CAN207 Continuous and Discrete Time Signals and Systems

Lecture 23

Final Revision_Part 1

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Room EE322

Content

- About Assignment 1
- Information of final exam
- Important changes of exam rules
- Office hour arrangement
- Walk through every lecture

- Please fill Module Questionnaire! Please :)

1. Information of final exam

- Time: 30-Dec-2024, 14:00-17:10
- Exam room: GYM-GMG01-Basketball Court

- Questions
  - 5 questions (20 marks each)
  - 15 subquestions

- Important notice:
  - Calculator: University approved Casio FS82/83 series (991 sereis is not allowed)
  - Reading time:
    - 14:00-14:10: reading
    - 14:10-17:10: answering

2024/25 Semester 1 – **Final** Exam

Bachelor Degree – Year 3

Continuous and Discrete Time Signals and Systems

Writing Time: 180 minutes

Reading Time: 10 minutes (no writing or annotating allowed anywhere)

INSTRUCTIONS TO CANDIDATES

a) This is a **closed-book** examination. **NO** notes or books are permitted.

b) Total marks available are 100. The number on the right indicates the mark for each question.

c) Attempt **ALL** questions. Write all the answers in the answer booklet provided.

d) Only solutions written in **English** will be accepted.

e) Correct answers do not guarantee a full score: mark penalties may be imposed for missing intermediate solution steps or illogical solution processes.

f) **No annotating is allowed in reading time or after the end of writing time.**

g) ALL communications-enabled & network accessible devices **MUST** be **switched OFF** & placed in the storage area.

h) **ALL** materials must be returned to the exam invigilators upon completion of the exam period. Failure to do so will be deemed academic misconduct and will be dealt with accordingly.

AUTHORISED MATERIALS

1. Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, and one scientific calculator.

2. Only the university approved calculator - **Casio FS82ES/83ES** can be used. Calculators are permitted in accordance with the rules of the university. They may be used for the processing of numerical solutions **ONLY**. They must not have been programmed nor should they store additional information.

3. You are **NOT** permitted to have on your desk or on your person any unauthorised materials. This includes but is not limited to laptops, tablets, mobile phones, smart watches and bands, smart glasses, cheat sheet, draft paper, and electronic dictionaries. Unauthorised material will be confiscated.

2. Important rules and tips (from Registry)

1. Bring <u>two documents</u> for admission携带双证参加考试:
    a. XJTLU Student ID Card学生证
    b. Official Identity Verification Document 官方身份证件
        i. Mainland China: Resident Identity Card（居民身份证）;
        ii. Hong Kong, Macau, Taiwan: Mainland Travel Permit （通行证）
        iii. International: Passport (护照)

2. Use the washroom before admission check.
    <u>No washroom breaks are allowed within the first two hours and last 15 minutes of each exam</u>.
    入场前如厕。考试开始后两小时内及考试结束前**15**分钟不得离场如厕。

2. Important rules and tips (from Registry)

3. (Students) Arrive at least <u>30 minutes early</u> for admission and <u>metal scanner</u> check.

至少提前**30**分钟到达考场门口进行入场检查。

4.Any unauthorized materials or misbehaviors are strictly prohibited. Violation of exam rules will result in <u>disciplinary actions</u> and <u>the imposition of demerit points on transcripts</u>.

严禁携带任何考试违禁品及任何违纪行为。违反考试规则者将受到纪律处分，并在成绩单上记录违规积分。

3. Office hour arrangement

Week 14							
December	16 Mon.	17 Tue.	18 Wed.	19 Thu.	20 Fri.	21 Sat.	22 Sun.
10:00-12:00	Liu (SC340)	Liu (SC340)	Liu (SC340)	Liu (SC340)			
13:00-15:00		Wang (EE322)			Wang (EE322)		

Week 15							
December	23 Mon.	24 Tue.	25 Wed.	26 Thu.	27 Fri.	28 Sat.	29 Sun.
10:00-12:00	Liu (SC340)						Wang (EE322)
13:00-15:00		Wang (EE322)			Wang (EE322)		Wang (EE322)
15:00-17:00							

4. Walk through every lecture

- The following slides are the "outline" of every lecture
- We will go through them quickly

Lecture 1 Introduction

- Start from several examples…

☆ What is a signal?

☆ What is a system?

☆ Continuous or Discrete?

