Digital Signal Processing
EE 5371-001 – CRN-28302
EE 4383-001 – CRN-28600
Spring 2021 – Syllabus
Wednesday, January 20, 2021

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1 General Information

• Course ID: Digital Signal Processing, EE 5371-001, CRN-28302
  Digital Signal Processing, EE 4383-001, CRN-28600

• Time: Monday and Wednesday, 12:00 pm – 1:20 pm

• Textbook: [OS11, Textbook] and [uM, Matlab],

• Format: synchronous online Blackboard lectures

• Prerequisites: EE 3353 Discrete-Time Signals and Systems with a grade “C” or better.

• Instructor: von Borries – rvonborries@utep.edu

• Office Hours: online Blackboard

• Version: Wednesday, January 20, 2021

2 Catalog Description

An introduction to basic one-dimensional processing methods including: sampling and quantization; discrete-time Fourier and z-domain LTI systems analysis, theory of operation and computational aspects of FIR and IIR digital filters; principles of filter design; the discrete Fourier transform and its application to spectral analysis.
3 Student Outcomes

- Describe and analyze the operations in the analog-to-digital conversion.
- Describe and analyze the operations in the digital-to-analog conversion.
- Describe and analyze discrete-time signals and linear time-invariant (LTI) discrete-time systems in the time domain: difference equation, convolution, correlation.
- Use the z-transform to analyze LTI systems.
- Describe LTI discrete-time systems in the frequency domain: FIR and IIR filters.
- Use the discrete Fourier transform (DFT) to perform analysis of signals.
- Understand basic algorithms for computing the DFT efficiently: fast Fourier transform (FFT).
- Implement FIR and IIR discrete-time systems in software.
- Design FIR and IIR systems using basic techniques.
- Implement sampling rate conversion.
- Analyze signals using multirate digital filter banks.
- Use Matlab to implement digital signal processing algorithms.

4 Syllabus

- 2. Discrete-Time Signals and Systems – this chapter presents the basic definitions, notation, and develop and review the basic concepts associated with discrete-time signals and systems: classes of systems (memoryless, linear, time-invariant, causality, stability; LTI systems, convolution, properties), linear constant-coefficient difference equations, frequency-domain representation of discrete-time signals and systems, representation of sequences by Fourier transforms, symmetry properties of the Fourier transform, Fourier transform theorems (linearity, time shifting, frequency shifting, time reversal, differentiation, Parseval’s theorem, convolution, windowing).

- 3. The z-Transform – this chapter develops the z-transform representation of a sequence and study how the properties of a sequence are related to the properties of its z-transform: z-transform, region of convergence, inverse z-transform (inspection, partial fraction expansion), properties (linearity, time shifting, multiplication by exponential sequence, differentiation, conjugation, time reversal, convolution), z-transforms and LTI systems.
4. Sampling of Continuous-Time Signals — this chapter reviews many of the basic issues of sampling continuous-time signals and their discrete-time processing: periodic sampling, frequency-domain representation of sampling, reconstruction of a bandlimited signal from its samples, changing the sampling rate using discrete-time processing (sampling rate reduction, increasing sampling rate, interpolation filters, changing the sampling rate by noninteger factor), multirate signal processing, interchange of filtering with compressor/expander, multistage decimation, polyphase decompositions, polyphase implementation of decimation filters, polyphase implementation of interpolation filters, multirate filter banks.

5. Transform Analysis of Linear Time-Invariant Systems — this chapter develops the representation and analysis of LTI systems using the Fourier and z-transforms: frequency response of LTI systems, linear constant-coefficient difference equations, frequency response for rational system functions, relationship between magnitude and phase, all pass systems, minimum-phase systems.

7. Filter Design Techniques — this chapter discusses different methods for designing both IIR and FIR filters: filter specifications, design of FIR filters by windowing, optimum approximations of FIR filters.

8. The Discrete Fourier Transform — this chapter discusses the relationship between periodic sequences and finite-length sequences, Fourier series representation of periodic sequences and the DFT of the finite-length sequence: representation of periodic sequences, properties of the DFS, the Fourier transform of periodic signals, sampling the Fourier transform, Fourier representation of finite-duration sequences, properties of the DFT, circular convolution, linear convolution using the DFT.


Applications
- Random signals and linear systems
- Adaptive filters
- Wavelet transform
- Compressive sensing
- Cepstrum and homomorphic deconvolution
- Phase vocoder
5 Evaluation

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The set of problems used in EE 4383 corresponds to a subset of the problems used in EE 5371.

6 Grading

\[ A = 100 - 90\%, \quad B = 90 - 80\%, \quad C = 80 - 70\%, \quad D = 70 - 60\% \quad \text{and} \quad F = 60 - 0\% . \]

7 Attendance

Class attendance is mandatory and will be monitored. Any student who has more than two unexcused absences will be dropped out of EE 5371/EE 4383. It is student’s responsibility to sign the attendance sheet provided by the instructor for each class.

8 UTEP E-mail Account

Student’s UTEP e-mail address is required for the instructor to communicate with the student and vice-versa. It is student’s responsibility to have a UTEP e-mail account working properly. By the end of the first week of classes, every student should have received at least one e-mail message from the instructor. If an e-mail problem is detected (if no EE 5371/EE 4383 e-mail message is received by the end of the first week of classes), the student should request assistance from UTEP’s help desk to fix the problem with the UTEP’s e-mail account.

9 Accommodations and Support Services

If you have a disability and need classroom accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email at cassutep.edu, or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at www.sa.utep.edu/cass.
10 Academic Integrity

Please review the policy on academic integrity available at https://www.utep.edu/student-affairs/osccr/student-conduct/academic-integrity.html.

References


11 Calendar

EE 5371, MW 12:00 pm to 1:20 pm

- **January**
  - 1 2 3
  - 4 5 6 7 8 9 10
  - 11 12 13 14 15 16 17
  - 19 20 21 22 23 24
  - 25 26 27 28 29 30 31

- **February**
  - 1 2 3 4 5 6 7
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  - 15 16 17 18 19 20 21
  - 22 23 24 25 26 27 28

- **March**
  - 1 2 3 4 5 6 7
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  - 22 23 24 25 26 27 28
  - 29 30 31

- **April**
  - 1 2 3 4
  - 5 6 7 8 9 10 11
  - 12 13 14 15 16 17 18
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  - 26 27 28 29 30

- **May**
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  - 3 4 5 6 7 8 9
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  - 17 18 19 20 21 22 23
  - 24 25 26 27 28 29 30
  - 31

**Test Part III:** May 14, Friday
1:00 pm to 3:45 pm
Chapters 7, 8 and 9
Dr. Martin Luther King, Jr. Holiday
January, 18
Spring Break
March 15 to 19
Course Drop/Withdrawal Deadline
April 1