

# 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 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 27 January 2020 (week 4)
Test 1	Thursday 6 February 2020 (week 5)
Problem Set 2 Solutions Posted	Monday 2 March 2020 (week 9)
Test 2	Thursday 12 March 2020 (week 10)
Problem Set 3 Solutions Posted	Monday 30 March 2020 (week 13)
Final Exam	13 - 22 April 2020

## Important Lab information:

Lab attendance is mandatory and attendance will be taken. Reports are due one week after the lab period. Late demos and late reports will incur mark penalties.

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 last day of classes. If your lab instructor is not satisfied that you have made a satisfactory effort on any lab, or if your lab instructor has not seen your lab work for any lab by the last day of classes, then you will receive a failing grade for the labs and therefore 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	DTMF Generation
12	11	DTMF Recovery
13	12	DTMF Generation and Recovery

## 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:	6.15abcdef, 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, additional approx filter shape problem
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, 10.15a, 10.21
Chapter 11:	11.2a, 11.4, 11.12, 11.13, 11.15, 11.16, 11.18, 11.21