信号与系统分析 教学大纲

Signal and System Analysis Subject Syllabus

一、课程信息 Subject Information

课程编号: Subject ID	3100112008.01	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	56	实验学时: EXP. Hours	0
PBL 学时: PBL Hours	0	实践学时/周: PRAC. Hours/Weeks	0
开课学院: College	计算机与通信工程学院	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
中方课程协调人: NEU Coordinator	李志华、徐思洋 LI Zhihua/XU Siyang	成绩记载方式: Result Type	百分制 Marks
先修课程: Requisites	高等数学、线性代数、复变函数与积分变换 advanced mathematics、linear algebra、Complex Variable and integral transforms		
英文参考教材: EN Textbooks	.Alan V. Oppenheim. Signals and Systems, Second Edition, 电子工业出版社, 2015.		
中文参考教材: CN Textbooks	郑君里，应启珩，杨为理:《信号与系统（第三版）》，高等教育出版社，2011； 吴大正主编，《信号与线性系统分析》，高等教育出版社，1986 年 管致中等著，《信号与线性系统》，高等教育出版社，2011 年		
教学资源: Resources	https://www.icourse163.org/course/xidian-483006		
课程负责人(撰写人): Subject Director	李志华、徐思洋 LI Zhihua/XU siyang	提交日期: Submitted Date	3/30/2023
任课教师(含负责人): Taught by	李志华、徐思洋 LI Zhihua/XU Siyang		
审核人: Checked by	韩鹏	批准人: Approved by	史闻博
		批准日期: Approved Date	4/21/2023

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.

整体目标: Overall Objective	通过本课程的学习，使学生掌握信号与系统理论的基本概念、基本原理和基本分析方法，包括：信号与系统的数学模型的建立、时域和频域的分析方法以及对结果的物理解释、物理意义等；理解各种变换（傅里叶变换、拉普拉斯变换等）的基本内容、性质和应用。特别要建立信号与系统的频域分析的概念以及系统函数的概念，为学生进一步学习后续课程（通信原理、数字信号处理等）打下坚实的基础。激发学生对本专业信号与系统学科方面的兴趣与学习热情，使学生分析问题和解决问题的能力有所提高。 Through the study of this course, students will master the basic concepts, basic principles and basic analysis methods of signal and system theory, including: the establishment of mathematical models of signals and systems, time-domain and frequency-domain analysis methods, and the physical interpretation of the results, Physical meaning, etc.; understand the basic content, properties and applications of various transforms (Fourier transform, Laplace transform, etc.). In particular, the concept of frequency domain analysis of signals and systems and the concept of system functions should be established to lay a solid foundation for students to further study subsequent courses (communication principles, digital signal processing, etc.). Stimulate students' interest and learning enthusiasm in the signal and system disciplines of this major, and improve their ability to analyze and solve problems	
（1）专业目标: Professional Ability	1-1	理解信号的概念和分类，熟练掌握信号的时域、频域以及变换域分析方法。 Understand the concept and classification of signals, and be proficient in signal analysis methods in the time domain, frequency domain, and transform domain.
	1-2	理解系统的概念和分类，掌握系统数学模型的建立方法，熟练掌握系统的时域、频域以及变换域分析方法。 Understand the concept and classification of the system, master the method of establishing the mathematical model of the system, and be proficient in the time domain, frequency domain and transform domain analysis methods of the system.
	1-3	熟练掌握系统分析方法在通信、控制等领域的工程应用。 Familiar with the engineering application of system analysis methods in the fields of communication and control.
	1-4	培养科学与工程应用的意识和素质，逐步培养学生的探索精神和创新能力。 Cultivate the consciousness and quality of science and engineering application, and gradually cultivate students' exploration spirit and innovation ability.

（2）德育目标: Essential Quality	2-1	激发学生对信号与信息处理方向的兴趣与学习热情，提高学生分析和解决实际工程问题的能力，为将来从事电子设备设计与研发奠定必要的基础。 Stimulate students' interest and learning enthusiasm in the direction of signal and information processing, improve students' ability to analyze and solve practical engineering problems, and lay the necessary foundation for future electronic device design and research and development.
	2-2	提高学生思维、判断、分析与解决问题能力，形成敬业、守信、高校、精益求精的职业素养。 Improve students' thinking, judgment, analysis and problem-solving abilities, and form professionalism of dedication, trustworthiness, colleges, and excellence.

