האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

FROM LINEAR ALGEBRA TO THE iPhone:INTRO TO ELECTRICAL AND SYSTEM ENGINEERING FROM BASIC PRINCIPLES - 83536

Last update 08-10-2019

HU Credits: *4*

Degree/Cycle: *1st degree (Bachelor)*

Responsible Department: *Applied Physics*

Academic year: *0*

Semester: *1st Semester*

Teaching Languages: *Hebrew*

Campus: *E. Safra*

Course/Module Coordinator: *Ori Katz*

Coordinator Email: *orik@mail.huji.ac.il*

Coordinator Office Hours:

Teaching Staff:
Prof Ori Katz,
Mr. Noam Ohayon,
Mr. Michael Blechman

Course/Module description:
The course aim is to provide the basis for understanding and quantitative analysis of modern technological systems, with emphasis on experimental systems combining physics and electronics. This will be achieved by developing the basic electrical-engineering analysis tools from the basic courses taken in the physics courses of the bachelor degree.
The course will cover linear-systems, digitization, analog and digital modulation and de-modlution techniques, noise, transmission lines, and information theory.

Course/Module aims:
The course aim is to provide basic tools for understanding and analyzing modern technological systems from basic physical and mathematical principles, with emphasis on real-life experimental systems such as sensor systems, communications. The course will show the students how to apply their already established toolbox of physical and mathematical principles to analyze real-world systems.

Learning outcomes - On successful completion of this module, students should be able to:
Analyze various linear systems (electrical, mechanical, and others) in time and frequency.
Analyze communication systems from end-to-end (excluding transmission/antenna systems that are covered in the second course): analog signal characterization, digitization, modulation, demodulation, SNR calculation.
Analyze detection systems: choice of optimal filters, detection threshold, calculation of detection probability and false alarm rate.

Attendance requirements(%):
0

Teaching arrangement and method of instruction: Lectures, Tutorials, HW, small experimental assignments including programming

Course/Module Content:

1. Mathematical introduction to linear systems in time and frequency domains.

2. Various mechanical and wave propagation systems as linear systems. RLC circuits as linear systems.

3. Introduction to analog communication systems: the concept of bandwidth, carrier frequency, AM, FM and PM modulation schemes, multiplexing.

4. Introduction to digital communication: ASK, FSK, PSK, QPSK, QAM. Bit-error rate (BER).

5.. Digitization and Sampling: Sampling theorem, Nyquist frequency, aliasing and anti-aliasing filters, quantization and quantization noise, companding.

6. Random signals and noise: what is noise? Noise as a random process. Characterization of noise in time and frequency domains. Common physical sources of noise: thermal noise, shot noise, 1/f noise.
Adding noise sources, calculation in dB. Correlation and autocorrelation, and the Wiener–Khinchin theorem.

7. Detection under the presence of noise: trade-off between probability of detection (PD) and false alarm rate (FAR). Choosing a detection threshold, and optimal filters (matched and Wiener filters).

8. Introduction to Information Theory: What is information? The fundamental limits on information transfer in a communication channel - Shannon's Theorem. (may be given in the second course)

9. Transmission-lines

10. Intro to digital signal-processing (DSP)

Required Reading:
course lecture notes

Additional Reading Material:

Course/Module evaluation:
End of year written/oral examination 90 %
Presentation 0 %

Participation in Tutorials 0 %
Project work 0 %
Assignments 10 %
Reports 0 %
Research project 0 %
Quizzes 0 %
Other 0 %

Additional information: