersonal skills. 具有良好的跨文化、跨领域沟通能力, 能够在本专业相关领域进行有效的技术沟通和交流 Good cross-cultural and cross-field communication skills, able to carry out effective technical communication and exchange in the relevant field of the major.	
重点: Key Points	振荡电路的组成, 振荡电路需满足的幅值条件、相位条件 The composition of oscillation circuit, The amplitude and phase conditions of oscillation circuit	
难点: Focal points	电路能否产生振荡的判断 Judgement of whether circuit can produce oscillation	

知识单元序号: Knowledge Unit No.	9	支撑教学目标: SLOs Supported	1-1,1-2,1-3
知识单元名称 Unit Title	功率放大器 Power Amplifiers		
知识点: Knowledge Delivery	放大器的类型 Amplifier classes		
	甲类、乙类、丙类、丁类功率放大器 Class A, Class B, Class AB, class C, class D Amplifier Operation		
	最大输出功率、转换效率 Maximum output power, Conversion efficiency		
学习目标: Learning Objectives	掌握: Master	放大器的类型 Amplifier classes	

		乙类功率放大器 Class B Amplifier Operation
		最大输出功率 Maximum output power
德育目标 Moral Objectives	<p>具有良好的团队协作意识和能力、较强的表达能力和人际交往能力 A strong sense and capability of teamwork, strong expression and interpersonal skills.</p> <p>具有良好的跨文化、跨领域沟通能力，能够在本专业相关领域进行有效的技术沟通和交流 Good cross-cultural and cross-field communication skills, able to carry out effective technical communication and exchange in the relevant field of the major.</p>	
重点: Key Points	乙类功率放大器、最大输出功率 Class B Amplifier Operation, Maximum output power	
难点: Focal points	功率放大电路参数的计算 Calculation of power amplifier circuit parameters	

(2) 实验教学 Experiments

注：可根据实际情况增减行数。实验类型可分为验证性、设计性、综合性，实验性质可分为选做、必做。

Note: Please add/reduce lines based on subject. The Type contains Verify, Design, and Comprehensive, while the Pattern contains Required and Elective

序号 No.	实验项目名称 Experiment Topic	学时 Hours	每组人数 MPG*	实验类型 Type	实验性质 Pattern
1	单管共发射极放大电路 One-stage Common Emitter Amplification Circuit	2	1	设计性 Design	必做 Elec
2	单级放大器幅频特性测量实验 Measuring Amplitude-frequency Characteristic of One-stage Amplifier	2	1	设计性 Design	必做 Elec
3	运算放大器信号运算电路实验 Experiment of Operational Amplifier Signal Operation Circuit	2	1	设计性 Design	必做 Elec
4	功率放大器实验 Power amplifier experiment	2	1	综合性 Comp	必做 Elec
	总计 Total	8			

*MPG: Members per group

实验项目序号: Experiment No.	1	支撑教学目标: SLOs Supported	1-1,1-3,1-4
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每组成员: Members per Group	1	指导教师: Tutor	李梅梅
实验名称: Experiment Title	单管共发射极放大电路 One-stage Common Emitter Amplification Circuit		
实验内容: Content	用 MULTISIM 仿真软件绘制电路图; Draw circuit diagram MULTISIM simulation software;		
	共发射极放大电路的静态工作点的调整; Adjustment of static operating point of common emitter amplifier circuit;		
	共发射极放大电路的电压放大倍数的测量; Measurement of Voltage Amplification Multiplex of common emitter amplifier circuit;		
	共发射极放大电路的输入电阻的测量; Measurement of the input resistance of a common emitter amplifier;		
	共发射极放大电路的输出电阻的测量。 Measurement of output resistance of a common emitter amplifier circuit.		
学习目标: Learning Objectives	熟悉 Multisim 软件的使用方法、学习放大器静态工作点、放大电压倍数、输入电阻、输出电阻的仿真方法。 Familiar with Multisim software; Study the simulation method of amplifier's static working point, voltage multiple, input resistance and output resistance.		
教学要求: Requirements	每个学生独立完成实验, 撰写实验报告 Each student completes the experiment independently, and writes the experiment report		
实验场地: Location	综合楼 1111 Z1111		
实验软硬件设备: Software/Hardware	MULTISIM 仿真软件 MULTISIM simulation software		