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电子信息工程相关问题。	指标点 1-1：掌握数学、自然科学、工程基础和专业知识，并能够将其运用到复杂电子信息工程问题的恰当表述中。	1-1、1-8、2-1、2-4、3-1、3-4、3-5。
	指标点 1-2：掌握信号与系统分析、数字信号处理、数字图像处理等专业知识，具备信号检测与处理的能力。	
	指标点 1-5：掌握在电子信息工程专业的相关领域进行工程设计、技术创新的能力。	1-3，1-4
2、问题分析：能够应用数学、自然科学和工程科学的基本原理，识别、表达、并通过文献研究分析复杂工程问题，以获得有效结论。	指标点 2-1：能够针对实际问题设计针对性的技术方案，并综合运用所学科学理论和技术手段分析解决。	1-2、1-3、1-4、1-6、1-7、2-2、2-3、3-2、3-3、3-5。
	指标点 2-2：能够有效分析和处理信号与通信系统、计算机网络、模拟及数字电路、微波及电磁技术等方面的技术与管理问题。	
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（部件）或工艺流程，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：具备本专业所需的设计/开发技能，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或工艺流程。	1-5、2-1、2-2、2-3、2-4、3-3、3-4、3-5。
	指标点 3-2：能够在工作中表现出创新意识，创新的解决复杂问题；	
	指标点 3-3：能够在工程设计中综合考虑社会、健康、安全、法律、文化等因素。	

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

理论教学 Lecture

<table>
<tr><td>知识单元序号:
Knowledge Unit No.</td><td colspan="2">1</td><td>支撑教学目标:
SLOs Supported</td><td>1-1、2-1、3-1、3-3</td></tr>
<tr><td>知识单元名称
Unit Title</td><td colspan="4">绪论 Introduction</td></tr>
<tr><td rowspan="8">知识点:
Knowledge Delivery</td><td colspan="4">信号与系统的定义 Definition of signal and system</td></tr>
<tr><td colspan="4">信号的描述、分类和典型示例 Signal description, classification and typical examples</td></tr>
<tr><td colspan="4">信号的运算 Calculation of signal</td></tr>
<tr><td colspan="4">阶跃信号与冲激信号 Step signal and impulse signal</td></tr>
<tr><td colspan="4">信号的分解 Decomposition of signals</td></tr>
<tr><td colspan="4">系统模型及其分类 System model and its classification</td></tr>
<tr><td colspan="4">线性时不变系统 Linear time invariant system</td></tr>
<tr><td colspan="4">LTI 系统分析方法 LTI system analysis method</td></tr>
<tr><td rowspan="3">学习目标:
Learning Objectives</td><td>了解:
Recognize</td><td colspan="3">信号与系统的基本概念，能画函数波形
Basic concepts of signals and systems, able to draw function waveforms</td></tr>
<tr><td>理解:
Understand</td><td colspan="3">线性时不变系统的定义和性质，并会应用这些性质
The definition and properties of linear time invariant systems, and will apply these properties</td></tr>
<tr><td>掌握:
Master</td><td colspan="3">常用基本信号（包括普通信号和奇异信号）的时域描述方法、特点与性质，并会应用这些性质；信号的时域分解、变换和运算的方法，并会求解
Common basic signal (including ordinary signal and singular signal) time domain description method, characteristics and properties, and will apply these properties. The time domain decomposition, transformation and operation of the signal are solved</td></tr>
<tr><td>德育目标:
Moral Objectives</td><td colspan="4">激发学生对信号与信息处理方向的兴趣与学习热情，提高学生分析和解决实际工程问题的能力，为将来从事电子设备设计与研发奠定必要的基础
Stimulate students' interest and learning enthusiasm in the direction of signal and information processing, improve students' ability to analyze and solve practical engineering problems, and lay the necessary foundation for future electronic device design and research and development.
提高学生思维、判断、分析与解决问题能力，形成敬业、守信、高校、精益求精的职业素养</td></tr>
</table>