- Implementation of the systems

Lecture 2 Math Review

- 1. Fundamentals
  - Exponential identities
  - Logarithmic identities
- 2. Integrals
- 3. Summation formulas
- 4. Orthogonality
- ☆ 5. Complex numbers & Euler's formula
- ☆ 6. Partial fraction expansion

Lecture 3-4 Introduction to signals

- 1. Introduction
  - signals, signal representation and examples.
- ⭐ 2. Signal classification (properties)
  - continuity, periodicity, determinacy, symmetry, energy and power.
- ☆ 3. Elementary signals and sequences
  - unit step, rectangular, signum, ramp, sinusoidal, sinc, exponential and unit impulse functions.
- ⭐ 4. Signal operations (time-domain transformation)
  - time shifting, scaling and reversal.

Lecture 5 Introduction to systems

- 1. Introduction
  - systems, some examples

- ⭐ 2. Systems classification (properties)
  - memory, invertibility, causality, stability, linearity and time-invariance

- ⭐ 3. Interconnection of systems
  - serial, parallel, feedback (loop)

Lecture 6 LTI Systems & Convolution

- 1. Importance of LTI systems
  - Strategy of analysis
  - Introduction of "convolution"
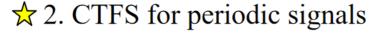 - Impulse response of a system
- ⭐ 2. Calculation of convolution
  - Conv. sum for DT systems
  - Conv. integral for CT systems
- 3. Convolution properties
  - Commutative, distributive, associative, and shifting
  - ⭐ Duration of convolutions
  - ⭐ Convolution with impulse function
- 4. Properties of LTI systems

Lecture 7 Fourier Series

- 1. Fundamentals of Fourier Analysis
  - Time and frequency analysis
  - ☆ Eigen-functions and eigen-values

- ⭐ 2. CTFS for periodic signals
  - Synthesis and analysis equations of CTFS
  - FS of real signals
  - Existence - Dirichlet condition
  - Signal spectrum
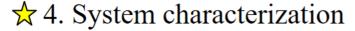
Lecture 8 CTFT_1

- 1. Fundamentals of CTFT
  - From CTFS to CTFT
  - Synthesis and Analysis equations
  - Linear and angular frequencies
  - Relationship between FT spectrum and FS coefficients
  - Convergence of CTFT: Dirichlet conditions
  - (Fourier transform of a periodic signal) optional
- 2. Fourier transform pairs
  - $e^{j\omega_0 t}$, $\delta(t)$, constant $x(t) = 1$, impulse train, square wave and sinc() function, etc.
  - Table of CTFT pairs

Lecture 9 CTFT_2

☆ 3. Properties of CTFT
 – Linearity, time and frequency scaling, time and frequency shifting, conjugation and symmetry, duality, Parseval's relation, convolution and multiplication properties

⭐ 4. System characterization
 – Frequency response of a system
   • Impulse response VS frequency response
 – Systems interconnection
 – LCCDE VS frequency response

Lecture 10 Laplace transform_1

☆ 1. Introduction to Laplace Transform
  - Eigenfunctions: $e^{j\omega t}$ and e^{st}
  - Definition of Laplace transform (also called s-transform)
  - Relationship between s-transform and CTFT

⭐ 2. Region of Convergence (ROC)
  - Definition and graphical depiction
  - Zeros and Poles
  - ROC propreties
  - Causality & Stability

⭐ 3. Calculating Laplace transform + ROC

Lecture 11 Laplace transform_2

- 1. Review, then...
  - Visualization of LT (compared with CTFT)
  - Fundamental LT pairs
- 2. Properties of LT
  - Especially the modification of the ROCs
- ☆ 3. Inverse Laplace Transform
  - Partial Fraction Expansion
  - ROC determination
- ☆ 4. Geometric Evaluation of CTFT based on LT
  - Zero-pole plot
  - Graphical interpretation of the zero-pole plot

Lecture 12 LCCDE in TD

- 1. Examples of LCCDE
  - CT examples
  - DT examples
- 2. Solving LCCDE
  - ⭐ 2.1 differential equations
  - 2.2 difference equations
- 3. Block diagrams of causal LTI systems
  - 3.1 difference equations
  - 3.2 direct form I and II
  - 3.3 differential equations

Lecture 13 Laplace transform_3

- 1. Unilateral Laplace Transform
  - Definition of Unilateral Laplace transform
  - ⭐ Initial- and final-value theorems
  - Differentiation property
  - ⭐ Solution of differential equations
- 2. Analysis of LTIC systems using LT
  - Impulse response $h(t)$, LCCDE $y(t)\ldots x(t)$ and system transfer function $H(s)$
  - System behavior VS system transfer function
- 3. System function algebra and block diagram representations
  - Interconnections
  - Block diagrams