At Rice, the Department of Electrical and Computer Engineering (ECE) is a dynamic and broad discipline that uses principles in mathematics, physics, and chemistry to address the challenges in engineering materials, electronic devices, photonics, signals, and systems. The domain of applications, which is equally dynamic and broad, includes healthcare, energy, computing, wireless communication, networked computing, and security. Distinguished by a collaborative culture and global perspective, ECE offers students a wealth of opportunities to form close relationships with outstanding faculty who redefine the limits of curricula and integrate the best technology into the learning experience. Students gain access to an excellent computing infrastructure and gain valuable research experience in technologically advanced laboratories. The department offers numerous opportunities for interaction and knowledge exchange with partners throughout industry and academia through colloquia, workshops, and student forums — both informal and formal.

THE PROGRAMS

The Electrical and Computer Engineering graduate program is the second largest at Rice. The quality of students in the program is outstanding with graduates placed in highly visible positions throughout academia and industry. The department offers three graduate degrees: Master of Electrical Engineering (M.E.E.), Master of Science (M.S.), and Doctor of Philosophy (Ph.D.). These degrees are offered in two separate programs, M.E.E. and M.S./Ph.D. The Master of Electrical Engineering is a terminal, non-thesis degree intended primarily for students who wish to strengthen their academic background through 30 hours of additional course work. The M.S./Ph.D. program is a continuing program that offers first an M.S. degree followed by a Ph.D. Both of these degrees require a thesis.

The M.S./Ph.D program consists of formal courses and original research conducted under the guidance of faculty advisors. The first academic year concentrates on foundation course work and focuses on a research area. Each student must successfully complete a project in a chosen research area. This project is in lieu of an oral or written “qualifying exam.” In addition to enabling the faculty to evaluate the student’s research potential, the project encourages timely completion of the M.S. degree. After the first year, research occupies the majority of the student’s time and is conducted on a full-time basis. The ECE department does not offer a terminal M.S. degree.

The student must complete a master’s thesis and successfully defend it in an oral examination. This examination along with satisfactory performance in course work and a statement from the prospective Ph.D. advisor determines selection for Ph.D. candidacy. Students who have acquired a master’s degree elsewhere are still required to complete a first-year project. A candidate for the Ph.D. degree must demonstrate independent, original research in electrical and computer engineering.

CURRENT RESEARCH

The electrical and computer engineering faculty conduct transformational research in a number of areas.

Computer Engineering: The Computer Engineering group at Rice University has a long track record of innovative research in physical modeling and characterization, VLSI signal processing, computer architecture, computer-aided design, and storage and network systems. Spanning the spectrum of computing from low-power personal devices to large-scale parallel information systems, networked computing solves a myriad of technology challenges. Future computing technologies, including the on-chip integration of systems and networks, will move us beyond current methods in silicon.
Neuroengineering: Neuroengineering is the analysis and control of the nervous system in order to enhance and restore neuronal function. At Rice, we develop technologies to understand, repair, replace, enhance, or treat the diseases of the nervous system. We also design, construct and study devices that interface with living neural tissue. Current neuroengineering research in ECE includes:

- Nanotechnology for measuring and manipulating neural cells and circuits
- Optogenetic and photonic neural interface technology
- Computational microscopy and functional neural imaging
- Neural recordings in behaving animals
- Cutting-edge tools and algorithms for systems neurobiology
- Information theory and signal processing methods for neuroengineering
- Closed-loop neuromodulation and real-time deep brain stimulation
- Theoretical and computational neuroscience

Photonics and Nanoengineering: The focus of this program is the improved understanding of electronic, photonic, and plasmonic materials, optical physics, the interaction of light and matter, along with the application of that knowledge to develop innovative devices and technologies. The specific areas of interest cover a broad range: nanophotonics and plasmonics, optical nanosensor and nano-actuator development, studies of new materials, in particular nanomaterials and magnetically active materials; imaging and image processing, including multispectral imaging and terahertz imaging; ultrafast spectroscopy and dynamics; laser applications in remote and point sensing especially for trace gas detection; nanometer-scale characterization of surfaces, molecules, and devices; organic semiconductor devices; single-molecule transistors; techniques for optical communications; and optical interactions with random, nanoengineered and periodic media; and applications of Nanoshells in biomedicine.