	Improve students' thinking, judgment, analysis and problem-solving abilities, and form professionalism of dedication, trustworthiness, colleges, and excellence.
重点: Key Points	信号和系统的定义和分类 Definition and classification of signals and systems
	连续时间信号的时域描述、波形变换和运算规则 Time domain description, waveform transformation and operation rules of continuous-time signals
	典型信号的定义、特性及应用 Definition, characteristics and applications of typical signals
	信号的奇、偶分量 The odd and even components of the signal
	线性时不变系统的基本性质和时域描述 Basic properties and time domain description of linear time invariant systems
难点: Focal points	时域运算中的自变量变化和函数值变化的区分和理解 Distinguishing and understanding the change of the independent variable and the change of the function value in the time domain operation.
	冲激信号和阶跃信号的极限模型和特性的理解及运用 Understanding and application of limit models and characteristics of impulse signals and step signals
	系统的线性、时不变性、因果性和稳定性等基本特性的理解、判断和运用 The understanding, judgment and application of the basic characteristics of the system such as linearity, time invariance, causality and stability.

知识单元序号: Knowledge Unit No.	2	支撑教学目标: SLOs Supported	1-2、2-1、3-1、3-3
知识单元名称 Unit Title	连续时间系统的时域分析 Time domain analysis of continuous time system		
知识点: Knowledge Delivery	系统数学模型（微分方程）的建立 The establishment of system mathematical model(differential equation)		
	用时域经典法求解微分方程 Solve differential equations with time-domain classical methods		
	起始点的跳变——从 0-到 0+状态的转换 Jumping of the starting point-the transition from 0- to 0+ state		
	零输入响应和零状态响应 Zero input response and zero state response		
	冲激响应与阶跃响应 Impulse response and step response		
	卷积及卷积的性质 The nature of convolution and convolution		
	用算子符号表示微分方程		

	Use operator symbols to express differential equations	
学习目标: Learning Objectives	了解: Recognize	算子方程及其求解方法 Operator equation and its solving method
	理解: Understand	系统的特征方程、特征根的意义，并会求解；系统的完全响应及其分解，即零状态响应与零输入响应之和、自由响应与强迫响应之和、瞬态响应与稳态响应之和，并会求解；单位冲激响应的定义及其对系统的描述作用，并会求解和运用；理解线性卷积的定义、性质和意义 The characteristic equation of the system, the meaning of the characteristic root, and will be solved. The complete response of the system and its decomposition, namely the sum of zero-state response and zero-input response, the sum of free response and forced response, and the sum of transient response and steady-state response, will be solved. The definition of unit impulse response and its description of the system will be solved and applied. Understanding the definition, properties and significance of linear convolution.
	掌握: Master	连续时间 LTI 系统微分方程的建立方法；系统的 0-状态和 0+状态，跳变条件，并会求解；卷积的求解方法 The establishment method of differential equation for continuous-time LTI system. The 0-state and 0 + state of the system, jump conditions, and will be solved. The solution method of convolution.
德育目标: Moral Objectives	激发学生对信号与信息处理方向的兴趣与学习热情，提高学生分析和解决实际工程问题的能力，为将来从事电子设备设计与研发奠定必要的基础 Stimulate students' interest and learning enthusiasm in the direction of signal and information processing, improve students' ability to analyze and solve practical engineering problems, and lay the necessary foundation for future electronic device design and research and development. 提高学生思维、判断、分析与解决问题能力，形成敬业、守信、高校、精益求精的职业素养 Improve students' thinking, judgment, analysis and problem-solving abilities, and form professionalism of dedication, trustworthiness, colleges, and excellence.	
重点: Key Points	常系数线性微分方程 Linear differential equations with constant coefficients	
	系统从 0-到 0+状态发生跳变的条件和跳变量的求解 The conditions for the system to jump from 0 − to 0 + and the solution of jump variables.	

	完全响应、自由响应、强迫响应、零状态响应、零输入响应、瞬态响应、稳态响应、单位冲激响应和单位阶跃响应的定义、特点和求解方法的异同点 Definitions, characteristics and solutions of complete response, free response, forced response, zero-state response, zero-input response, transient response, steady-state response, unit impulse response and unit step response.
	系统因果性、稳定性的时域判断 Time-domain judgment of system causality and stability.
	卷积运算的定义、运算规则、性质及其应用 Definition, operation rules, properties and applications of convolution operation.
	0-和+状态的描述和计算 Description and calculation of 0− and 0+ states.
难点: Focal points	各种响应类型及其求解方法的不同之处 Differences between various response types and their solving methods
	卷积运算 Convolution operation.

