EE 337 Engineering micro and nano-systems
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http://www.usc.edu/dept/engineering/eleceng/Adv_Network_Tech/Html/ee337.html

This 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 20% on homework, 50% 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.

Meeting	**Non-intuitive nano-device design**
1	***Lecture* 1**: Numerical tools: Introduction to programming in MATLAB. Fourier series, Fourier integral, FFT, and implementing high, low, and band pass filters.
2 - 4	***Lectures* 2 - 4**: Current: Physical values, introduction to electron current, potential, charge and current conservation. Concept of resistance, Ohms law, conductivity, mobility, and relaxation time approximation. Coulomb blockade. Current-voltage characteristics of a single-electron transistor.
5	***Lecture* 5**: Light: Introduction length scales and interaction of light with matter. Introduction to refractive index, Snell's law, impedance matching, reflection. Thin film optical filter. Solving the Helmholtz equation using the propagation matrix method.
6	***Lecture* 6 *and Laboratory 1***: Numerical evaluation of optical transmission and reflection through arbitrary thickness dielectric layers. Design of high index contrast mirrors for optical microcavities. Experimental measurement of time-domain and frequency domain response of 8 GHz and 14 GHz RF cavity.
7	***Lecture 7***: Optimal control: Searching for optimal device designs with a few free-parameters. Implementation of visualized 2-D problems using MATLAB and the concept of non-intuitive designs. i. Gradient-based optimization including steepest descent. ii. Guided random walk.
8	***Lecture 8***: Optimal design of dielectric structures for photonics. Design of a custom multi-layer optical filter and submission for fabrication.
	System integration
9	***Lecture* 9**: Measuring small currents and voltages that vary in time i. Amplifier, noise, filtering, contact resistance ii. Oscilloscope and ADC
10	***Lecture* 10**: Devices, packaging, and system integration 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
11	***Lecture* 11**: Passing measured data to a system, USB standard interface, device drivers, manipulation and display of data. i. Data types, Bytes, ASCII, timestamp ii. Protocol stack iii. Manipulation of data using MATLAB iv. Display of data

12 ***Lecture 12 and Laboratory 2***: Laboratory experiments using a USB device to monitor light level, temperature, humidity, and air pressure. Development of applications including a weather station.

Exam

13 Exam on elements of material presented in the first 10 sessions.

Project definition

14 ***Lecture 13***: Class presentation of initial project ideas.

Signal processing and firmware programming

15 ***Lecture 14***: FFT windowing, sub-sampling, real-time filtering.
16 ***Lecture 15***: Introduction to firmware programming
17 ***Lecture 16 and Laboratory 3***: Firmware programming using a boot-loader. Laboratory experiments programming USB device.

18 ***Lecture 17 and Laboratory 4***: Laboratory experiments to measure the performance of the class designed custom multi-layer optical filter (from lecture 6).

Time-domain signal processing

19 ***Lecture 18***: Feature extraction and classifiers. Testing against models.

20 ***Lecture 19***: Practice project presentations.
21 ***Lecture 20 and Laboratory 5***: Project troubleshooting.

22 ***Lecture 21***: How to make a presentation and write a report.

23 ***Lecture 22***: Practice project presentations.
24 ***Lecture 23 and Laboratory 6***: Project troubleshooting.
25 *Lecture* 24: Measuring small signals
26 *Lecture 25*: Noise in systems
27 *Lecture 26*: Review

Class presentations

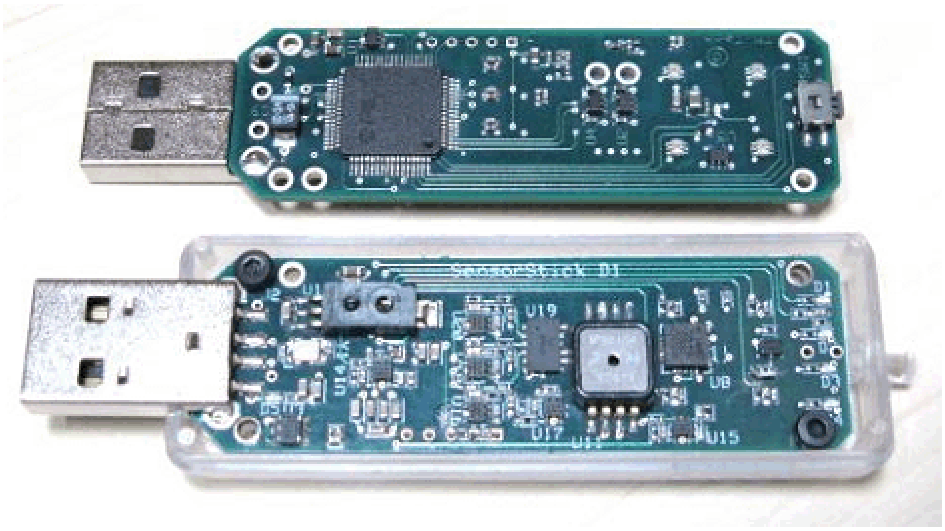
28 Presentation of results

Final Exam

29 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. More information on the device is available from 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/