

先进物联网技术 教学大纲

IoT Components and Fabrications

Subject Syllabus

一、课程信息 Subject Information

课程编号: Subject ID	3100112009	开课学期: Semester	4
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	3.5	总学时/周: Total Hours/Weeks	56
理论学时: LECT. Hours	28	实验学时: EXP. Hours	28
PBL 学时: PBL Hours	0	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	引进 UTS
中方课程协调人: NEU Coordinator	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao	成绩记载方式: Result Type	百分制 Marks
先修课程: Requisites	集成电路系统设计、数字电子技术基础 Integrated Circuit System Design, Fundamentals of Digital Electronic Technology		
英文参考教材: EN Textbooks	Fundamentals of Microfabrication: The Science of Miniaturization, Second Edition By Marc J Madou, Taylor and Francis, 2001.		
中文参考教材: CN Textbooks	无 None		
教学资源: Resources	https://lms.cloudcampus.com.cn/courses/24		
课程负责人(撰写人): Subject Director	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao	提交日期: Submitted Date	3/15/2023
任课教师(含负责人): Taught by	Dush Thalakotuna ,Lewis Millington, Yuchan Xie Zhiao cao, 谢好婵, 曹知奥		
审核人: Checked by	韩鹏	批准人: Approved by	史闻博
		批准日期: Approved Date	3/15/2023

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.

<p>整体目标: Overall Objective</p>	<p>本课程涵盖物联网(IoT)节点组件级的硬件技术，特别关注微型化和纳米技术提供的可能性。能够打开“组件箱”，熟悉当前的小型化技术及其功能和局限性，是有意义的物联网系统设计的关键要求，也是预测下一个技术进步以开启突破性创新的关键要求。</p> <p>学生学习微型化系统所需的各种电子和光子组件。他们能够基本掌握半导体物理和技术，小型化逻辑、通信和传感器件的工作原理，它们的性能窗口/规格，以及它们是如何制作和使用的打包。学生还能够辨别性能、质量和可靠性的概念，总的来说，他们能够选择一类组件和电子/光子方法来构建一个小型化系统，以解决给定的现实中的问题。</p> <p>This subject covers hardware technologies in Internet of Things (IoT) nodes at the component level, with particular focus on the possibilities offered by miniaturisation and nanotechnology. Being able to open the 'component boxes' and become familiar with current miniaturised technologies and their capabilities and limitations is a crucial requirement for meaningful design of an IoT system and for anticipating the next technological advances to unlock radical innovation.</p> <p>Students learn about the diverse electronic and photonic components required in a miniaturised system. They achieve a basic command of semiconductor physics and technologies, the working principles of miniaturised logic, communication and sensing devices, their performance windows/specifications and how they are fabricated and Packaged. Students are also able to discern the concepts of performance, quality and reliability, and overall, they are able to select a class of components and electronic/photonic approaches to build a miniaturised system for a solving a given real life problem.</p>	
<p>(1) 专业目标: Professional Ability</p>	<p>1-1</p>	<p>描述掺杂、结、二极管和晶体管，以及它们在半导体技术中的制造过程</p> <p>Describe doping, junctions, diodes and transistors, and their fabrication in semiconductor technologies</p>
	<p>1-2</p>	<p>研究传感、转导的广泛原理，以及传感器如何在电子学和光子学中实现和制造</p> <p>Investigate the broad principles of sensing, transduction, and how sensors are realised and are fabricated in electronics and photonics</p>
	<p>1-3</p>	<p>解构微结构:制造，包装和测试，对电子产品进行失效分析</p> <p>Deconstruct a microcomponent: fabrication, packaging and testing, to perform failure analysis in electronics products.</p>