知识单元序号: Knowledge Unit No.	3	支撑教学目标: SLOs Supported	1-3、2-1、2-2、3-1、3-3、3-5
知识单元名称 Unit Title	傅里叶变换 Fourier transform		
知识点: Knowledge Delivery	周期信号的傅里叶级数分析 Fourier series analysis of periodic signals		
	典型周期信号的傅里叶级数 Fourier Series of Typical Periodic Signals		
	傅里叶变换 Fourier transform		
	典型非周期信号的傅里叶变换 Fourier transform of typical aperiodic signals		
	冲激函数和阶跃函数的傅里叶变换 Fourier transform of impulse function and step function		
	傅里叶变换的基本性质 Basic properties of Fourier transform		
	卷积特性 Convolution characteristics		
	周期信号的傅里叶变换 Fourier transform of periodic signal		
	抽样信号的傅里叶变换 Fourier transform of sampling signal		
	抽样定理 Sampling theorem		
	雷达测距原理，雷达信号的频谱 Radar ranging principle, radar signal spectrum		

<table>
<tr><td rowspan="2">学习目标:
Learning Objectives</td><td>理解:
Understand</td><td>连续时间周期信号的频谱特点，能用傅里叶级数和傅里叶变换求解周期信号的频谱和频带宽度，会画频谱图；连续时间非周期信号的频谱特点，能用傅里叶变换求解非周期信号的频谱和频带宽度，会画频谱图
The spectrum characteristics of continuous-time periodic signals can be solved by Fourier series and Fourier transform, and the spectrum diagram can be drawn. Spectrum Characteristics of Continuous - time Aperiodic Signals and Fourier Transform Spectrum and bandwidth will draw the spectrum diagram.</td></tr>
<tr><td>掌握:
Master</td><td>抽样的作用、实现方法以及抽样信号的频谱特点，并会求解；抽样定理
Sampling function, implementation method and sampling signal spectrum characteristics, and will solution; Sampling theorem.</td></tr>
<tr><td>德育目标:
Moral Objectives</td><td colspan="2">激发学生对信号与信息处理方向的兴趣与学习热情，提高学生分析和解决实际工程问题的能力，为将来从事电子设备设计与研发奠定必要的基础
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Improve students' thinking, judgment, analysis and problem-solving abilities, and form professionalism of dedication, trustworthiness, colleges, and excellence.</td></tr>
<tr><td rowspan="7">重点:
Key Points</td><td colspan="2">单边频谱、双边频谱及其相互关系
Unilateral spectrum, bilateral spectrum and their relationship</td></tr>
<tr><td colspan="2">周期信号的频谱特点
Spectrum characteristics of periodic signals</td></tr>
<tr><td colspan="2">非周期信号的频谱特点
Spectrum characteristics of aperiodic signals</td></tr>
<tr><td colspan="2">时域、频域在信号波形、基本运算、能量（或平均功率）、对称性等方面的对应关系
The correspondence between time domain and frequency domain in signal waveform, basic operation, energy (or average power) and symmetry.</td></tr>
<tr><td colspan="2">典型信号的频谱及其特点
Spectrum and characteristics of typical signals.</td></tr>
<tr><td colspan="2">频带宽度
Frequency bandwidth</td></tr>
<tr><td colspan="2">周期信号的傅里叶变换及其与傅里叶级数的关系</td></tr>
</table>

	Fourier transform of periodic signal and its relation with Fourier series
	时域、频域抽样的作用、实现方法及其在另一个域引起的相应变化 Functions of sampling in time and frequency domains, implementation methods and corresponding changes in another domain.
	抽样定理 Sampling theorem
	周期信号与非周期信号的频谱关系 Spectrum relationship between periodic signal and non-periodic signal.
难点: Focal points	傅里叶级数和傅里叶变换的理解 Understanding of Fourier series and Fourier transform.
	信号频谱和频带宽度的理解 Understanding of signal spectrum and bandwidth.
	连续时间信号在时域、频域的一一对应关系 One-to-one correspondence of continuous-time signals in time domain and frequency domain.
	连续时间周期信号与非周期信号频谱的描述、特点和相互关系 Continuous-time periodic signal and non-periodic signal spectrum description
	连续时间信号与离散时间信号的相互转换及其频谱关系 The conversion between continuous-time signal and discrete-time signal and their spectral relationship.
	连续谱与离散谱的相互转换和时域波形关系 Inter-conversion and time-domain waveform relationship between continuous spectrum and discrete spectrum.
	抽样定理 Sampling theorem.

