Digital Signal Processing

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Course Details

- Course Code : SEN522
- Course Name: Digital Signal Processing
  (Sayısal İşaret İşleme)
- Instructor : Nizamettin AYDIN

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Assesment

Method	Quantity	(%)
Attendance& participation	-	05
Quiz	-	05
Homework	3	15
Presentation	1	10
Midterm Exam(s)	1	25
Final Exam	1	40

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Course Outline

1. Introduction.
Mathematical Representation of Signals. Mathematical Representation of Systems.

2. Sinusoids.
Review of Sine and Cosine Functions. Sinusoidal Signals. Sampling and Plotting Sinusoids. Complex Exponentials and Phasors. Phasor Addition. Time Signals.

3. Spectrum Representation.
The Spectrum of a Sum of Sinusoids. Beat Notes. Periodic Waveforms. Fourier Series Analysis and Synthesis. Time-Frequency Spectrum. Frequency Modulation.

4. Sampling and Aliasing.
Sampling. Spectrum View of Sampling and Reconstruction. Discrete-to-Continuous Conversion. The Sampling Theorem.

5. FIR Filters.
Discrete-Time Systems. The Running Average Filter. The General FIR Filter. Implementation of FIR Filters. Linear Time-Invariant (LTI) Systems. Convolution and LTI Systems. Cascaded LTI Systems. Example of FIR Filtering.

6. Frequency Response of FIR Filters.
Sinusoidal Response of FIR Systems. Superposition and the Frequency Response. Steady State and Transient Response. Properties of the Frequency Response. Graphical Representation of the Frequency Response. Cascaded LTI Systems. Running-Average Filtering. Filtering Sampled Continuous-Time Signals.

7. z-Transforms.
Definition of the z-Transform. The z-Transform and Linear Systems. Properties of the z-Transform. The z-Transform as an Operator. Convolution and the z-Transform. Practical Bandpass Filter Design. Properties of Linear Phase Filters.

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Course Outline

8. IIR Filters.
The General IIR Difference Equation. Time-Domain Response. System Function of an IIR Filter. Poles and Zeros. Frequency Response of an IIR Filter. The Inverse z-Transform and Some Applications. Second-Order Filters. Frequency Response of Second-Order IIR Filter. Example of an IIR Lowpass Filter.

9. Continuous-Time Signals and LTI Systems.
Continuous-Time Signals. The Unit Impulse. Continuous-Time Systems. Linear Time-Invariant Systems. Impulse Responses of Basic LTI Systems. Convolution of Impulses. Evaluating Convolution Integrals. Properties of LTI Systems.

10. The Frequency Response.
The Frequency Response Function for LTI Systems. Response to Real Sinusoidal Signals. Ideal Filters. Application of Ideal Filters. Time-Domain or Frequency-Domain?

11. Continuous-Time Fourier Transform.
Definition of the Fourier Transform. The Fourier Transform and the Spectrum. Examples of Fourier Transform Pairs. Properties of Fourier Transform Pairs. The Convolution Property. Basic LTI Systems. The Multiplication Property.

12. Filtering, Modulation, and Sampling.
Linear Time-Invariant Systems. Sinewave Amplitude Modulation. Sampling and Reconstruction.

13. Computing the Spectrum.
Finite Fourier Sum. Time-windowing. Analysis of a Sum of Sinusoids. Discrete Fourier Transform. Spectrum Analysis of Finite-Length Signals. Spectrum Analysis of Periodic Signals. The Spectrogram. The Fast Fourier Transform (FFT).

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COURSE OBJECTIVE

- Students will be able to:
  - Understand **mathematical** descriptions of signal processing **algorithms**
  - Express those algorithms as computer **implementations**
    - MATLAB
    - OCTAVE
    - SCILAB
    - C, C++, JAVA, PYTHON, …
    - ⋮

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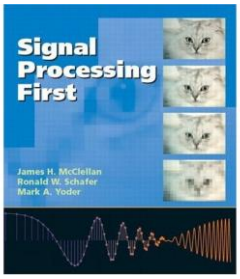
Main course book

Signal Processing First

by James H McClellan, Ronald W. Schaffer and Mark A. Yoder.

Published by Prentice Hall.

Isbn: 0-13-120265-0



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Some recommended books

- **Understanding Digital Signal Processing** by Richard G. Lyons.
- **The Scientist and Engineer's and Guide to Digital Signal Processing** by Steven W. Smith.
- **Digital Signal Processing and the Microcontroller** by Dale Grover and John R. (Jack) Deller with illustrations by Jonathan Roth.
- **Discrete-Time Signal Processing** by A. V. Oppenheim and R. W. Schafer.
- **Digital Signal Processing: Principles, Algorithms, and Applications** by J. G. Proakis and D. G. Manolakis.
- **Digital Signal Processing in Communication Systems** by Marvin E. Frerking.
- **Multirate Digital Signal Processing** by R. E. Crochiere and L. R. Rabiner.
- **Theory and Application of Digital Signal Processing** by Rabiner and Gold. A comprehensive, industrial-strength DSP reference book.
- **Digital Signal Processing** by Alan V. Oppenheim and Ronald W. Schafer. Another industrial-strength reference.
- **Digital Signal Processing** by William D. Stanley.
- ⋮

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Rules of the Conduct

- No eating /drinking in class
  - *except water*
- Cell phones must be kept outside of class or switched-off during class
  - *If your cell-phone rings during class or you use it in any way, you will be asked to leave and counted as unexcused absent.*
- No web surfing and/or unrelated use of computers,
  - when computers are used in class or lab.

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Rules of the Conduct

- You are responsible for checking the class web page often for announcements.
- http://www3.yildiz.edu.tr/~naydin
- Academic dishonesty and cheating will not be tolerated and will be dealt with according to university rules and regulations
  - *Presenting any work, or a portion thereof, that does not belong to you is considered academic dishonesty.*
- University rules and regulations:
- http://www.ogi.yildiz.edu.tr/category.php?id=17
- https://www.yok.gov.tr/content/view/544/230/lang,tr_TR/

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Attendance Policy

- The requirement for attendance is **70%**.
  - *Hospital reports are not accepted to fulfill the requirement for attendance.*
  - *The students, who fail to fulfill the attendance requirement, will be excluded from the final exams and the grade of F0 will be given.*

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