	1-4	为一个组件和一个小系统建模,并确定电子性能上下文中的模型限制。 Model a component and a small system, and identify the model limitations in the context of electronics performance.
	1-5	确定所需组件的方法、类型和规格 Identify the approach, type and specifications of components needed
(2) 德育目标: Essential Quality	2-1	具有正确的价值观和社会责任感,培养优秀的职业道德和行为规范。获得良好的口头和书面沟通能力,团队协作意识和人际交往能力。 Have correct values and sense of social responsibility and cultivate excellent professional ethics and codes of conduct. Obtain good oral and written communication skills, teamwork awareness and interpersonal skills.
	2-2	提高学生的创新意识,不怕困难和有效解决实际问题的能力 Improving students' sense of innovation, not afraid of difficulties and the ability to effectively solve practical problems
	2-3	拥有良好的跨文化和领域的沟通能力,培养能对专业领域的任务进行合理的规划,分解任务并按时、高效率和高质量完成的能力。 Possessing good cross-cultural and field communication skills and cultivate the ability to reasonably plan tasks in the professional field, break down tasks and complete them on time, with high efficiency and high quality.
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、工程基础和专业知识用于解决复杂工程问题。	指标点 1-3:了解本专业及相关行业的发展趋势以及相关产业的运营模式,具备在本专业相关领域进行工程设计、技术创新的能力。	1-1, 1-2, 1-3, 1-4, 1-5
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, 1-4, 1-5
	指标点 3-3:能够在设计和开发的各个环节中综合考虑社会、健康、安全、法律、文化以及环境等因素。	
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、	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;	1-1, 1-2, 1-3, 1-4, 1-5

并通过信息综合得到合理有效的结论。		
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;	1-1, 1-2, 1-3, 1-4, 1-5
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 9-2:具有良好的跨文化、跨领域沟通交流能力,适应本专业相关行业的团队协作机制,积极主动的在团队中发挥作用。	2-1, 2-2, 2-3

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、2-1、2-2、2-3
知识单元名称 Unit Title	组件介绍 Introduction to Components		
知识点: Knowledge Delivery	纳米技术摩尔定律 Moore' s Law to Nanotechnology		
	CMOS 晶体管 CMOS transistor		
	小型化装置与系统 Miniaturized device and system		
学习目标: Learning Objectives	了解: Recognize	课程概况和要求 Subject overview and requirements	
	理解: Understand	纳米技术摩尔定律 Moore' s Law to Nanotechnology	
	掌握: Master	CMOS 晶体管 小型化装置与系统 CMOS transistor Miniaturized device and system	
德育目标 Moral Objectives	培养正确的价值观和社会责任感,培养优秀的职业道德和行为规范。培养具有不畏困难、不惧失败、敢于尝试、迎难而上的精神,并在学习过程中培养自己的细心和耐心的良好品质。 Cultivate correct values and social responsibility and cultivate excellent professional ethics and codes of conduct. Cultivate the spirit of not being afraid of difficulties, not afraid of failure, daring to try, and facing difficulties, and cultivate their own good qualities of care and		

	patience in the learning process.
重点: Key Points	CMOS 晶体管 小型化装置与系统 CMOS transistor Miniaturized device and system
难点: Focal Points	纳米技术摩尔定律 Moore' s Law to Nanotechnology

知识单元序号: Knowledge Unit No.	2	支撑教学目标: SLOs Supported	1-2、2-3
知识单元名称 Unit Title	半导体理论 Semiconductor Theory		
知识点: Knowledge Delivery	晶体管,半导体,本征半导体, 带隙和费米能级的基本概念和内涵 Concept and insight meaning of transistor, semiconductor, intrinsic semiconductors, band gap and Fermi level		
	—二极管的原理 Principle of a diode		
	整流 p-n 结的基本原理 Principle of a diode and the rectifying p-n junction		
学习目标: Learning Objectives	了解: Recognize	晶体管,半导体,本征半导体, Concept and insight meaning of transistor, semiconductor, intrinsic semiconductors,	
	理解: Understand	带隙和费米能级的基本概念和内涵 Band gap and Fermi level	
	掌握: Master	—二极管的原理, 整流 p-n 结的基本原理 Principle of a diode and the rectifying p-n junction	
德育目标 Moral Objectives	熟悉跨文化跨领域的有效沟通和交流的方法, 掌握获取知识的有效途径。 Familiar with cross-cultural and cross-domain effective communication and communication methods, and master effective ways to acquire knowledge.		
重点: Key Points	—二极管的原理, 整流 p-n 结的基本原理 Principle of a diode and the rectifying p-n junction		
难点: Focal Points	带隙和费米能级的基本概念和内涵 Band gap and Fermi level		