知识单元序号: Knowledge Unit No.	4	支撑教学目标: SLOs Supported	1-4、2-1、2-3、3-3、3-4、3-5
知识单元名称 Unit Title	拉普拉斯变换、连续时间系统的 s 域分析 Laplace transform, s-domain analysis of continuous time system		
知识点: Knowledge Delivery	拉普拉斯变换的定义、收敛域； 拉普拉斯变换的基本性质；拉普拉斯逆变换 The definition and convergence domain of Laplace transform. Basic properties of Laplace transform. Laplace inverse transformation		
	用拉普拉斯变换分析电路、s 域元件模型；系统函数 The circuit and s-domain component model are analyzed by Laplace transform. System functions		
	由系统函数零、极点分布决定时域特性 Time domain characteristics are determined by zero and pole distribution of system functions.		
	由系统函数零、极点分布决定频响特性 Frequency response characteristics are determined by zero and pole distribution of system functions		
	二阶谐振系统的 s 平面分析		

	The s-plane analysis of second-order resonant system.	
	全通函数与最小相移函数的零、极点分布 Zero and pole distribution of all-pass function and minimum phase shift function.	
	线性系统的稳定性 Stability of linear system.	
	双边拉普拉斯变换 Bilateral Laplace transform.	
	拉普拉斯变换与傅里叶变换的关系 Relationship between Laplace transform and Fourier transform.	
学习目标: Learning Objectives	了解: Recognize	全通网络和最小相移网络的特点 The characteristics of all-pass network and minimum phase-shift network
	理解: Understand	系统函数的定义、物理意义及其零极点图；系统频率响应的定义、物理意义和应用，会求解系统频率响应，会画系统的频响特性曲线，能确定系统的滤波特性和频带宽度 The definition, physical meaning and zero-pole diagram of system functions. The definition, physical meaning and application of the system frequency response will solve the system frequency response, draw the frequency response characteristic curve of the system, and determine the filtering characteristics and frequency bandwidth of the system.
	掌握: Master	单边拉普拉斯变换的定义和基本性质，会求解单边拉普拉斯变换及其逆变换；系统函数的多种方法求解；用系统函数及其零极点图分析系统的时域、频域特性；利用 s 域方法求解系统的各种响应；判断系统稳定性 The definition and basic properties of unilateral Laplace transform will solve unilateral Laplace transform and its inverse transform. Several methods for solving system functions. The time-domain and frequency-domain characteristics of the system are analyzed with the system function and its zero-pole diagram. The s domain method is used to solve various responses of the system. Judge the stability of the system.
德育目标: Moral Objectives	激发学生对信号与信息处理方向的兴趣与学习热情，提高学生分析和解决实际工程问题的能力，为将来从事电子设备设计与研发奠定必要的基础 Stimulate students' interest and learning enthusiasm in the direction of signal and information processing, improve students' ability to analyze and solve practical engineering problems, and lay the necessary foundation for future electronic device design	

	and research and development. 提高学生思维、判断、分析与解决问题能力，形成敬业、守信、高校、精益求精的职业素养 Improve students' thinking, judgment, analysis and problem-solving abilities, and form professionalism of dedication, trustworthiness, colleges, and excellence.
重点: Key Points	单边拉普拉斯变换的定义、收敛域 Definition and convergence domain of unilateral Laplace transform.
	时域、s 域基本运算的对应关系 The corresponding relationship between the basic operation in time domain and s domain.
	典型信号的拉普拉斯变换 Laplace transform of typical signals.
	部分分式展开法 Partial fraction expansion method.
	完全响应、自由响应、强迫响应、零状态响应、零输入响应、瞬态响应、稳态响应、单位冲激响应和单位阶跃响应的 s 域的求解方法及其异同点 Complete response, free response, forced response, zero state response, zero input response, transient response, steady-state response, unit impulse response and unit step response s domain solution method and its similarities and differences.
	系统函数及其零极点分布图 System functions and their zero-pole distributions.
	由系统函数零、极点分布决定时域和频响特性 Time domain and frequency response characteristics are determined by zero and pole distribution of system functions.
	系统频率响应的定义、物理意义及其应用 The definition, physical meaning and application of system frequency response
	系统的滤波特性和频带宽度 Filter characteristics and bandwidth of the system.
	系统稳定性的 s 域判断 The s-domain judgment of system stability.
难点: Focal points	不同响应类型的 s 域求解方法的不同之处 Differences in the s-domain solutions of different response types
	系统函数及其零极点分布与系统时域、频域特性的对应关系 The relationship between the system function and its zero-pole distribution and the time domain and frequency domain characteristics of the system.
	系统频率响应的物理意义和应用 Physical significance and application of system frequency response.
	系统的滤波特性及其判断 Filtering characteristics and judgment of the system.