实验项目序号: Experiment No.	2	支撑教学目标: SLOs Supported	1-1,1-3,1-4
每组成员: Members per Group	1	指导教师: Tutor	李梅梅
实验名称: Experiment Title	单级放大器幅频特性测量实验 Measuring Amplitude-frequency Characteristic of One-stage Amplifier		
实验内容: Content	用 MULTISIM 仿真软件绘制电路图; Draw circuit diagram MULTISIM simulation software;		
	负载电阻对通频带的影响 Effect of Load Resistance on Pass Band		
	发射极电阻对通频带的影响 Effect of emitter resistance on passband		
	耦合电容 C1 对通频带的影响		

	Effect of coupled capacitance C1 on passband 旁路电容 Ce 对通频带的影响 Effect of bypass capacitor Ce on passband
学习目标: Learning Objectives	学习放大器幅频特性曲线和上、下限截止频率的测量方法; 了解负载电阻、发射极电阻、耦合电容和旁路电容对幅频特性的影响。 Learn the measurement method of amplifier amplitude-frequency characteristic curve and upper and lower limit cutoff frequency; understand the influence of load resistance, emitter resistance, coupling capacitance and bypass capacitance on amplitude-frequency characteristic.
教学要求: Requirements	每个学生独立完成实验, 撰写实验报告 Each student completes the experiment independently, and writes the experiment report
实验场地: Location	综合楼 1111 Z1111
实验软硬件设备: Software/Hardware	MULTISIM 仿真软件 MULTISIM simulation software

实验项目序号: Experiment No.	3	支撑教学目标: SLOs Supported	1-2,1-3,1-4
每组成员: Members per Group	1	指导教师: Tutor	李梅梅
实验名称: Experiment Title	运算放大器信号运算电路实验 Experiment of Operational Amplifier Signal Operation Circuit		
实验内容: Content	绘制反相比例运放放大器并进行数据分析 Draw up inverse proportional operational amplifier and analyze data		
	绘制电压跟随器并进行数据分析 Draw voltage follower and analyze data		
	绘制反相求和电路并进行数据分析 Draw the inverse phase circuit and analyze the data		
	绘制减法运算电路并进行数据分析 Draw the subtraction circuit and analyze the data		
学习目标: Learning Objectives	熟悉 multisim 软件的使用方法; 熟悉运算放大器工作于线性区的特点, 加深对运算放大器基本性质的理解; 熟悉由运算放大器组成的反相比例运算电路、电压跟随器、加法器、减法器电路的构成, 以及它们的运算关系。 Familiar with multisim software; Familiar with the characteristics of operational amplifier working in linear region, deepen the understanding of the basic properties of operational amplifier; Familiar with the inverse proportional operation circuit, voltage follower, adder, subtracter circuit, and their operation relations.		

教学要求: Requirements	每个学生独立完成实验, 撰写实验报告 Each student completes the experiment independently, and writes the experiment report
实验场地: Location	综合楼 1111 Z1111
实验软硬件设备: Software/Hardware	MULTISIM 仿真软件 MULTISIM simulation software

实验项目序号: Experiment No.	4	支撑教学目标: SLOs Supported	1-2,1-3,1-4
每组成员: Members per Group	1	指导教师: Tutor	李梅梅
实验名称: Experiment Title	功率放大器实验 Power amplifier experiment		
实验内容: Content	调节静态工作点 Adjust Q points		
	观察并记录输出的交越失真波形 Observe and record the output cross distortion waveform		
	测量功率放大器的上、下限截止频率 f_H 和 f_L Measurement of upper and lower cutoff frequency f_H and f_L of power amplifiers		
	测量并计算最大不失真输出功率 P_{om} , 功率放大器的效率 η Measure and calculate the efficiency η of maximum undistorted output power P_{om} , power amplifier		
学习目标: Learning Objectives	熟悉 OTL 互补对称功率放大器的工作原理; 学习功率放大器最大不失真功率和效率的测量方法; 掌握集成功率放大电路的性能指标和主要参数的测量方法。 Familiar with the working principle of OTL complementary symmetric power amplifier; learn the measurement method of maximum undistorted power and efficiency of power amplifier; Master the measurement method of performance index and main parameters of integrated power amplifier circuit.		
教学要求: Requirements	每个学生独立完成实验, 撰写实验报告 Each student completes the experiment independently, and writes the experiment report		
实验场地: Location	综合楼 1111 Z1111		
实验软硬件设备: Software/Hardware	MULTISIM 仿真软件 MULTISIM simulation software		

(3) 课外实践教学 PBL

PBL 项目序号: PBL No.	1	支撑教学目标: SLOs Supported	1-2,1-3,1-4,2-1
项目名称: PBL Title	函数信号发生器设计与实现 Design and Implementation of Function Signal Generator		
每组成员: Members per Group	6	指导教师: Tutor	李梅梅
学时 Hours	4	成果物 Achievements	PBL 实验报告
项目内容: Content	安装 Multisim14 仿真软件 Installation Multisim14 simulation software		
	选择电路方案, 完成对确定方案电路的设计与调试 Select circuit scheme, complete the design and debugging of the circuit		
	计算电路元件参数与元件选择并画出各部分原理图, 阐述基本原理 Calculate the circuit element parameters and component selection and draw the schematic diagram of each part, explain the basic principle.		
学习目标: Learning Objectives	<p>熟悉 Multisim14 仿真软件的使用; 研究正弦波等振荡电路的振荡条件; 学习波形产生、变换电路的应用及设计方法以及主要技术指标的测试方法; 掌握模拟电路的安装, 测试与调试的基本技能; 熟悉课程所学基本概念; 培养综合应用所学知识来指导实践的能力。</p> <p>Familiar with the use of Multisim14 simulation software; study the oscillation conditions of sinusoidal oscillation circuits; learn waveform generation, conversion circuit application and design methods and test methods of main technical indicators; master the basic skills of analog circuit installation, testing and debugging; familiar with the basic concepts of the course; develop the ability to apply the knowledge to guide practice.</p>		
教学要求: Requirements	<p>1、输出波形: 正弦波、方波、三角波、锯齿波; 2、频率范围: 在 10—10000Hz 范围内连续可调, 线性失真小; 3、输出信号峰峰值: 正弦波 3V, 矩形波 10V, 锯齿波 6V;</p> <p>1.Output waveform: sine wave, square wave, triangle wave, sawtooth wave; 2.Frequency range: continuously adjustable in the range of 10-10000 Hz, small linear distortion; 3.Peak output signal: sine wave 3 V, rectangular wave 10 V, sawtooth wave 6 V;</p>		
实践场地: Location	学生自主选择, 可在实验室、PBL Studio 或其他地点 Labs, PBL Studio or so based on the students		
实践软硬件设备: Software/Hardware	计算机, Multisim14 仿真软件 PC, Multisim14 simulation software		

四、教学安排 Teaching Schedule

注: 可根据实际情况增减行数

Note: Please add/reduce lines based on subject.

教学内容 Teaching Content	学时(周) Hour(Week)			
	理论 LECT.	实验 EXP.	课外实践 PBL	实践 PRAC.
电子系统概述、半导体二极管 Overview of electronic system, Semiconductor Diode	4			
双极型结型晶体管及其放大电路分析 Bipolar Junction Transistor and its Amplifier Circuit Analysis	6			
场效晶体管及其电路分析 Field Effect Transistor and Its Amplifier Circuit Analysis	4			
BJT 和 FET 频率响应 BJT and FET Frequency Response	2			
运算放大器(差分放大电路) Operational Amplifiers	2			
反馈电路 Feedback Circuits	2			
运算放大器应用—运算电路、有源滤波 比较器、施密特触发器 Op-Amp Applications- Operation circuit, active filter, comparator, Schmidt trigger	4			
振荡电路 Oscillating circuit	2			
功率放大器 Power Amplifiers	2			
单管共发射极放大电路 Single transistor common emitter amplifier		2		
单级放大器幅频特性测量 Measurement of amplitude frequency characteristics of single stage amplifier		2		
运算放大器信号运算电路 Operational amplifier signal operational circuit		2		
功率放大器 Power amplifier		2		
函数信号发生器设计与实现 Design and implementation of function signal generator			4	
总计 Total	28	8	4	

五、教学方法 Teaching Methodology

注：可根据实际情况增减行数或修改内容

Note: Please add/reduce lines or revise content based on subject.

