Department of Electrical Engineering and Computer Science

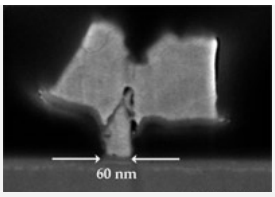
nanoEECS:

Why small is beautiful in Electrical Engineering and Computer Science

http://www.eecs.mit.edu/nanoeecs/

Nanoscale technology exploits unique effects that emerge as materials and devices shrink. EECS lays the foundation for this field starting with introductory courses, where the concept of a "bit" (the smallest unit of information) and the utility of a transistor (the elemental nano-electronic device) are explained, and expands from there.

The EECS department has been researching and teaching nanotechnology for decades, since well before the field attracted its recent attention. But the curriculum is complex. This brochure clarifies for the student in EECS what his or her "nanoEECS" options are: it should be the first stop in finding courses and research in nanoEECS.



Cross sectional view of InGaAs high-electron mobility transistor. *Jesus del Alamo*

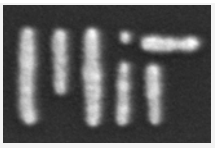
Nanoelectronics, magnetics, and optics

Electromagnetism applied at the nanoscale can be used to achieve a wide variety of phenomena, including topics as diverse as organic molecules that emit light and ultra-fast electronics. The EECS curriculum includes courses in every aspect of these varied disciplines.

	Faculty	Classes
Nanoelectronics	Antoniadis, Baldo, Berggren, Bulovic, Chandrakasan, del Alamo, Hoyt, Hu, Kong, Orlando, Palacios, H.I. Smith, White	**6.007, 6.A46, 6.085, 6.374, 6.376, 6.720, 6.728, 6.729, 6.774, 6.789, 6.975**
Nanomagnetics	Fonstad, Zahn	**6.641 and 6.642**
Nano/Micro-optics	Berggren, Bulovic, Dresselhaus, Freeman, Hu, Ippen, Kaertner, Kolodziejski, Ram, H.I. Smith, White, Yanik	**6.07, 6.012, 6.013, 6.A46, 6.084, 6.728, 6.731, 6.732, 6.789**

Nanofabrication, nanomaterials, and nanobiomaterials

The fabrication of new nanostructures and the development of new materials are the building-blocks upon which the development of future devices and applications are based. The tools and techniques of nanofabrication and nanomaterials are presented in a range of EECS courses.



Gold on silicon with sub-20-nm length-scale features. *Karl Berggren*

	Faculty	Classes
Nanomaterials and nanobiomaterials	Antoniadis, Baldo, Berggren, Bhatia, Bulovic, Dresselhaus, Han, Hoyt, Hu, Kong, Lozano-Perez, Ram, H.I. Smith, Tidor, Zahn	**6.730, 6.728, 6.732, 6.789**
Nanofabrication and self-assembly	Akinwande, Berggren, Boning, Bulovic, del Alamo, Hoyt, Kolodziejski, Palacios, Ram, Schmidt, H.I. Smith	**6.152J, 6.774, 6.781, 6.789**

Nanofluidic molecular filter array microdevice for fractionating proteins. *Jongyoong Han*

Nanobiotechnology

Nanobiotechnology

Quantitative understanding, manipulation and use of biological systems at nanoscopic length scales are the major goals of nanobiotechnology research. These groups develop and use many technologies, including nano/micro-fluidics, precision electronics, femtosecond optics, computational models and molecular probes to study a variety of biosystems.

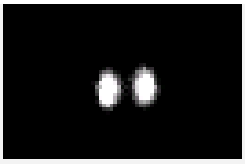
	Faculty	Classes
Nanobiotechnology	Baldo, Bhatia, Freeman, Han, Ram, Sarpeshkar, Voldman, White, Yanik, Zahn	**6.07, 6.021, 6.023, 6.376, 6.581**

Macroscopic ferrohydrodynamic instabilities observed in fluids containing 10-nm-scale suspended magnetite particles. *Markus Zahn*

Nano- and micro-mechanics and fluidics

Microelectromechanical systems are well-established as an important commercial and research technology. Microfluidic systems are now emerging as potentially transformative to health-care. As these systems scale to the nano domain, new applications and possibilities continue to emerge.

	Faculty	Classes
Nano/Micro-mechanics	Akinwande, Freeman, Schmidt, Voldman, Zahn	**6.152, 6.641, 6.642, 6.777**
Nano/Micro-fluidics	Freeman, Han, Schmidt, Voldman, White, Yanik, Zahn	**6.07, 6.021, 6.023, 6.152, 6.641, 6.642, 6.777**



Individual strontium ions, shown here trapped in a vacuum, form a quantum bit for for computation. *Isaac Chuang*

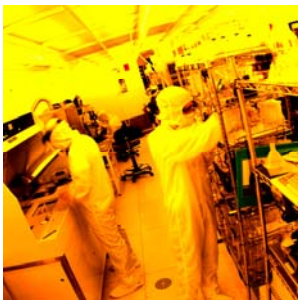
Quantum information Processing

Quantum information processing

At the nanoscale, information can be manipulated using the laws of quantum mechanics, enabling many new applications. The new field of quantum information promises to revolutionize computation and communication.

Faculty	Classes
Berggren, Chuang, Orlando, Shapiro	**6.085, 6.443J, 6.453, 6.728**

Major EECS Nano Labs and Facilities



Microsystems Technology Laboratory http://www.mtl.mit.edu*:* provides facilities for micro- and nano-device processing. Over 500 students from across MIT use this laboratory. 6.152J provides instruction and training for students wanting to access this facility.

NanoStructures Laboratory http://nanoweb.mit.edu*:* develops sub-100-nm processing tools and techniques. This lab focuses on developing new methods and tools for nanoscale fabrication

Scanning-Electron-Beam Lithography Facility http://www.rle.mit.edu/sebl*:* provides access to tools capable of sub-10-nm feature definition.