	系统的频带宽度 Frequency bandwidth of the system.

知识单元序号: Knowledge Unit No.	5	支撑教学目标: SLOs Supported	1-3、2-1、2-4、3-4、3-5
知识单元名称 Unit Title	傅里叶变换应用于通信系统——滤波、调制与抽样 Fourier transform applied to communication systems-filtering, modulation and sampling		
知识点: Knowledge Delivery	利用系统函数 H(j ω)求响应 Responses are obtained using system function H(jω)		
	无失真传输 No distortion transmission		
	理想低通滤波器 Ideal low-pass filter		
	系统的物理可实现性——佩利-维纳准则 Physical realization – Perry – Wiener criterion of the system.		
	利用希尔伯特变换研究系统函数的约束条件 The constraint conditions of system functions are studied by Hilbert transform.		
	调制与解调 Modulation and demodulation		
	带通滤波系统的运用 Application of band-pass filtering system		
	从抽样信号恢复连续时间信号 Recovery of continuous-time signals from sampling signals		
学习目标: Learning Objectives	了解: Recognize	系统频率响应及其物理含义；失真产生的原因和作用 System frequency response and its physical meaning; the cause and effect of distortion	
	理解: Understand	无失真传输的概念和意义；系统的物理可实现性；佩利-维纳准则、希尔伯特变换的意义和应用；滤波器的作用；实际滤波器与理想滤波器的关系和区别；利用冲激响应和阶跃响应测量滤波器参数的基本方法；调制、解调的实现方法、意义和频谱变换； The concept and meaning of distortion less transmission; the physical reliability of the system; the meaning and application of the Paley-Wiener criterion and the Hilbert transform; the role of filters; the relationship and difference between actual filters and ideal filters ; The basic method of using impulse response and step response to measure filter parameters; the realization method, meaning and spectrum transformation of modulation and demodulation;	
	掌握: Master	无失真传输的时域、频域条件，并会判断和应用；理想滤波器的频率响应和频响特性曲线 Non-distortion transmission in time domain, frequency	

		domain conditions, and will be judged and applied. Frequency response and frequency response characteristic curve of ideal filter.
德育目标: Moral Objectives	激发学生对信号与信息处理方向的兴趣与学习热情，提高学生分析和解决实际工程问题的能力，为将来从事电子设备设计与研发奠定必要的基础 Stimulate students' interest and learning enthusiasm in the direction of signal and information processing, improve students' ability to analyze and solve practical engineering problems, and lay the necessary foundation for future electronic device design and research and development. 提高学生思维、判断、分析与解决问题能力，形成敬业、守信、高校、精益求精的职业素养 Improve students' thinking, judgment, analysis and problem-solving abilities, and form professionalism of dedication, trustworthiness, colleges, and excellence.	
重点: Key Points	线性失真和非线性失真及其特点，线性失真产生的原因——幅度失真和相位失真，无失真传输的条件（时域、频域） Linear distortion and nonlinear distortion and their characteristics, the causes of linear distortion-amplitude distortion and phase distortion, conditions for distortion-free transmission (time domain, frequency domain)	
	理想低通滤波器的频响特性，冲激响应和阶跃响应曲线与滤波器截止频率的对应关系 The frequency response characteristics of an ideal low-pass filter, the corresponding relationship between the impulse response and step response curves and the cut-off frequency of the filter	
	系统物理可实现性的频域判断 Frequency domain judgment of the physical feasibility of the system.	
	调制、解调的意义、实现方法和频谱变换 The significance of modulation and demodulation, implementation methods and spectrum conversion.	
	从抽样信号中恢复连续时间信号 Recover the continuous time signal from the sampled signal.	
难点: Focal points	失真的分类、特点及产生的原因，无失真传输及其在通信系统中的作用 The classification, characteristics and causes of distortion, distortion-free transmission and its role in communication systems.	
	理想滤波器的作用、频响特性、参数测量方法及其应用 The role of ideal filters, frequency response characteristics, parameter measurement methods and their applications	
	系统的物理可实现性及其判断方法；调幅的实现方法和频谱变换 The physical reliability of the system and its judgment method; the realization method of amplitude modulation and frequency spectrum	

	conversion.