勾选 Check	教学方法与特色 Teaching Methodology & Characters
<input checked="" type="checkbox"/>	多媒体教学：基于信息化设备的课堂教学 Multi-media-based lecturing
<input checked="" type="checkbox"/>	实践能力传授：理论与行业、实际案例相结合 Combining theory with industrial practical problems
<input checked="" type="checkbox"/>	课程思政建设：知识讲授与德育相结合 Knowledge delivery with ethic education
<input checked="" type="checkbox"/>	PBL 教学：问题驱动的分组学习与交流 Problem-based learning
<input type="checkbox"/>	其他:单击或点击此处输入文字。 Other:单击或点击此处输入文字。

六、成绩评定 Assessment

注：可根据实际情况增减行数或修改内容

Note: Please add/reduce lines or revise content based on subject.

考核环节: Assessment Content	平时 Behavior	环节负责人: Director	宋爱娟 黄彩梅
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	20
考核方式: Measures	满分 100 分，使用学习通记录学生平时的课堂表现，每次考勤计 10 分，缺勤不得分，缺勤五次及以上取消考试资格。每次作业计 10 分，抄袭、给他人抄袭或未交作业不得分。每次课堂正确回答问题计 5 分，每次课堂注意力不集中、影响课堂纪律等情况扣 5 分。最后总分不超过 100 分，不低于 0 分。		

考核环节: Assessment Content	实验 Experiment	环节负责人: Director	李梅梅
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	20
考核方式: Measures	满分 100 分，实验成绩不及格（低于 60 分）不得参加期末考试。通过课堂表现及实验报告记录学生成绩，实验报告 50 分，课堂操作 50 分。抄袭、给他人抄袭或未交实验报告不得分，缺席一次或多次实验无实验成绩。最后总分不超过 100 分，不低于 0 分。		

考核环节: Assessment Content	期中 Mid-term	环节负责人: Director	李梅梅
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给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	10
考核方式: Measures	满分 100 分, 通过 PBL 实验报告和每组的答辩情况, 以及每组组员在整个过程中发挥的作用评定学生成绩, 按照学生的报告完成情况和贡献程度酌情给分, 抄袭、给他人抄袭或未交实验报告不得分。		

考核环节: Assessment Content	期末 Final	环节负责人: Director	宋爱娟 黄彩梅
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	50
考核方式: Measures	试卷满分 100 分, 通过批阅期末考试试卷给出学生成绩。期末试卷成绩占最终考核成绩 50%		

七、改进机制 Improvement Mechanism

注: 未尽事宜以教学团队以及学院教学指导委员会商定为准。

Note: Matters not covered in this file shall be determined by AAB of SSTC, NEU.

教学大纲改进机制 Subject Syllabus Improvement Mechanism			
考核周期(年): Check Period (YR)	4	修订周期(年): Revise Period (YR)	4
改进措施: Measures	课程负责人根据课程教学内容与人才培养目标组织课程团队讨论并修改教学大纲, 报分管教学工作副院长审核后由执行院长批准。 The subject coordinator shall be responsible for the syllabus discussion and improvement, and the revised version shall be submitted to deputy dean (teaching affairs) for reviewing then to executive dean for approval.		
成绩评定改进机制 Assessment Improvement Mechanism			
考核周期(年): Check Period (YR)	1	修订周期(年): Revise Period (YR)	1
改进措施: Measures	课程负责人根据课程教学内容、课堂教学效果以及成绩分布, 对课程教学方法和成绩评定环节进行改进, 并同步优化评定办法。 The subject coordinator shall revise the syllabus based on the teaching content, effect and result distribution while optimize the assessment measures.		