Systems: Communications, Control, Networks and Signal Processing: The understanding of how to analyze and restructure signals is applied to a wide range of areas, including image and video analysis, representation, and compression; wavelets and multiscale methods; statistical signal processing, pattern recognition, and learning theory; distributed signal processing and sensor networks; communication systems; and computational neuroscience. Emergent applications include high-performance, scalable and widely deployed wireless Internet and expanding “broadband” services for residences and public spaces.

FACULTY
The Department of Electrical and Computer Engineering is committed to excellence and leads innovative research programs that have significant global and societal impact. The department currently has 22 tenure-track faculty, two research faculty, 20 joint faculty, three professors emeriti, and three professors in the practice. In addition, ECE has a number of lecturers, faculty and postdoctoral fellows, and various visitors.

The breadth of awards and honors demonstrate our diversity and commitment to research excellence, including fellows of the IEEE, DoD National Security Science and Engineering Faculty, Optical Society of America, American Association for the Advancement of Science (AAAS), the American Physical Society, the Sloan Foundation, SPIE International Society for Optical Engineering. In addition, there are U.S. patent holders, National Science Foundation (NSF) CAREER awards, ONR and NSF Young Investigator awards, and the Defense Advanced Research Projects Agency Young Faculty awards, a member of the National Academy of Sciences, a recipient of a Top 50 Nano Researchers Award and the Defense Advanced Projects Research Agency Young Faculty Award, a member of the American Academy of Arts and Sciences, and a Jack Kilby medalist. Several faculty members have received multiple teaching awards at Rice.


FACILITIES

Anne and Charles Duncan Hall is designed to promote the sharing of resources among engineering departments, facilitating multidisciplinary research and education. Private offices, classroom, laboratories, lecture halls, an auditorium, conference rooms, and courtyards surround an atrium. The atrium, Martel Hall, is where many poster sessions, conference receptions and engineering events are held. Departments, research institutes, and centers in Duncan Hall include electrical and computer engineering, as well as computational and ap-
plied mathematics, statistics, and computer science, the Ken Kennedy Institute for Information Technology, and the Center for Multimedia Communication (CMC) which is situated in a dedicated Texas Instruments Wing. The Abercrombie Building, located adjacent to Duncan Hall, houses part of electrical and computer engineering, as well as chemical engineering and civil and environmental engineering.

All research programs in the department use the extensive computing facilities available for education and research, including two state of the art clean rooms, an undergraduate lab, and a DSP “Elite” Lab. Resources are on a local area network of heterogeneous machines running variations of UNIX operating systems, Windows, and various networking software. The computational hardware available to our faculty and students includes the Rice Computational Research Cluster, a 3 TeraFLOP Gray XD1 Linux cluster, and the Rice Terascale Cluster, a 1 TeraFlop HP Integrity Linux cluster. In addition to these large scale shared resources, individual research groups and departments have access to and manage various parallel machines and small clusters of workstations and PCs.

**RESEARCH INSTITUTES, CENTERS, LABORATORIES, GROUPS**

Rice ECE maintains a number of research entities that foster collaborative research on multidisciplinary projects that attract faculty from other departments and schools on campus and outside of Rice. Depending on size, these entities are referred to as institutes, centers, laboratories or groups.

**Institutes**

**Ken Kennedy Institute for Information Technology**

The Ken Kennedy Institute for Information Technology (K2I) is a research-centric institute dedicated to the advancement of applied interdisciplinary research in the areas of computer and information technology. K2I’s heritage and primary strengths are in the areas of high-performance computing and computational science and engineering. K2I’s goals are to support, foster, and develop a strong community of research and education across a wide area of computing technologies, computational engineering, and information processing agencies – multidisciplinary or process optimization, collaborative development, distributed computing and parallel computational environments, data mining, and advanced visualization.

**Institute of Biosciences and Bioengineering (IBB)**

IBB leverages existing strengths of Rice University’s first-rate biosciences/bioengineering program. The institute coordinates activities located in the traditional academic divisions, encouraging multidisciplinary, collaborative relationships and strengthening the areas of bioengineering, biochemistry, and biology. IBB faculty performs research in many diverse areas including for example: Developmental Biology, Tissue Engineering, Bio-nanotechnology, Biology and Physics of Membranes, Evolutionary Biology, and Metabolic Engineering.