知识单元序号: Knowledge Unit No.	6	支撑教学目标: SLOs Supported	1-6、2-1、3-3、3-4
知识单元名称 Unit Title	离散时间系统的时域分析 Time Domain Analysis of Discrete Time System		
知识点: Knowledge Delivery	离散时间信号——序列 Discrete time signal-sequence.		
	离散时间系统的数学模型 Mathematical model of discrete time system.		
	常系数线性差分方程的求解 Solving linear difference equations with constant coefficients.		
	离散时间系统的单位冲激响应 Unit impulse response of discrete time system.		
	卷积（卷积和） Convolution (convolution sum)		
学习目标: Learning Objectives	理解: Understand	LTI 离散时间系统响应的类型及其时域求解方法；单位冲激响应的定义、意义和应用 The type of LTI discrete-time system response and its time-domain solution method. The definition, significance and application of unit impulse response.	
	掌握: Master	序列的各种描述方法；典型序列的描述、特性和作用，并会应用；序列的运算方法和规则；离散时间系统的线性、移不变性、因果性和稳定性的时域判断方法；线性卷积和运算的意义和求解方法 Various description methods of sequences. The description, characteristics and functions of typical sequences will be applied. The operation methods and rules of sequences. Time domain judgment method for linear, shift invariance, causality and stability of discrete time systems. Meaning and solution of linear convolution sum operation.	
德育目标: Moral Objectives	激发学生对信号与信息处理方向的兴趣与学习热情，提高学生分析和解决实际工程问题的能力，为将来从事电子设备设计与研发奠定必要的基础 Stimulate students' interest and learning enthusiasm in the direction of signal and information processing, improve students' ability to analyze and solve practical engineering problems, and lay the necessary foundation for future electronic device design and research and development. 提高学生思维、判断、分析与解决问题能力，形成敬业、守信、高校、精益求精的职业素养		

	Improve students' thinking, judgment, analysis and problem-solving abilities, and form professionalism of dedication, trustworthiness, colleges, and excellence.
重点: Key Points	离散时间信号的时域描述、特点及其与连续时间信号的关系和区别 Time domain description, characteristics of discrete-time signals and their relationship with continuous-time signals
	典型序列的定义和特性，及其与典型连续时间信号之间的关系 Definition and characteristics of typical sequences, and their relationship with typical continuous-time signals.
	序列的基本运算和规则 Basic operations and rules of sequences.
	序列的共轭对称分解 Conjugate symmetric decomposition of sequences.
	线性时不变离散时间系统的基本性质和各响应类型，单位冲激响应及其对系统特性的描述，卷积和运算及其对系统输入输出关系的描述。 The basic properties and response types of linear time-invariant discrete-time systems, the unit impulse response and its description of the system characteristics, convolution and operation and its description of the relationship between input and output of the system.
难点: Focal points	离散时间信号与连续时间信号的关系和异同 The relationship and similarities and differences between discrete-time signals and continuous-time signals.
	正弦序列的周期性判断，及其与连续时间正弦信号在周期性、频域参数等方面的联系和区别 Periodicity judgment of sinusoidal sequence, and its relationship and difference with continuous-time sinusoidal signal in periodicity and frequency domain parameters.
	序列运算与连续时间信号运算的联系和差异 The relation and difference between sequential operation and continuous time signal operation.

知识单元序号: Knowledge Unit No.	7	支撑教学目标: SLOs Supported	1-7、2-1、3-3、3-4
知识单元名称 Unit Title	z 变换、离散时间系统的 z 域分析 z-transform, z-domain analysis of discrete-time systems		
知识点: Knowledge Delivery	z 变换的定义、典型序列的 z 变换 Definitions of z transform z transform of typical sequence.		
	z 变换的收敛域 Convergence region of z transform.		
	逆 z 变换 Inverse z transform.		
	z 变换的基本性质 Basic properties of z transform.		