知识单元序号: Knowledge Unit No.	3	支撑教学目标: SLOs Supported	1-1、1-3、1-4、1-5、 2-3
知识单元名称 Unit Title	MOS 器件及制造 CMOS Devices and Fabrication		
知识点: Knowledge Delivery	中间能带,半导体 p-n 结, intermediate bandgap, Semiconductor p-n junction		
	mos 场效应晶体管 CMOS 技术 MOS FET, CMOS technology		

	MOSFETs 在 NAND 门硅逻辑中的应用 Application of MOSFETs in a NAND gate silicon logic technologies	
学习目标: Learning Objectives	了解: Recognize	中间能带,半导体 p-n 结, intermediate bandgap, Semiconductor p-n junction
	理解: Understand	mos 场效应晶体管 CMOS 技术 MOS FET, CMOS technology
	掌握: Master	MOSFETs 在 NAND 门硅逻辑中的应用 Application of MOSFETs in a NAND gate silicon logic technologies
德育目标 Moral Objectives	培养的学科应用的整体观, 鼓励学生创新和解决问题的能力 Cultivate a holistic view of subject application, encourage students to innovate and solve problems	
重点: Key Points	mos 场效应晶体管 CMOS 技术 MOS FET, CMOS technology	
难点: Focal Points	MOSFETs 在 NAND 门硅逻辑中的应用 Application of MOSFETs in a NAND gate silicon logic technologies	

知识单元序号: Knowledge Unit No.	4	支撑教学目标: SLOs Supported	1-2、1-3、1-5、2-3
知识单元名称 Unit Title	光电子学和发光二极管 Optoelectronics and LEDs		
知识点: Knowledge Delivery	LED (Light emitting diode)的发射光谱 Emission spectrum of an LED (Light emitting diodes)		
	半导体激光器对 GaAsP 发光二极管的注射制作工艺 Methods of injection Semiconductor lasers GaAsP LEDs		
	对评估有关的第一部分基本内容的反馈 Feedback on the basics of the first part of the assessment		
学习目标: Learning Objectives	了解: Recognize	LED (Light emitting diode)的发射光谱 Emission spectrum of an LED (Light emitting diodes)	
	理解: Understand	半导体激光器对 GaAsP 发光二极管的注射制作工艺 Methods of injection Semiconductor lasers GaAsP LEDs	
	掌握: Master	对评估有关的第一部分基本内容的反馈 Feedback on the basics of the first part of the assessment	
重点: Key Points	半导体激光器对 GaAsP 发光二极管的注射制作工艺 Methods of injection Semiconductor lasers GaAsP LEDs		
难点: Focal Points	对评估有关的第一部分基本内容的反馈 Feedback on the basics of the first part of the assessment		

知识单元序号: Knowledge Unit No.	5	支撑教学目标: SLOs Supported	1-4、1-5、2-3、2-4
知识单元名称 Unit Title	微机电系统介绍 Introduction to MEMS		
知识点:	MEMS 的类型传感器		

