

# ECET 282 Digital Signal Processing

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## 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) 40%  
Labs 30%  
Final Exam 30%

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:

Test 1 (week 5) Tues 9 Feb 2021  
Test 2 (week 11) Tues 23 Mar 2021  
Final Exam 19 – 27 April 2021

## Laboratory Exercises

Lab posting and due dates may be found on D2L. Except for week 1, new labs will be posted each Friday and reports will be due 10 days later on Monday.

Week assigned	Lab Number	Lab Title
1	1	Applications of DSP
1	2	Spectra in MATLAB
2	3	Sampling and Quantization
3	4	Signal and Spectra in MATLAB
4	5	Defining Systems and Filtering in MATLAB
5	6	Introduction to Audio Weaver
6		Reading Break
7	7	Audio Effects
8	8	Voice Scrambling
9	9	Reverberation
10	10	DTMF Generation
11	11	DTMF Recovery
12	12	IIR Filters and FFTs

## 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, 9.15, 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

Problem Set 1

Problem Set 2

Problem Set 3

Solutions to all of the chapter problems and all of the problem sets will be posted.