Electrical Engineering
EE 337 Engineering micro and nano-systems.

A. F. J. Levi

12.30-1.50pm, KAP 140, Tue/Thu

Office hours Thu 2.00pm-3.00pm and 4.00pm-5.00pm

TA: Amine Abouzaid (abouzaid@usc.edu)

Last Day of Classes Spring Semester 2016: Friday, April 29

Study Days: Saturday, April 30 – Tuesday, May 3

Final Exam: Wednesday May 11, 2016, 2.00pm - 4.00pm, KAP140

http://www.usc.edu/dept/engineering/eleceng/Adv_Network_Tech/Html/index.html

http://www.usc.edu/dept/engineering/eleceng/Adv_Network_Tech/Html/ee337.html

http://classes.usc.edu/term-20161/classes/ee

EE 337 Outline and course content

This course course is designed as an introduction to micro and nano-technology, methods to control and exploit the new degrees of freedom delivered by nano-science, and the integration of micro and nano-technology into systems. It is a hands-on experimentally-driven course in which participants can expect to gain practical experience working in small teams to design, implement, and explore device and system context of emerging micro and nano-scale components.

EE 337 Engineering nano-systems syllabus

Grading policy is 10% on homework, 30% on midterm, 30% on project, and 30% on the final exam. It is a requirement that individuals attending the class have been at USC for two years. While not a prerequisite, it is expected that individuals participating in the class have access to and experience with MATLAB to at least the level of EE150.

Lecture

1: Numerical tools: Introduction to programming in MATLAB. Fourier series, Fourier integral, FFT, high, low, and band pass filters. Scales in nanoscience and system integration.

2-6: Quantum mechanics: Light as a particle, experiment to prove the photon exists, diffraction and interference of electrons, the Schroedinger equation, orthonormal states, wave packet dispersion, electron current, transmission and reflection of unbound states, electron scattering at a potential step, electron tunneling, the propagation matrix method for tunneling and resonant tunneling, propagation method for bound states, solution to Schroedinger equation by matrix diagonalization.

7-8: Symmetry of indistinguishable particles, transmission of single photon at lossless 50:50 beam splitter, the Mandel effect.

9: Few and many particle distributions, electron density of states and quantum conductance.

10-11: Experimental demonstration of Mandel effect.

12: Review home work.

13-14: Review density of states and quantum conductance. Maxwell equations, the coulomb blockade due to quantized charge.

15-17: Poisson equation and the depletion approximation. Review.

18: Midterm Exam.

_____SPRING BREAK_____

System integration

19-24: Measuring small currents and voltages that vary in time

i. Amplifier, noise, filtering, contact resistance

ii. Oscilloscope and ADC

SensorStick: How the sensors work.

i. Devices used to measure light level, temperature, humidity, and air pressure.

ii. Thermal, mechanical, electrical, optical physical models

iii. System integration of devices up to ADC

Passing measured data to a system, using a USB device to monitor light level, temperature, humidity, and air pressure.

FFT windowing, sub-sampling, real-time filtering.

How to make a presentation and write a report.

Project definition

25: Class presentation of initial project ideas.

26: Project troubleshooting.

27: Review

Class presentations

Presentation of results

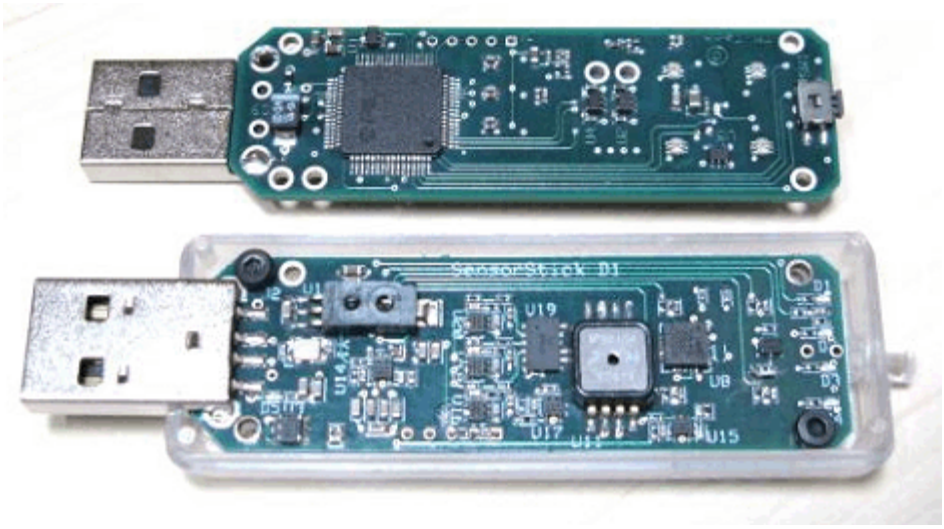
Final Exam

Final exam on elements of material drawn from the course

Resources

A manual has been developed to describe operation of a USB device and its interface to a computer.

Further information on SensorStick.



Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A:

http://www.usc.edu/dept/publications/SCAMPUS/gov/

Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at:

http://www.usc.edu/student-affairs/SJACS/

Guest Lectures in 2010

Science of Carbon Nanotubes: Steve Cronin

Applications of CNT and oxide NWs: Koungmin Ryu

Guest Lectures in 2011

Exceptional Properties and Unique Applications of Carbon Nanotubes and Graphene: Steve Cronin

Carbon Nanotube Nanoelectronics and Macroelectronics: Chuan Wang

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Guest Lectures in 2012

Carbon Nanotube Nanoelectronics and Macroelectronics: Jialu Zhang

Nano-biosensors: Shelley Wang

Properties and applications of CNTs and graphene: Steve Cronin

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Student projects in 2010

Aaron Sacks and Meharban Sobti Project Report and Presentation

Mina Eskandrous Project Report and Presentation

Nicolas Roy Project Report and Presentation

Paul Moldovan Project Report and Presentation

Simon Wagner Project Report and Presentation

Yoshitake Nakajima Project Report

Yu-Hsuan Lu Project Report and Presentation