Knowledge Delivery	MEMS type transducers	
	传感器性能指标 Main parameters of sensor	
	MEMS 传感器系统的简单实例 Examples of MEMS sensor system.	
学习目标: Learning Objectives	了解: Recognize	MEMS 的类型传感器 MEMS type transducers
	理解: Understand	MEMS 传感器系统的简单实例 Examples of MEMS sensor system.
	掌握: Master	传感器性能指标 Main parameters of sensor
德育目标 Moral Objectives	培养工程思维, 基于任务需求选择最适合的技术方法 Developing engineering mind, and matching the most appropriate technical approach with task requirements	
重点: Key Points	MEMS 传感器系统的简单实例 Examples of MEMS sensor system.	
难点: Focal Points	传感器性能指标 Main parameters of sensor	

知识单元序号: Knowledge Unit No.	6	支撑教学目标: SLOs Supported	1-2、1-4、1-5、2-1、 2-2、2-3
知识单元名称 Unit Title	先进电子设备 Advanced electronic devices		
知识点: Knowledge Delivery	先进电子设备 Advanced electronic devices		
	先进电子设备 Advanced electronic devices		
学习目标: Learning Objectives	了解: Recognize	先进电子设备 Advanced electronic devices	
	理解: Understand	先进电子设备 Advanced electronic devices	
	掌握: Master	先进电子设备 Advanced electronic devices	
德育目标 Moral Objectives	熟悉跨文化跨领域的有效沟通和交流的方法, 掌握获取知识的有效途径。 Familiar with cross-cultural and cross-domain effective communication and communication methods, and master effective ways to acquire knowledge.		
重点: Key Points	先进电子设备 Advanced electronic devices		
难点: Focal Points	先进电子设备 Advanced electronic devices		

知识单元序号: Knowledge Unit No.	7	支撑教学目标: SLOs Supported	1-4、1-5、2-1、2-3
知识单元名称 Unit Title	微电系统与电子系统 MEMS and Electronic Systems		
知识点: Knowledge Delivery	MEMS 运行原理 MEMS actuation mechanisms		
	数字微镜器件, MEMS 例子 The digital micro-mirror device MEMS examples		
学习目标: Learning Objectives	了解: Recognize	MEMS 例子 MEMS examples	
	理解: Understand	数字微镜器件, MEMS 例子 The digital micro-mirror device MEMS examples	
	掌握: Master	MEMS 运行原理 MEMS actuation mechanisms	
德育目标 Moral Objectives	熟悉跨文化跨领域的有效沟通和交流的方法, 团队分工与合作的实践 Familiar with cross-cultural and cross-field effective communication and communication methods, team division of labor and the practice of cooperation.		
重点: Key Points	MEMS 运行原理 MEMS actuation mechanisms		
难点: Focal Points	数字微镜器件, MEMS 例子 The digital micro-mirror device MEMS examples		

知识单元序号: Knowledge Unit No.	8	支撑教学目标: SLOs Supported	1-3、1-5、2-1、2-2、 2-3
知识单元名称 Unit Title	包装和可靠性 Packaging and Reliability		
知识点: Knowledge Delivery	电子包装, 包装步骤, 芯片封盖粘接方法 Electronic packaging, packaging steps, Chip Capping & Bonding methods		
	可靠性, 加速可靠性测试全球标准测试 Reliability concepts, accelerated Reliability test standards, agreed worldwide		
学习目标: Learning Objectives	了解: Recognize	可靠性, 加速可靠性测试全球标准测试 Reliability concepts, accelerated Reliability test standards, agreed worldwide	
	理解: Understand	芯片封盖粘接方法 Chip Capping & Bonding methods	
	掌握: Master	电子包装, 包装步骤, 芯片封盖粘接方法 Electronic packaging, packaging steps, Chip Capping & Bonding methods	
德育目标 Moral Objectives	了解包装和可靠性对于社会经济发展的重要意义 Be aware of the significant meanings of Packaging and Reliability in society economic development.		

重点: Key Points	电子包装, 包装步骤, 芯片封盖粘接方法, Electronic packaging, packaging steps, Chip Capping & Bonding methods.
难点: Focal Points	芯片封盖粘接方法 Chip Capping & Bonding methods

知识单元序号: Knowledge Unit No.	9	支撑教学目标: SLOs Supported	1-2、2-1、2-2、2-3
知识单元名称 Unit Title	软件定义微波 Software Defined Radios		
知识点: Knowledge Delivery	软件定义微波 Software Defined Radios		
	软件定义微波 Software Defined Radios		
学习目标: Learning Objectives	了解: Recognize	软件定义微波 Software Defined Radios	
	理解: Understand	软件定义微波 Software Defined Radios	
	掌握: Master	软件定义微波 Software Defined Radios	
重点: Key Points	软件定义微波 Software Defined Radios		
难点: Focal Points	软件定义微波 Software Defined Radios		

知识单元序号: Knowledge Unit No.	10	支撑教学目标: SLOs Supported	1-1、1-2、1-4、2-1、 2-2、2-3
知识单元名称 Unit Title	计算引论 Introduction to Lasers		
知识点: Knowledge Delivery	计算引论 Introduction to Lasers		
	计算引论 Introduction to Lasers		
学习目标: Learning Objectives	了解: Recognize	计算引论 Introduction to Lasers	
	理解: Understand	计算引论 Introduction to Lasers	
	掌握: Master	计算引论 Introduction to Lasers	
重点: Key Points	计算引论 Introduction to Lasers		
难点: Focal Points	计算引论 Introduction to Lasers		

知识单元序号: Knowledge Unit No.	11	支撑教学目标: SLOs Supported	1-4、2-1、2-2、2-3
知识单元名称 Unit Title	关于 5G 空间应用的 3D 打印电子设备 3D Printed Electronic Devices for 5G and Space Applications		
知识点: Knowledge Delivery	关于 5G 空间应用的 3D 打印电子设备 3D Printed Electronic Devices for 5G and Space Applications		
	关于 5G 空间应用的 3D 打印电子设备 3D Printed Electronic Devices for 5G and Space Applications		
学习目标: Learning Objectives	了解: Recognize	关于 5G 空间应用的 3D 打印电子设备 3D Printed Electronic Devices for 5G and Space Applications	
	理解: Understand	关于 5G 空间应用的 3D 打印电子设备 3D Printed Electronic Devices for 5G and Space Applications	
	掌握: Master	关于 5G 空间应用的 3D 打印电子设备 3D Printed Electronic Devices for 5G and Space Applications	
重点: Key Points	关于 5G 空间应用的 3D 打印电子设备 3D Printed Electronic Devices for 5G and Space Applications		
难点: Focal Points	关于 5G 空间应用的 3D 打印电子设备 3D Printed Electronic Devices for 5G and Space Applications		

(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	二极管电流-电压特性;NMOS 和 PMOS 晶体管的转移特性和漏极特性 Diode I-V characteristics; Transfer characteristics and Drain characteristics for NMOS and PMOS transistors	2	1	设计性 Design	必做 Elec
2	CMOS 逆变器的瞬态分析 Transient analysis of a CMOS inverter	2	1	设计性 Design	必做 Elec
3	逻辑门:NAND/AND, NOR/OR, XOR / XNOR Logic gates: NAND/AND, NOR/OR, XOR/XNOR	2	1	验证性 Verify	必做 Elec
4	对第一部分评估知识进行反馈 Feedback on Assessment Part 1	2	1	综合性 Comp	必做 Elec

