

四川大学教案

【首页】

课程名称	Digital Signal Processing	授课专业	无线电技术与信息系统 信息与通信工程 电子信息科学与技术 计算机通信等			年级	本科三年 级下半学 期
课程编号	20507630						
课程类型	必修课	校级公共课 ()；基础及专业基础课 ()； 专业课 (√)					
	选修课	限选课 ()；任选课 ()					
授课方式	课堂讲授 (√)；实践课 ()			考核方式	考试 (√)；考查 ()		
课程教学 总学时数	51			学分数	3		
课时分配	课堂讲授 51 学时；实践课 学时						
教材名称	Digital Signal Processing A Computer-Based Approach Second Edition	作者	Sanjit K.Mitra	出版社及出版时间	Tsinghua University Press McGraw-Hill 2001		
指定参考书	1. 《数字信号处理》 2. 《数字信号处理学习指导》 3. 《数字信号处理教程》 4. 《数字信号处理》	作者	丁玉美、高西全 编著 丁玉美、高西全 编著 程佩青 编著 冷建华等 编著	出版社及出版时间	西安电子科技大学出版社，2001 西安电子科技大学出版社，2001 清华大学出版社，2001 国防工业出版社，2002		
授课教师	何培宇			单位	电子信息学院		
授课时间	春季学期，2月至6月；秋季学期，9月至1月						

注：表中 () 选项请打“√”。

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【理、工科】

周次	第 1 周			备 注
章节名称	Chapter 1 Signals and Signal Processing 1.1 What is Signal and Signal Processing? 1.2 Characterization and Classification of Signals 1.3 Typical Signal Processing Operations 1.4 Why Digital Signal Processing?			
授课方式	理论课 (√); 实验课 (); 实习 ()	教学时数	3	
教学目的及要求	Objectives and Requirements: 1) Handle the basic concepts of signal and signal processing; 2) Understand how to characterize and classify signals; 3) Understand typical signal processing operations; 4) Understand the reasons of carrying out digital signal processing.			
教学内容提要			时间分配	
1.0 Objectives and Requirements of the Multimedia Dual-Language (bilingual) Course			15 minutes	
1.1 What is Signal and Signal Processing? ◆ What is Signal? ◆ Examples of Typical Signals are Introduced ◆ What is Signal Processing?			20 minutes	
1.2 Characterization and Classification of Signals ◆ Classification of Signals ◆ Characterization of Signals			40 minutes	
1.3 Typical Signal Processing Operations ◆ Elementary Time-Domain Operations ◆ Some Other Signal Processing Operations			35 minutes	
1.4 Why Digital Signal Processing? ◆ Scheme for the Digital Processing of an Analog Signal ◆ Advantages of Digital Signal Processing ◆ Disadvantages of Digital Signal Processing			25 minutes	

<p>教学重点与难点</p>	<ol style="list-style-type: none"> 1. Reasons of Carrying Out Digital Signal Processing 2. Scheme for the Digital Processing of an Analog Signal 3. Classification of signals <ol style="list-style-type: none"> 1) One-dimensional Signal and Multidimensional Signal 2) Analog Signal and Digital Signal 3) Sampled-Data Signal and Quantized Boxcar Signal 4) Deterministic Signal and Random Signal 4. Typical Signal Processing Operations <ol style="list-style-type: none"> 1) Scaling 2) Delay 3) Addition 4) Integration 5) Differentiation 6) Filtering 	
<p>习、讨论、作业</p>	<p>Review the first part of Chapter 1 and try to remember some typical English terms of digital signal processing.</p>	
<p>手段 教学</p>	<p>Multimedia</p>	
<p>参考资料</p>	<p>The same as the first page</p>	

