

## Digital Signal Processing

Prof. Nizamettin AYDIN

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## Course Details

- Course Code : 0113620
- 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).

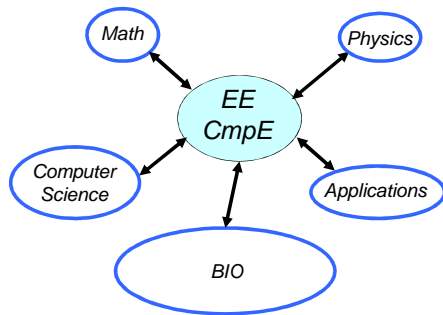
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## COURSE OBJECTIVE

- Students will be able to:
- Understand **mathematical** descriptions of signal processing **algorithms**
- Express those algorithms as computer **implementations** (**MATLAB** or **SCILAB**)

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## CONVERGING FIELDS



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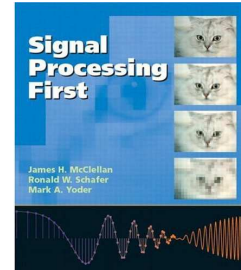
## Main course book

### 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 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. Schaffer.
- **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. Schaffer. 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.
- 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/](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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