<table>
<tr><td></td><td colspan="2">z 变换与拉普拉斯变换的关系
The relationship between z transform and Laplace transform.</td></tr>
<tr><td></td><td colspan="2">离散系统的系统函数
Systems function of discrete system.</td></tr>
<tr><td></td><td colspan="2">序列的傅里叶变换
Fourier transform of sequences.</td></tr>
<tr><td rowspan="2">学习目标:
Learning Objectives</td><td>理解:
Understand</td><td>z 变换的定义、收敛域及其性质；LTI 离散时间系统的系统函数的定义
The definition, convergence domain and properties of z transform.
Definitions of system function of LTI discrete-time system.</td></tr>
<tr><td>掌握:
Master</td><td>逆 z 变换的部分分式展开法；LTI 离散时间系统的 z 域分析；系统函数与系统稳定性的关系；LTI 离散时间系统的频率响应特性。
Partial fraction expansion methods of inverse z transform.
Z-domain analysis of LTI discrete-time system. Relationship between system function and system stability.
Frequency response characteristics of LTI discrete-time system.</td></tr>
<tr><td>德育目标:
Moral Objectives</td><td colspan="2">激发学生对信号与信息处理方向的兴趣与学习热情，提高学生分析和解决实际工程问题的能力，为将来从事电子设备设计与研发奠定必要的基础
Stimulate students' interest and learning enthusiasm in the direction of signal and information processing, improve students' ability to analyze and solve practical engineering problems, and lay the necessary foundation for future electronic device design and research and development.
提高学生思维、判断、分析与解决问题能力，形成敬业、守信、高校、精益求精的职业素养
Improve students' thinking, judgment, analysis and problem-solving abilities, and form professionalism of dedication, trustworthiness, colleges, and excellence.</td></tr>
<tr><td rowspan="4">重点:
Key Points</td><td colspan="2">z 变换及其收敛域
Z transform and its convergence domain.</td></tr>
<tr><td colspan="2">序列在时域和 z 域的对应关系
The corresponding relationship of sequences in time domain and z domain.</td></tr>
<tr><td colspan="2">z 变换与拉氏变换的关系
The relationship between z transform and Laplace transform.</td></tr>
<tr><td colspan="2">离散时间傅里叶变换（DTFT）
Discrete-time Fourier transform (DTFT).</td></tr>
</table>

	LTI 离散时间系统的系统函数、频率响应特性 System function and frequency response characteristics of LTI discrete-time system.
	LTI 离散时间系统的因果性和稳定性判断 Causality and stability judgment of LTI discrete-time system.
难点: Focal points	z 变换的收敛域 Convergence region of z transform.
	逆 z 变换 Inverse z transform.

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.
知识单元一：绪论 Knowledge Unit 1:Introduction	4	0	0	0
知识单元二：连续时间系统的时域分析 Knowledge Unit 2: Time Domain Analysis of Continuous Time System	4	0	0	0
知识单元三：傅里叶变换 Knowledge Unit 3: Fourier Transform	14	0	0	0
知识单元四：拉普拉斯变换、连续时间系统的 s 域分析 Knowledge unit 4: Laplace transform, s-domain analysis of continuous-time systems	12	0	0	0
知识单元五：傅里叶变换应用于通信系统——滤波、调制与抽样 Knowledge unit 5: Fourier transform applied to communication systems-filtering, modulation and sampling	6	0	0	0
知识单元六：离散时间系统的时域分析 Knowledge Unit 7: Time Domain Analysis of Discrete Time System	6	0	0	0
知识单元七：z 变换、离散时间系统的 z 域分析 Knowledge unit 8: z-transform, z-domain analysis of discrete-time systems	10	0	0	0
总计 Total	56	0	0	0

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
☑	多媒体教学：基于信息化设备的课堂教学 Multi-media-based lecturing
☑	实践能力传授：理论与行业、实际案例相结合 Combining theory with industrial practical problems
☑	课程思政建设：知识讲授与德育相结合 Knowledge delivery with ethic education
□	PBL 教学：问题驱动的分组学习与交流 Problem-based learning
□	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	李雨纯
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	50
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	期末 Final	环节负责人: Director	李雨纯
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	50
考核方式: Measures	满分 100 分，通过批阅期末考试试卷给出学生成绩。		

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 approvement.		
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.		