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周次	第 2 周			备 注
章节名称	<p align="center">Chapter 1 Signals and Signal Processing</p> <p>1.5 Typical Digital Signal Processing Applications</p> <p align="center">Chapter 2</p> <p align="center">Discrete-Time Signals and Systems in the Time-Domain</p> <p>2.1 Discrete-Time Signals</p>			
授课方式	理论课 (√); 实验课 (); 实习 ()	教学时数	3	
求 教 学 目 的 及 要	<p>Objectives and Requirements:</p> <ol style="list-style-type: none"> 1) Understand some typical digital signal processing applications and find interest on learning this course; 2) Handle the basic concepts of discrete-time signals. 			
教学内容提要			时间分配	
<p>1.5 Typical Digital Signal Processing Examples via Vivid Multimedia Slides</p> <ul style="list-style-type: none"> ◆ Cellular Phone ◆ Digital Camera ◆ Digital Sound Synthesis ◆ Signal Coding and Compression ◆ Signal Enhancement ◆ Blind Signal Separation (BSS) ◆ Acoustic Echo Cancellation (AEC) 			90 minutes	
<p>2.1 Discrete-Time Signals</p> <ul style="list-style-type: none"> ◆ Time-Domain Representation ◆ Operations on Sequences <ul style="list-style-type: none"> ✓ Basic Operations ✓ Combination of Basic Operations ✓ Sampling Rate Alteration 			45 minutes	

<p>教学重点与难点</p>	<p>1. Stimulate students' interest in <u>Digital Signal Processing</u> via the vivid multimedia lectures.</p> <p>2. Emphasize on the following basic concepts about discrete-time sequences and important operations on sequences:</p> <ul style="list-style-type: none"> ● Sampling Period (Interval) and Sampling Frequency ● Finite-Length Sequence and Infinite-Length Sequence ● Right-Sided Sequence and Left-Sided Sequence ● Causal Sequence and Anti-causal Sequence ● Real Sequence and Complex Sequence ● Sampled-data Signal and Digital Signal <ul style="list-style-type: none"> ■ Product Operation ■ Multiplication Operation ■ Addition Operation ■ Time-Shifting Operation ■ Time-Reversal Operation ■ Branching Operation <p>3. Stress especially on <u>Sampling Rate Alteration</u>:</p> <ul style="list-style-type: none"> ● Interpolation; Up-Sampling; Up-Sampler ● Decimation; Down-Sampling; Down-Sampler 	
<p>习、讨论、作业</p>	<p>Review the first part of Chapter 2 and try to remember some typical English terms of discrete-time sequences.</p>	
<p>手段 教学</p>	<p>Multimedia</p>	
<p>参考资料</p>	<p>The same as the first page</p>	

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周次	第 3 周			备 注
章节名称	<p style="text-align: center;">Chapter 2</p> <p style="text-align: center;">Discrete-Time Signals and Systems in the Time-Domain</p> <p>2.1 Discrete-Time Signals</p> <p>2.2 Typical Sequences and Sequence Representation</p> <p>2.3 The Sampling Process</p>			
授课方式	理论课 (√); 实验课 (); 实习 ()	教学时数	3	
求 教 学 目 的 及 要	<p>Objectives and Requirements:</p> <p>1) Understand the classification of sequences;</p> <p>2) Handle some basic sequences and their representation;</p> <p>3) Handle sampling theorem.</p>			
教学内容提要			时间分配	
<p>2.1 Discrete-Time Signals</p> <p>◆ Classification of Sequences</p> <p>✓ Classification Based on Symmetry</p> <p>✓ Periodic and Aperiodic Signals</p> <p>✓ Energy and Power Signals</p> <p>✓ Other Types of Classification</p>			45 minutes	
<p>2.2 Typical Sequences and Sequence Representation</p> <p>◆ Some Basic Sequences</p> <p>✓ Unit Sample Sequence</p> <p>✓ Unit Step Sequence</p> <p>✓ Real Sinusoidal Sequence</p> <p>✓ Exponential Sequence</p> <p>◆ Representation of an Arbitrary Sequence</p>			45 minutes	
<p>2.3 The Sampling Process</p> <p>◆ Some Basic Terms about Sampling</p> <p>◆ Sampling Theorem</p>			45 minutes	

教学重点与难点	<ul style="list-style-type: none"> ● Exponential Sequence and Its <u>Two Important Properties</u> ● Sampling Frequency and Sampling Period ● Sampling Angular Frequency ● Normalized Digital Angular Frequency (or Digital Frequency) and Its Unit ● Analog Angular Frequency and Its Unit ● <u>Sampling Theorem</u> 	
讨论、练习、作业	<p>Exercises:</p> <p>2.1</p> <p>2.3</p> <p>2.6 (b)</p> <p>2.18</p> <p>2.21 (a) (d)</p> <p>2.23</p>	
手段 教学	Multimedia	
参考资料	The same as the first page	

