# Introduction to Signal Analysis

**Spring Semester**

**LECTURER** Yaniv Isbi
**INSTRUCTOR** Tom Mahler
E-mail: tommahle@mail.tau.ac.il

**COURSE TOPICS**

**Week 1-2: Fourier Series (discrete and continuous time) [**1, chapter 3]:
The response of LTI systems to complex exponenetials, filters (LPF , HPF , BPF , BSF) , Continuous-Time Fourier Series (FS) and Discrete-Time Fourier Series (DFS). Properties and Examples. Gibbs phenomenon. Parseval's relation. Fourier series for generalized functions.

**Week 3-4: Fourier Transform (discrete and continuous time) [**1, chapters 4,5]:
Representation of aperiodic signals. Development of Continuous-Time Fourier Transform (FT) and Discrete-Time Fourier Transform (DTFT). Properties and examples. Finite total energy signals and finite average power signals. FT of periodic signals and the relation with FS. The convolution property. Duality and the inverse transform. Parseval's relation.

**Week 5-6: Applications in Communications** [1 , chapter 8]:
Amplitude Modulations (AM, SSB, DSB-SC). Synchronous and asynchronous demodulation. Phase modulation (Narrowband and wideband FM). Sinusoidal frequency modulation. Multiplexing

**Week 7-8: Sampling and Reconstruction** [2, chapter 4]:
Sampling theorem and ideal reconstruction. Replicas and aliasing. Interpolation methods (ZOH, FOH). Discrete-Time processing of continuous-time signals. Examples
Sampling rate reduction and increase by an integer factor and by non-integer factor.

**Week 9-10: Digital Processing of Analog Signals** [2, chapter 4]:
A/D conversion, D/A conversion. Analysis of quantization errors.

**Week 11-12: The Laplace Transform and the Z-Transform** [1 , chapter 9, 10]:

Relation between Laplace and Z transforms. Graphical inspection of the transforms and Bode plots.

## ASSIGNMENTS

7 bi-weekly homework assignments will be given, 6 of which must be handed in for evaluation.
In addition, 3 Matlab assignment will be given, all of which must be handed in for evaluation.

## MIDTERM COURSE POLICY

A midterm exam will be scheduled in the beginning of the semester. During an examination, students shall only use formulae sheets given by the instructor and a basic calculator. The formulae sheets shall be available at the course' web site from the beginning of the semester. The midterm will count for up to 15% of the total course grade.

## FINAL COURSE POLICY

The final exam will cover the entire course material and will count for 75%/90% of the total course grade. There will be 3 questions (without choice). The duration will be 3 hours. During an examination, students shall only use formulae sheets given by the instructor and a basic calculator. The formulae sheets shall be available at the course' web site from the beginning of the semester.
Students will have a first exam, Moed A. If the student does not pass, he/she can retake the exam, Moed B. The last exam taken will be the student's final grade for the exam.

## FINAL COURSE GRADE

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| 6% | - homework assignments |
| 4% | - Malab assignments |
| 15% | - midterm exam |
| 75%/90% | - final exam |

## REQUIRED READING

**[1]** Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, ***Signals & Systems***, Prentice Hall, 2nd edition, 1997

[2] Alan V. Oppenheim, Ronald W. Schafer, John R. Buck, ***Discrete-Time Signal Processing***, Prentice Hall, 2nd edition, 1999