ECET 282 Digital Signal Processing

Instructor: Joyce van de Vegte
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Text: Fundamentals of Digital Signal Processing (Van de Vegte)

Objectives:

This course provides an introduction to the field of digital signal processing. It includes the process of digitizing signals, extracting information using various transforms and designing digital filters using recursive and non-recursive techniques.

Evaluation:

Tests (2)   30%
Labs   25%   (final lab is 10%)
Final Exam   45%
Problem sets will be assigned but not graded. Solution sets will be posted.
To be successful in the course, you must achieve 60% on theory and 60% on lab, including a minimum 50% on the final exam.

Important Dates:

Problem Set 1 Solutions Posted   Monday 28 January 2019 (week 4)
Test 1   Thursday 7 February 2019 (week 5)
Problem Set 2 Solutions Posted   Monday 4 March 2019 (week 9)
Test 2   Thursday 14 March 2019 (week 10)
Problem Set 3 Solutions Posted   Monday 1 April 2019 (week 13)
Final Exam   15 - 26 April 2019

Important Lab information:

Lab attendance is mandatory and attendance will be taken. Late demos and late reports will incur mark penalties.

Lab demos and reports must be handed in by the last day of classes for maximum credit. From the last day of classes up to and including the final day of the exam period, you may offer demos and reports but your grade will be discounted by 50%.

Even if you are not finished a lab, you must ensure that you have demonstrated the work you have completed on the lab so far, no later than the final day of the exam period. If your lab instructor is not satisfied that you have made some reasonable effort

on any lab, or if your lab instructor has not seen your lab work for any lab by the last day of exams, then you will receive a failing grade for the labs and therefore fail the course.

Laboratory Exercises

Week	Lab Number	Lab Title
1	1	Applications of DSP
2	2	Spectra of Common Signals
3	3	Sampling and Quantization
4	4	Signal and Spectra in MATLAB
5	5	Defining Systems and Filtering in MATLAB
6	6	Introduction to Audio Weaver
7		Reading break
8	7	Audio Effects
9	8	Voice Scrambling
10	9	Reverberation
11	10	TBA
12	11	TBA
13	12	TBA

Topics:

Review
- Fourier Series
- Complex Fourier Spectra
- Fourier Transform
- Impulse Function and Impulse Response
- Convolution

Introduction to Digital Signal Processing (Ch. 2) (2 hours)
- A Simple DSP System
- Review of Sampling
- Review of Quantization
- Aliasing
- Oversampling and Undersampling

Digital Signals (Ch. 3) (3 hours)
- Notation
- Basic Digital Signal Types

Filtering (Ch. 4 & 5) (4 hours)
- Analog vs Digital Filters
- Difference Equations
- Impulse and Step Responses
- Convolution
- Moving Average Filters

z Transforms (Ch. 6) (5 hours)
- Definition
- Transfer Functions
- Computing Filter Outputs
- Inverse z Transforms
- Poles and Zeros
- Stability

Frequency Responses and Spectra (Ch. 7) (4 hours)
- Fourier Transform
- Filter Shape using Fourier Transform
- Filter Shape using Poles and Zeros

FIR Filters (Ch. 9) (5 hours)
- Moving Average Filters
- Characteristics of FIR Filters
- Windowing
- Design of Low, Band, and High Pass FIR Filters
- Equiripple FIR Filters

IIR Filters (Ch. 10) (4 hours)
- Characteristics of IIR Filters
- IIR Filters Derived from Analog Designs
- Bilinear Transformation
- Impulse Invariance IIR Design

Discrete and Fast Fourier Transform (Ch. 11) (4 hours)
- DFT
- DFT Resolution
- Spectrograms
- FFT

DSP Hardware (Ch. 12) (1 hour)
- DSP Architectures
- Special Hardware Units
- Special Instructions

Applications of DSP (Ch. 14 & 15) (1 hour)
- Signal Processing
- Image Processing

Tests (2 hours)
Review (4 hours)

Practice Problems:

Chapter 2:	2.1 - 2.7, 2.9, 2.11, 2.13, 2.15, 2.19, 2.25, 2.27
Chapter 3:	3.1 - 3.6, 3.9, 3.10, 3.16 - 3.19, 3.23
Chapter 4:	4.9, 4.11, 4.13, 4.15, 4.16, 4.24, 4.25, 4.27, 4.28, 4.30, 4.32
Chapter 5:	5.4, 5.5, 5.6, 5.13, 5.17, 5.18, 5.19
Chapter 6:	6.15abdef, 6.6 - 6.8, 6.17, 6.18, 6.23, 6.28, 6.30, 6.31, 6.34
Chapter 7:	7.7, 7.10, 7.17, 7.24, 7.25
Chapter 9:	9.1, 9.4, 9.6ab approx c, 9.12, 9.13, 9.16, 9.20a, 9.21, 9.23, 9.26
Chapter 10:	10.3, 10.4abcd, 10.5, 10.6a, 10.7, 10.8, 10.13, 10.14a, 10.15, 10.16, 10.21
Chapter 11:	11.2a, 11.4, 11.12, 11.13, 11.15, 11.16, 11.18, 11.21