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周次	第 4 周			备 注
章节 名称	Chapter 2 Discrete-Time Signals and Systems in the Time-Domain 2.4 Discrete-Time System 2.5 Time-Domain Characterization of LTI Discrete-Time System			
	授课方 式	理论课（√）；实验课（）；实习 （）	教学 时 数	
求 教 学 目 的 及 要	Objectives and Requirements: 1) Understand the classification of discrete-time systems; 2) Handle the concepts of impulse and step response of a discrete-time system; 3) Handle the time-domain characterization of an LTI discrete-time system			
教 学 内 容 提 要			时 间 分 配	
2.4 Discrete-Time Systems ◆ Simple Discrete-Time Systems ◆ Classifications of Discrete-Time Systems ◆ Impulse and Step Responses			45 minutes	
2.5 Time-Domain Characterization of LTI Discrete-Time System ◆ Input-Output Relationship ◆ Simple Interconnection Schemes ◆ Stability Condition in Terms of the Impulse Response ◆ Causality Condition in terms of the Impulse Response			90 minutes	

教学重点与难点	<ul style="list-style-type: none"> ● Basic Concepts <ul style="list-style-type: none"> ➤ Accumulator ➤ M-Point Moving Average System ➤ <u>Linear Time-Invariant System</u> ➤ Causal System ➤ Stable System ➤ Passive and Lossless Systems ➤ Impulse and Step Responses ● LTI Discrete-Time System <ul style="list-style-type: none"> ➤ <u>Convolution Sum</u> ➤ Stability Condition in Terms of the Impulse Response ➤ Causality Condition in Terms of the Impulse Response 	
讨论、练习、作业	<p>Exercises:</p> <p>2.26 (a) (e) (f)</p> <p>2.32</p> <p>2.45 (a) (b) (c)</p> <p>2.57</p>	
手段 教学	Multimedia	
参考资料	The same as the first page	

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周次	第 5 周			备 注
章节名称	Chapter 2 Discrete-Time Signals and Systems in the Time-Domain 2.6 Finite-Dimensional LTI Discrete-Time Systems			
	Chapter 3 Discrete-Time Signals in the Transform-Domain 3.1 The Discrete-Time Fourier Transform (DTFT)			
授课方式	理论课（√）；实验课（ ）；实习（ ）	教学时数	3	
教学目的及要求	Objectives and Requirements: 1) Understand the characterization of finite-dimensional LTI discrete-time systems and classification of LTI discrete-time systems; 2) Handle the basic concept and properties of Discrete-Time Fourier transform (DTFT) and its physical meaning; 3) Handle the basic usage of MATLAB for DTFT computation			
教学内容提要			时间分配	
2.6 Finite-Dimensional LTI Discrete-Time Systems <ul style="list-style-type: none">◆ Linear Constant Coefficient Difference Equation Characterization◆ Classification of LTI Discrete-Time Systems			25 minutes	
3.1 The Discrete-Time Fourier Transform (DTFT) <ul style="list-style-type: none">◆ Definition◆ Convergence Condition◆ Bandlimited Signals◆ DTFT Properties◆ Energy Density Spectrum◆ DTFT Computation Using MATLAB<ul style="list-style-type: none">✓ How to Use MATLAB for Starters✓ Examples of DTFT Computation Using MATLAB◆ Linear Convolution Using DTFT			20 minutes 25 minutes 5 minutes 15 minutes 10 minutes 30 minutes 5 minutes	

教学重点与难点	<ul style="list-style-type: none"> ● Basic Concepts <ul style="list-style-type: none"> ➤ The <u>Order</u> of an LTI system ➤ <u>Finite Impulse Response System</u> (FIR) ➤ <u>Infinite Impulse Response System</u> (IIR) ➤ Nonrecursive System and Recursive System ➤ Real System and Complex System ● Important DTFT Properties <ul style="list-style-type: none"> ➤ Linearity ➤ <u>Convolution</u> ➤ Modulation ➤ Parseval's Relation ● Usage of MATLAB for Starters 	
讨论、练习、作业	<p>1) Exercises:</p> <p>3.4</p> <p>3.14 (a) (b) (c)</p> <p>3.15 (a) (c)</p> <p>3.22</p> <p>3.25 (a) (c) (d)</p> <p>3.27 (b) (c)</p> <p>2) Practice on MATLAB</p>	
手段 教学	Multimedia	
参考资料	The same as the first page	