5	用门设计一个组合电路 Design a combinational circuit using the gates	2	1	设计性 Design	必做 Elec
6	使用门电路的自动化系统 An automated system using the gates	2	1	设计性 Design	必做 Elec
7	CMOS 运算放大器的频率响应 Frequency Response of CMOS Operational amplifier	2	1	设计性 Design	必做 Elec
8	每个学生评估 5 分钟演示 Assessment 5min presentations for every students	2	1	综合性 Comp	必做 Elec
9	MEMS 1-横向谐振器 MEMS 1-Lateral resonator	2	1	设计性 Design	必做 Elec
10	MEMS 2-旋转侧驱动静电电机 MEMS 2-Rotary side drive electrostatic motor	2	1	设计性 Design	必做 Elec
11	光子学/光学干涉仪的交流小信号分析 Photonics/Optics AC small signal analysis of Interferometer	2	1	设计性 Design	必做 Elec
12	点评:最终报告(全部) Assessment: Final Report (all)	2	1	综合性 Comp	必做 Elec
13	讨论最终报告存在的问题, 得出完善意见 Discuss the problems existing in the final report and give suggestions for improvement	2	1	综合性 Comp	必做 Elec
14	完善修改最终报告 Improvement and modification Final report	2	1	综合性 Comp	必做 Elec
	总计 Total	28			

*MPG: Members per group

实验项目序号: Experiment No.	1	支撑教学目标: SLOs Supported	1-1、1-2、1-5、2-1、 2-2、2-3
每组成员: Members per Group	3	指导教师: Tutor	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao
实验名称: Experiment Title	1、二极管电流-电压特性; 2、NMOS 和 PMOS 晶体管的转移特性和漏极特性 Diode I-V characteristics; Transfer characteristics and Drain characteristics for NMOS and PMOS transistors		
实验内容:	课程设计任务介绍和示例, 分组, 软件安装		

Content	Design Tools for designing, simulating, and laying out ICs. Tanner EDA is a suite of tools for the design of integrated circuits. T
	实验设计目的和要求, 学习可能用到的软硬件知识 The assignment goal and requirements of experimental design, and learn the software and hardware knowledge that may be used
学习目标: Learning Objectives	实验项目分组, 了解实验设计目的和要求, 学习可能用到的软硬件知识 Group the experimental projects, understand the purpose and requirements of experimental design, and learn the knowledge of software and hardware that may be used
教学要求: Requirements	完成分组, 充分理解实验设计的要求 Complete grouping and fully understand the requirements of experimental design
实验场地: Location	科技楼 6058 Science Building 6058
实验软硬件设备: Software/Hardware	Computer, soft Tanner

实验项目序号: Experiment No.	2	支撑教学目标: SLOs Supported	1-2、2-1、2-2、2-3
每组成员: Members per Group	4	指导教师: Tutor	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao
实验名称: Experiment Title	CMOS 逆变器的瞬态分析 Tutorial 2: Transient analysis of a CMOS inverter		
实验内容: Content	逆变器的暂态分析 Transient Analysis of an inverter, 用 L-Edit 逆变器布局逆变器 Inverter layout by L-Edit		
学习目标: Learning Objectives	掌握用 L-Edit 逆变器布局逆变器 Inverter layout by L-Edit		
教学要求: Requirements	个人独立完成 Work independently		
实验场地: Location	科技楼 6058 Science Building 6058		
实验软硬件设备: Software/Hardware	Computer, soft Tanner		

实验项目序号: Experiment No.	3	支撑教学目标: SLOs Supported	1-1、1-5、2-1、2-2、2-3
每组成员:	4	指导教师:	谢好婵、曹知奥

Members per Group		Tutor	Yuchan Xie,Zhiao Cao
实验名称: Experiment Title	逻辑门:NAND/AND, NOR/OR, XOR / XNOR Logic gates: NAND/AND, NOR/OR, XOR/XNOR		
实验内容: Content	熟悉逻辑门 Familiarization of logic gates		
学习目标: Learning Objectives	熟悉逻辑门 Familiarization of logic gates		
教学要求: Requirements	个人独立完成 Work independently		
实验场地: Location	科技楼 6058 Science Building 6058		
实验软硬件设备: Software/Hardware	Computer, soft Tanner		

