TKU212141

Signals and Systems

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BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Required
Course Classification	Engineering Topics
Prerequisites	Differential Equations; Complex Variable Analysis; Linear Algebra; Multi-Variable Calculus

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

Fundamental and Engineering Knowledge (KP.1) Development of Engineering Solution (KP.2)

Learning Outcomes

LO1 The students are able to analyze the relationship between the input and output of a linear system and determine the system characteristics in the time domain.

LO2 The students are able to apply Laplace and Fourier transform and to identify the characteristic of a continuous-time linear system including its stability, frequency response, causailty and other important properties.

LO3 The students are able to analyze the relationship between a continuous-time and discrete-time signals and system based on sampling theory.

LO4 The students are able to apply Discrete-Time Fourier Transform to analyze and characterize discrete-time linear system as well as its relationship to discrete-time input and output signals.

COURSE DESCRIPTION

This course discusses the theoretical anaylsis of signals, spectra, and linear system and its application in the field of engineering.

TOPICS

1. Introduction to Signal and System

1.1 Introduction to Signal

1.2 Continuous-Time System

1.3 Discrete-Time System

1.4 System Interconnection

1.5 System Properties

2. Discrete-Time and Continuous-Time LTI System

2.1 Discrete-Time LTI System Impulse Response

2.2 Convolution Sum

2.3 Continuous-Time LTI System Impulse Response
2.4 Convolution Integral

3. Properties of LTI System
3.1 Commutative Property
3.2 Associative Property
3.3 Distributive Property
3.4 LTI System without and with Memory
3.5 Invertibility
3.6 Causality
3.7 Stability
3.8 Representation of System using Differential and Difference Equations

4. Fourier Analysis on LTI System
4.1 The relationship between the convolution (multiplication) operation in time domain and the multiplication (convolution) operation in frequency domain
4.2 LTI system response to exponential complex and the concept of Eigen function
4.3 LTI system frequency response, condition on Fourier transform of system LTI impulse response (Bounded Input Bounded Output)
4.4 Frequency Shaping Filter
4.5 Frequency Selective Filter
4.6 LTI System characterized by Linear Differential Equation with constant coefficient

5. Laplace Transform (First Part)
5.1 Introduction to Laplace Transform
5.2 The relationship between Fourier and Laplace Transform
5.3 Region of Convergence and Representation of the Laplace Transform on the S-plane
5.4 Laplace Transform and Rational Function
5.5 Pole and Zero
5.6 Properties of Region of Convergence

6. Laplace Transform (Second Part)
6.1 Analysis and Synthesis Equation of Laplace Transform
6.2 Inverse Laplace Transform on Rational Function
6.3 Partial Fraction Expansion
6.4 Properties of Laplace Transform
6.5 Unilateral Laplace Transform

7. Analysis of Continuous-Time LTI System using Laplace Transform
7.1 Analysis of Causal and Non-Causal LTI System
7.2 Analysis of LTI System Stability
7.3 Analysis of LTI System characterized by Linear Differential Equation with Constant Coefficient

8. Frequency Response Analysis using Bode Plot

9. Discrete Signals and Sampling Process (Signal and System, Oppenheim Bab 7)

9.1 Discrete Signals: Overview

9.2 Sampling Theory, Nyquist Theorem, and Impulse-Train Sampling

9.3 Signal Reconstruction from Digital Samples based on Interpolation

9.4 The effect of Under sampling: Aliasing

9.5 Discrete-Time Processing of Continuous-Time Signal

10. Discrete Time Fourier Series

10.1 Fourier Series Representation of Discrete-Time Signals

10.2 Properties of Fourier Series of Discrete-Time Signals

10.3 Discrete Time Filtering

11. Discrete Time Fourier Transform (DTFT)

11.1 DTFT of Aperiodic Signals

11.2 DTFT of Periodic Signals

11.3 Properties of DTFT

11.4 Duality

12. Analysis of Discrete Signal and LTI System in Time and Frequency Domain

12.1 Time Domain Analysis: FIR and IIR System, Correlation of Discrete-Time Signal

12.2 Frequency Domain Analysis of Discrete Time Signal and LTI System

REFERENCES

[1] Oppenheim, A.V., Willsky, I., 1998, Signals and Systems, 2nd ed., Prentice Hall

[2] Kamen, Edward W. ; Heck, Bonnie S., 1997, Fundamentals of Signals and systems using Matlab, New Jersey, Printice Hall