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周次	第 6 周			备 注
章节名称	<p style="text-align: center;">Chapter 3</p> <p style="text-align: center;">Discrete-Time Signals in the Transform-Domain</p> <p>3.2 The Discrete Fourier Transform (DFT)</p> <p>3.3 Relation between the DTFT and the DFT, and Their Inverses</p> <p>3.4 Discrete Fourier Transform Properties</p>			
授课方式	理论课 (√); 实验课 (); 实习 ()	教学时数	3	
教学目的及要求	<p>Objectives and Requirements:</p> <p>1) Handle the basic concept of Discrete Fourier Transform (DFT);</p> <p>2) Handle the basic method of DFT computation using MATLAB;</p> <p>3) Handle the relation between DTFT and DFT, and their inverses;</p> <p>4) Handle some basic DFT properties.</p>			
教学内容提要			时间分配	
<p>3.2 The Discrete Fourier Transform (DFT)</p> <ul style="list-style-type: none"> ◆ Definition ◆ Matrix Relations ◆ DFT Computation Using MATLAB 			60 minutes	
<p>3.3 Relation between the DTFT and the DFT, and Their Inverses</p> <ul style="list-style-type: none"> ◆ DTFT from DFT by Interpolation ◆ Sampling the DTFT ◆ Numerical Computation of the DTFT Using DFT 			30 minutes	
<p>3.4 Discrete Fourier Transform Properties</p> <ul style="list-style-type: none"> ◆ DFT Properties ◆ Circular Shift of a Sequence ◆ Circular Convolution 			45 minutes	

教学重点与难点	<ul style="list-style-type: none"> ● Sampling the DTFT ● MATLAB Functions <ul style="list-style-type: none"> ➤ fft () ➤ ifft () ● <u>Circular Convolution</u> ● Basic DFT Properties <ul style="list-style-type: none"> ➤ Linearity ➤ <u>Circular Time-Shifting</u> ➤ <u>N-Point Circular Convolution</u> ➤ Modulation ➤ Parseval's Relation 	
讨论、练习、作业	<p>1) Exercises:</p> <p>3.33</p> <p>3.39 (a) (b) (e)</p> <p>3.48 (a) (b) (c)</p> <p>3.51 (a) (b)</p> <p>3.54 (a) (c)</p> <p>2) Practice on MATLAB</p>	
手段 教学	Multimedia	
参考资料	The same as the first page	

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周次	第 7 周			备 注
章节 名称	Chapter 3 Discrete-Time Signals in the Transform-Domain 3.5 Computation of the DFT of Real Sequences (*) 3.6 Linear Convolution Using the DFT 3.7 The z-Transform 3.8 Region of Convergence of a Rational z-Transform 3.9 Inverse z-Transform			The section which is marked with (*) is not compulsory to learn.
授课方 式	理论课 (√); 实验课 (); 实习 ()	教学 时 数	3	
教学 目的 及要 求	Objectives and Requirements: 1) Understand the basic principle of linear convolution implementation using circular convolution; 2) Understand the basic concept and function of Fast Fourier Transform (FFT); 3) Handle z-transform and its inverse z-transform, and understand their corresponding MATLAB tools; 4) Have a better understanding of region of convergence (ROC);			
教学内容提要			时间分配	
3.15 Computation of the DFT of Real Sequences (*) 3.16 Linear Convolution Using the DFT ◆ Linear Convolution of Two Finite-Length Sequences ◆ Linear Convolution of a Finite-Length Sequence with an Infinite-Length Sequence (*) 3.17 The z-Transform ◆ Definition ◆ Rational z-Transforms 3.18 Region of Convergence of a Rational z-Transform ◆ The ROC of Several Typical Sequences ◆ Computation for Rational z-Transform Using MATLAB 3.19 Inverse z-Transform ◆ General Expression ◆ Inverse z-Transform by Partial-Fraction Expansion ◆ Partial-Fraction Expansion Using MATLAB	15 minutes 30 minutes 55 minutes 35 minutes			