实验项目序号: Experiment No.	4	支撑教学目标: SLOs Supported	1-2、1-4、1-5、2-1、 2-2、2-3
每组成员: Members per Group	4	指导教师: Tutor	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao
实验名称: Experiment Title	用门设计组合电路 Design a combinational circuit using the gates		
实验内容: Content	用逻辑门设计一个组合电路 Design a combinational circuit using the logic gates 使用 L-Edit 设计和门的布局 Design the layout of AND gate using L-Edit		
学习目标: Learning Objectives	用逻辑门设计一个组合电路 Design a combinational circuit using the logic gates		
教学要求: Requirements	个人独立完成 Work independently		
实验场地: Location	科技楼 6058 Science Building 6058		
实验软硬件设备: Software/Hardware	Computer, soft Tanner		

实验项目序号: Experiment No.	5	支撑教学目标: SLOs Supported	1-4、1-5、2-1、2-2、 2-3
每组成员: Members per Group	4	指导教师: Tutor	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao
实验名称:	使用门电路的自动化系统		

Experiment Title	An automated system using the gates
实验内容: Content	利用比较器设计一个 4 位密码检测系统 Design a 4-bit password detection system using a comparator.
学习目标: Learning Objectives	利用比较器设计一个 4 位密码检测系统 Design a 4-bit password detection system using a comparator.
教学要求: Requirements	个人独立完成 Work independently
实验场地: Location	科技楼 6058 Science Building 6058
实验软硬件设备: Software/Hardware	Computer, soft Tanner

实验项目序号: Experiment No.	6	支撑教学目标: SLOs Supported	1-1、1-2、1-3、2-1、 2-2、2-3
每组成员: Members per Group	4	指导教师: Tutor	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao
实验名称: Experiment Title	CMOS 运算放大器的频率响应 Frequency response of CMOS operational amplifier (op amp)		
实验内容: Content	CMOS 操作放大器的频率响应 Frequency response of CMOS operational Amplifier		
学习目标: Learning Objectives	仿真 CMOS 操作放大器的频率响应 Simulate the frequency response of CMOS operational Amplifier		
教学要求: Requirements	个人独立完成 Work independently		
实验场地: Location	科技楼 6058 Science Building 6058		
实验软硬件设备: Software/Hardware	Computer, soft Tanner		

实验项目序号: Experiment No.	7	支撑教学目标: SLOs Supported	1-2、2-1、2-2、2-3
每组成员: Members per Group	4	指导教师: Tutor	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao
实验名称: Experiment Title	MEMS 1-横向谐振器 MEMS 1-Lateral resonator		
实验内容: Content	熟悉使用 S-Edit 构造 MEMS 系统 Familiarization of MEMS system using S-Edit		
学习目标: Learning Objectives	MEMS 1-横向谐振器设计 Design MEMS 1-Lateral resonator		

教学要求: Requirements	个人独立完成 Work independently
实验场地: Location	科技楼 6058 Science Building 6058
实验软硬件设备: Software/Hardware	Computer, soft Tanner

实验项目序号: Experiment No.	8	支撑教学目标: SLOs Supported	1-2、2-1、2-2、2-3
每组成员: Members per Group	4	指导教师: Tutor	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao
实验名称: Experiment Title	MEMS 2-旋转侧驱动静电电机 MEMS 2-Rotary side drive electrostatic motor		
实验内容: Content	熟悉使用谐振器 L-Edit 构造 MEMS 系统 Familiarization of a Resonator (MEMS) system using L-Edit MEMS		
学习目标: Learning Objectives	熟悉使用谐振器 L-Edit 构造 MEMS 系统 Familiarization of a Resonator (MEMS) system using L-Edit MEMS		
教学要求: Requirements	个人独立完成 Work independently		
实验场地: Location	科技楼 6058 Science Building 6058		
实验软硬件设备: Software/Hardware	Computer, soft Tanner		