<p>教学重点与难点</p>	<ul style="list-style-type: none"> ● Linear Convolution of Two Finite-Length Sequences <u>Using Circular Convolution</u> ● Basic Concepts <ul style="list-style-type: none"> ➤ Unit Circle ➤ Zeros ➤ Poles ➤ Region of Convergence (ROC) <ul style="list-style-type: none"> ✓ ROC of a Finite-Length Sequence ✓ ROC of a Right-Sided Sequence or Causal Sequence when $n \geq 0$ ✓ ROC of a Left-Sided Sequence or Anti-causal Sequence when $n \leq 0$ ✓ ROC of a Two-Sided Sequence ● Computation for Rational z-Transform Using MATLAB 	
<p>讨论、练习、作业</p>	<p>1) Exercises:</p> <p>3.64 (a) (b)</p> <p>3.84</p> <p>3.85 (a) [i] [ii] (b) [i] [ii]</p> <p>3.86</p> <p>3.98 (a)</p> <p>2) Practice on MATLAB</p>	
<p>手段 教学</p>	<p>Multimedia</p>	
<p>参考资料</p>	<p>The same as the first page</p>	

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周次	第 8 周			备 注
章节 名称	<div>Chapter 3</div> <div>Discrete-Time Signals in the Transform-Domain</div> <div>3.9 Inverse z-Transform</div> <div>3.10 z-Transform Properties</div> <div>3.11 Relation between DTFT of a Discrete-Time Sequence and FT of its Counterpart in Continuous Time-Domain</div> <div>Chapter 4</div> <div>LTI Discrete-Time Systems in the Transform-Domain</div> <div>4.1 Finite Dimensional LTI Discrete-Time Systems</div> <div>4.2 The Frequency Response (FR)</div>			The section which is marked with (*) is not compulsory to learn.
	授课方式	理论课 (✓); 实验课 (); 实习 ()	教学时 数	
教学目的及要求	<div>Objectives and Requirements:</div> <div>1) Understand inverse z-transform via long division using MATLAB;</div> <div>2) Handle the basic properties of z-transform;</div> <div>3) Have a better understanding of the relation between the DTFT of a sequence and the FT of its corresponding analog signal;</div> <div>4) Handle the definition and physical interpretation of frequency response (FR), and FR computation using MATLAB.</div>			
教学内容提要			时间分配	
<div>3.9 Inverse z-Transform</div> <div>◆ Inverse z-Transform via Long Division</div> <div>◆ Inverse z-Transform Using MATLAB</div> <div>3.10 z-Transform Properties</div> <div>3.11 Relation between DTFT of a Discrete-Time Sequence and FT of its Counterpart in Continuous Time-Domain</div> <div>4.1 Finite Dimensional LTI Discrete-Time Systems</div> <div>4.2 The Frequency Response (FR)</div> <div>◆ Definition</div> <div>◆ FR Computation Using MATLAB</div>			<div>20 minutes</div> <div>25 minutes</div> <div>45 minutes</div> <div>15 minutes</div> <div>30 minutes</div>	

教学重点与难点	<ul style="list-style-type: none"> ● Inverse z-Transform Using MATLAB ● Basic Properties of z-Transform <ul style="list-style-type: none"> ➤ Linearity ➤ Convolution ➤ Modulation ● Relation between DTFT of a Discrete-Time Sequence and FT of its Counterpart in Continuous Time-Domain ● <u>Physical Interpretation</u> of Frequency Response ● FR Computation Using MATLAB 	
讨论、练习、作业	<p>1) Exercises:</p> <p>4.8</p> <p>4.9</p> <p>2) Practice on MATLAB</p>	
手段 教学	Multimedia	
参考资料	The same as the first page	

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周次	第 9 周			备 注
章节名称	<p style="text-align: center;">Chapter 4</p> <p style="text-align: center;">LTI Discrete-Time Systems in the Transform-Domain</p> <p>4.2 The Frequency Response (FR)</p> <p>4.3 The Transfer Function (TF)</p>			The section which is marked with (*) is not compulsory to learn.
授课方式	理论课 (√); 实验课 (); 实习 ()	教学时数	3	
教学目的及要求	Objectives and Requirements: <ol style="list-style-type: none"> 1) Handle the frequency-domain characterization of an LTI discrete-time system; 2) Handle the concept of filtering; 3) Handle the definition of transfer function (TF) and the relation between FR and TF, and understand the geometric interpretation of FR computation; 4) Handle the stability condition in terms of pole locations. 			
教学内容提要			时间分配	
4.2 The Frequency Response (FR) <ul style="list-style-type: none"> ◆ Steady-State Response ◆ Response to a Causal Exponential Sequence ◆ The Concept of Filtering ◆ Frequency-Domain Characterization of the LTI Discrete-Time System ◆ Phase and Group Delays (*) 			65 minutes	
4.3 The Transfer Function (TF) <ul style="list-style-type: none"> ◆ Definition ◆ Derivation of the TF Expression ◆ Frequency Response (FR) from TF ◆ Geometric Interpretation of FR Computation ◆ Stability Condition in Terms of Pole Locations 			70 minutes	

<p>教学重点与难点</p>	<ul style="list-style-type: none"> ● Relation between FR and TF ● The Concept of Filtering ● Geometric Interpretation of FR Computation ● Stability Condition in Terms of Pole Locations 	
<p>讨论、练习、作业</p>	<p>1) Exercises:</p> <p>4.16</p> <p>4.17</p> <p>4.20</p> <p>2) Practice on MATLAB</p>	
<p>手段 教学</p>	<p>Multimedia</p>	
<p>参考资料</p>	<p>The same as the first page</p>	

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周次	第 10 周			备 注
章节名称	Chapter 4 LTI Discrete-Time Systems in the Transform-Domain 4.4 Types of Transfer Functions			The section which is marked with (*) is not compulsory to learn.
授课方式	理论课 (√); 实验课 (); 实习 ()	教学时 数	3	
教学目的及要求	Objectives and Requirements: 1) Handle the definitions of all kinds of ideal filters; 2) Handle the concepts of zero-phase digital filter and linear-phase digital filter, and understand their transfer functions; 3) Handle the classification of linear-phase digital filters.			
教学内容提要			时间分配	
4.4 Types of Transfer Functions ◆ Ideal Filters ◆ Zero-Phase and Linear-Phase TFs ◆ Types of Linear-Phase FIR TFs			25 minutes 65 minutes 45 minutes	

教学重点与难点	<ul style="list-style-type: none"> ● Concepts of Ideal Digital Filters ● Zero-Phase and Linear-Phase TFs ● MATLAB Examples ● Types of Linear-Phase FIR TFs 	
讨论、练习、作业	1) Exercises: 4.6 4.7 4.21 2) Practice on MATLAB	
手段 教学	Multimedia	
参考资料	The same as the first page	

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周次	第 11 周			备 注
章节名称	<p style="text-align: center;">Chapter 4</p> <p style="text-align: center;">LTI Discrete-Time Systems in the Transform-Domain</p> <p>4.4 Types of Transfer Functions 4.5 Simple Digital Filters 4.6 Allpass Transfer Function (*) 4.7 Minimum-Phase and Maximum-Phase Transfer Functions (*)</p>			The section which is marked with (*) is not compulsory to learn.
授课方式	理论课 (√); 实验课 (); 实习 ()	教学时数	3	
教学目的及要求	Objectives and Requirements: <ul style="list-style-type: none"> 2) Handle the definitions of all kinds of ideal filters; 3) Handle the concepts of zero-phase digital filter and linear-phase digital filter, and understand their transfer functions; 4) Handle the classification of linear-phase digital filters. 			
教学内容提要			时间分配	
4.4 Types of Transfer Functions <ul style="list-style-type: none"> ◆ Zero Locations of Linear-Phase FIR TFs ◆ Bounded Real Transfer Functions 4.5 Simple Digital Filters <ul style="list-style-type: none"> ◆ Simple FIR Digital Filters ◆ Simple IIR Digital Filters ◆ Comb Filters (*) 4.6 Allpass Transfer Function (*) <ul style="list-style-type: none"> ◆ Definition ◆ Properties ◆ A Simple Application 4.7 Minimum-Phase and Maximum-Phase Transfer Functions (*)			<div>30 minutes</div> <div>50 minutes 55 minutes</div>	