实验项目序号: Experiment No.	9	支撑教学目标: SLOs Supported	1-2、1-4、1-5、2-1、 2-2、2-3
每组成员: Members per Group	4	指导教师: Tutor	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao
实验名称: Experiment Title	光子学/光学干涉仪的交流小信号分析 Photonics/Optics AC small signal analysis of Interferometer		
实验内容: Content	采用 Tannery 波形查看器进行光信号可视化 Optical signal visualization with Tanner Waveform Viewer		
学习目标: Learning Objectives	采用 Tannery 波形查看器进行光信号可视化 Optical signal visualization with Tanner Waveform Viewer		
教学要求: Requirements	个人独立完成 Work independently		
实验场地: Location	科技楼 6058 Science Building 6058		

实验软硬件设备: Software/Hardware	Computer, soft Tanner
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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	集中实践 PRAC.
组件介绍 Introduction to Components 课程设计任务介绍和示例, 分组, 软件安装 学习可能用到的软硬件知识 Introduction and examples of course design tasks, grouping, software installation Learn the software and hardware knowledge that may be used	2	2		
半导体理论 Semiconductor Theory 逆变器的暂态分析 Transient Analysis of an inverter	2	2		
MOS 器件及制造 CMOS Devices and Fabrication 熟悉逻辑门 Familiarization of logic gates	2	2		
光电子学和发光二极管 Optoelectronics and LEDs 对第一部分评估知识进行反馈 Feedback on Assessment Part 1	2	2		
微机电系统介绍 Introduction to MEMS 用逻辑门设计一个组合电路 Design a combinational circuit using the logic gates	2	2		
先进电子设备 Advanced electronic devices 利用比较器设计一个 4 位密码检测系统 Design a 4-bit password detection system using a comparator	2	2		
微电系统与电子系统 CMOS 操作放大器的频率响应 Frequency Response of CMOS Operational Amplifier	2	2		

每个学生评估 5 分钟演示 Assessment 5min presentations for every students				
包装和可靠性 Packaging and Reliability MEMS and Electronic Systems 熟悉使用 S-Edit 构造 MEMS 系统 Familiarization of MEMS system using S-Edit	2	2		
软件定义的微波 Software Defined Radios 熟悉使用谐振器 L-Edit 构造 MEMS 系统 Familiarization of a Resonator (MEMS) system using L-Edit MEMS	2	2		
计算引论 Introduction to Lasers 采用 Tannery 波形查看器进行光信号可视化 Optical signal visualization with Tanner Waveform Viewer	2	2		
关于 5G 空间应用的 3D 打印电子设备 3D Printed Electronic Devices for 5G and Space Applications	2	2		
点评:最终报告(全部) Assessment: Final Report (all)	2	2		
讨论最终报告存在的问题, 得出完善意见 Discuss the problems existing in the final report and give suggestions for improvement	2	2		
完善修改最终报告 Improvement and modification Final report	2	2		
总计 Total	28	28		

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	实验 Experiment	环节负责人: Director	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	30
考核方式: Measures	该部分成绩由实验报告结果获得。		

考核环节: Assessment Content	平时 Behavior	环节负责人: Director	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	30
考核方式: Measures	演示最终报告主题，描述当前的技术水平，以及指定技术的优势和瓶颈 The presentation should introduce the topic,describe the current state-of-the-art,and the advantages and bottlenecks of the assigned technology		

考核环节: Assessment Content	期末 Final	环节负责人: Director	谢好婵、曹知奥 Yuchan Xie,Zhiao Cao
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	40
考核方式: Measures	期末报告成绩根据报告完成质量给以成绩，占总成绩的 40%。提交方式为在有效期内学生自行上传至云校园相关链接，晚交作业按照晚一天扣 10%成绩计算，晚于规定时间 7 天，本作业无成绩。 The final report grade will be based on the quality of the report, accounting for 40% of the total grade. Students can upload the relevant links to the cloud campus by themselves within the validity period. If the homework is submitted late, 10% of the grade will be deducted for one day, 7 days later than the specified time, and there will be no grade for the homework.		

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 TAB 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.		