教学重点与难点	<ul style="list-style-type: none"> ● Zero Locations of Linear-Phase FIR TFs for <ul style="list-style-type: none"> ➤ Type 1 ➤ Type 2 ➤ Type 3 ➤ Type 4 	
讨论、练习、作业	<p>1) Exercises:</p> <p style="padding-left: 40px;">4.6</p> <p style="padding-left: 40px;">4.7</p> <p style="padding-left: 40px;">4.21</p> <p>2) Practice on MATLAB</p>	
手段 教学	Multimedia	
参考资料	The same as the first page	

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周次	第 12 周			备 注
章节名称	Chapter 7 Digital Filter Design 7.1 Preliminary Considerations 7.2 Bilinear Transformation Method of IIR Filter Design 7.3 Analog Lowpass Filter Design (*)			The section which is marked with (*) is not compulsory to learn.
授课方式	理论课（√）；实验课（）；实习（）	教学时数	3	
教学目的及要求	Objectives and Requirements: 1) Understand and handle digital filter design specifications; 2) Handle the basic principle of bilinear transformation method of IIR filter design; 3) Understand the basic method of analog lowpass filter design.			
教学内容提要			时间分配	
7.1 Preliminary Considerations ◆ Digital Filter Specifications ◆ Selection of the Filter Type ◆ Basic Approaches to Digital Filter Design			35 minutes	
7.2 Bilinear Transformation Method of IIR Filter Design ◆ The Bilinear Transformation ◆ Design of Digital IIR Notch Filters			30 minutes	
7.3 Analog Lowpass Filter Design (*) ◆ Filter Specifications ◆ Butterworth Approximation ◆ Chebyshev Approximation ◆ Elliptic Approximation ◆ Analog Filter Design Using MATLAB			70 minutes	

<p>教学重点与难点</p>	<ul style="list-style-type: none"> ● <u>Digital Filter Design Specifications</u> ● Bilinear Transformation Method of IIR Filter Design 	
<p>讨论、练习、作业</p>	<p>1) Exercises:</p> <p>7.1</p> <p>7.2</p> <p>2) Practice on MATLAB</p>	
<p>教学手段</p>	<p>Multimedia</p>	
<p>参考资料</p>	<p>The same as the first page</p>	

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周次	第 13 周			备 注
章节名称	<div>Chapter 7</div> <div>Digital Filter Design</div> <div>7.4 Design of Analog Highpass, Bandpass, and Bandstop Filters (*)</div> <div>7.5 Design of Lowpass IIR Digital Filters</div> <div>7.6 Design of Highpass, Bandpass, and Bandstop IIR Digital Filters (*)</div> <div>7.7 Spectral Transformations of IIR Filters</div>			<div>The section which is marked with (*) is not compulsory to learn.</div>
授课方式	理论课（√）；实验课（）；实习（）	教学时数	3	
求 教 学 目 的 及 要	<div>Objectives and Requirements:</div> <div>1) Handle the design principle of IIR digital filters using bilinear transformation;</div> <div>2) Understand the spectral transformations of IIR filters.</div>			
教学内容提要			时间分配	
<div>7.4 Design of Analog Highpass, Bandpass, and Bandstop Filters (*)</div> <div>◆ Analog Highpass Filter Design</div> <div>◆ Analog Bandpass Filter Design</div> <div>◆ Analog Bandstop Filter Design</div> <div>7.5 Design of Lowpass IIR Digital Filters</div> <div>◆ Using Bilinear Transformation</div> <div>7.6 Design of Highpass, Bandpass, and Bandstop IIR Digital Filters (*)</div> <div>◆ Highpass</div> <div>◆ Bandpass</div> <div>◆ Bandstop</div> <div>7.7 Spectral Transformations of IIR Filters</div> <div>◆ Lowpass-to-Lowpass Transformation</div> <div>◆ Other Transformations</div>			<div>55 minutes</div> <div>10 minutes</div> <div>25 minutes</div> <div>45 minutes</div>	

<p>教学重点与难点</p>	<ul style="list-style-type: none"> ● <u>Design of Lowpass IIR Digital Filters Using Bilinear Transformation</u> 	
<p>讨论、练习、作业</p>	<p>1) Exercises: 7.4 7.14</p> <p>2) Practice on MATLAB</p>	
<p>手段 教学</p>	<p>Multimedia</p>	
<p>参考资料</p>	<p>The same as the first page</p>	

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周次	第 14 周			备 注
章节名称	<p style="text-align: center;">Chapter 7</p> <p style="text-align: center;">Digital Filter Design</p> <p>7.8 FIR Filter Design Based on Windowed Fourier Series</p> <p>7.9 Digital Filter Design Using MATLAB</p>			The section which is marked with (*) is not compulsory to learn.
授课方式	理论课 (√); 实验课 (); 实习 ()	教学时数	3	
教学目的及要求	Objectives and Requirements: 1) Understand and handle the basic principle of FIR filter design based on windowed Fourier series; 2) Handle the basic MATLAB methods of IIR digital filter design using bilinear transformation and FIR digital filter design based on window functions;			
教学内容提要			时间分配	
7.8 FIR Filter Design Based on Windowed Fourier Series <ul style="list-style-type: none"> ◆ Least Integral-Squared Error Design of FIR Filters ◆ Impulse Responses of Filters ◆ Gibbs Phenomenon ◆ Fixed Window Functions ◆ Adjustable Window Functions (*) ◆ Impulse Responses of FIR Filters with a Smooth Transition 			90 minutes	
7.9 Digital Filter Design Using MATLAB <ul style="list-style-type: none"> ◆ IIR Digital Filter Design Using MATLAB ◆ Window-Based FIR Filter Design Using MATLAB 			45 minutes	

<p>教学重点与难点</p>	<ul style="list-style-type: none"> ◆ IIR Digital Filter Design Using MATLAB ◆ Window-Based FIR Filter Design Using MATLAB 	
<p>讨论、练习、作业</p>	<p>1) MATLAB Exercises:</p> <p style="padding-left: 40px;">M 7.2</p> <p style="padding-left: 40px;">M 7.3 (*)</p> <p style="padding-left: 40px;">M 7.13</p> <p style="padding-left: 40px;">M 7.14 (*)</p> <p>2) Practice on MATLAB</p>	
<p>手段 教学</p>	<p>Multimedia</p>	
<p>参考资料</p>	<p>The same as the first page</p>	

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周次	第 15-17 周			备 注
章节名称	Chapter 10 (*) Multirate Digital Signal Processing 10.1 The Basic Sample Rate Alteration Devices 10.2 Filters in Sampling Rate Alteration Systems ■ Exercise Lessons ■ Mid Examination ■ Review			The chapter or section which is marked with (*) is not compulsory to learn.
授课方式	理论课 (√); 实验课 (); 实习 ()	教学时数	3	
教学目的及要求	Objectives and Requirements: 1) Understand the basic concepts and principles about Multirate Digital Signal Processing; 2) Strengthen the knowledge points of this course with exercise lessons, mid exam and review.			
教学内容提要			时间分配	
10.1 The Basic Sample Rate Alteration Devices 10.2 Filters in Sampling Rate Alteration Systems 10.3 Multistage Design of Decimator and Interpolator (*) 10.4 The Polyphase Decomposition (*) 10.5 Arbitrary-Rate Sampling Rate Converter (*) 10.6 Digital Filter Banks (*) ◆ Two or three class hours are used for mid exam; Note: Mid exam can be inserted Chapter 4 and Chapter 7. ◆ Four or three class hours are used for summaries and answering questions from students 'exercises; Note: Exercise lessons can be flexibly inserted between Chapter 3 and Chapter 4 or Chapter 4 and Chapter 7 or in between according to student's response to what they have learnt. ◆ Three class hours are used for review or /and introduction to <u>Multirate Digital Signal Processing</u> . Note: These three class hours can be also used for both reviewing and answering questions from students.				