**Rice Quantum Institute (RQI)**

RQI’s primary mission is to facilitate and promote research in atomic, molecular, and optical physics. RQI is a collaborative group of chemists, physicists, and engineers study a diverse range of effects, on scales ranging from atomic dimensions to interstellar distances. The simultaneous pursuit of basic and applied research provides a valuable training ground for careers in science and technology. Research groups in RQI have participated in a number of such cutting-edge developments, including the discovery of fullerenes, the development of carbon nanotube and metal nanoshell technologies, the manufacture of molecular-scale electronic devices, and the Bose-Einstein condensation of ultra-cold atoms. Advanced characterization tools provide insight into the world of the ultra-small. The development of powerful computational algorithms combined with fundamental theory is applied to increasingly complex problems of physical interest. Theoretical research programs include electronic structure, electronic and nuclear dynamics, molecular dynamics simulations and statistical mechanics.

**Centers**

**The Center for Multimedia Communication (CMC)**

The multidisciplinary Center for Multimedia Communication includes faculty members in the Departments of Electrical and Computer Engineering and Computer Science who conduct research in wireless communications and VLSI signal processing architecture. CMC is supported by a significant commitment of facilities and equipment from Rice University, the National Science Foundation, National Instruments, Nokia, Texas Instruments, Intel, Xilinx, the State of Texas. Students working in the CMC lab explore power efficiency and complexity issues in wireless communication systems. The CMC lab is equipped with advanced hardware and software research tools, including multiprocessor workstations, digital signal processing hardware and tools, field programmable gate array (FPGA) hardware and tools, RF hardware, RF and digital test equipment, research design and simulation environments, and CAD software suites. The Rice Wireless Open Access Research Platform (WARP) hardware testbed provides support for evaluation and performance analysis of FPGA and ASIC structures for digital baseband processors.

**The Laboratory for Nanophotonics (LANP)**

A team of graduate students and faculty in the Laboratory for Nanophotonics perform groundbreaking research of near and long-term societal benefit in the broad multidisciplinary field of nanophotonics. The research spans the physical, chemical, biological and information sciences, with applications in medicine, energy, and computing. In graduate education and training, LANP was awarded an NSF IGERT (Integrative Graduate Education and Research Training) grant in nanophotonics, the first graduate degree program in the US in this emerging field. It has provided Rice students and those from outside Rice hands-on undergraduate research experiences that will provide advantages in subsequent graduate and professional opportunities. LANP is the home of the Conjunto Scholars and Mentors Program. The goal of the Conjunto Project is to effect long-range improvement in science education for predominantly minority students and to increase the flow of underrepresented ethnic minorities, particularly Hispanic men and women, into science and engineering careers. LANP is an affiliate of the Richard E. Smalley Institute for Nanoscale Science and Technology, which is devoted to nurturing science and technology at the nanometer scale. It encourages multi-disciplinary collaborations where researchers from all disciplines of science and engineering can come together to share ideas and discuss their views and prospects of nanoscience, nanotechnology, and nanotechnology.

**Rice Center for Neuroengineering**

In addition to the ongoing neuroengineering research efforts in individual laboratories across campus, the university has established the Rice Center for Neuroengineering (RCNE). The center’s goal is to integrate state-of-the-art research and technologies developed by individual research teams into broader research efforts to interrogate and understand neural systems. The mission of the RCNE is to apply engineering principles to neuroscience in a way that advances both the science and technology related to neural systems. RCNE is uniquely
positioned as a leader in neuroengineering thanks to the broad, interdisciplinary research performed in conjunction with the world’s largest medical center (Texas Medical Center), steps away from the Rice University campus.

**Groups**

**Connexions®**

Connexions, which originated in ECE is a web based environment for collaboratively developing, freely sharing, and rapidly publishing scholarly content. The “content commons” contains educational materials for everyone — from children to college students to professionals — organized in small modules that connect easily into larger courses. All content is free to use and reuse under the Creative Commons “attribution” license. More than one million people from 194 countries are tapping into more than 3000 modules and 200 courses developed by a worldwide community of authors in many fields. In addition to modules written in English, one can find modules written in Chinese, Italian, Japanese, Portuguese, Spanish, and Thai.

**Digital Signal Processing (DSP) Group**

The DSP group has assembled an innovative team of faculty, staff and graduate students that solves modern signal processing problems; ranging from compressive sensing, distributed signal processing on sensor networks, multiscale geometric analysis, network modeling and inference, to single pixel cameras.

**Dynamical Systems Group (DSG)**

DSG fosters collaboration and interdisciplinary research in the dynamical systems area across several departments in the School of Engineering. The emphasis is on computational aspect arising in large scale systems with applications ranging from VLSI design to molecular dynamics to high rise buildings.

**Laser Science Group**

The Laser Science Group is a multidisciplinary team with members from the Schools of Natural Sciences and Engineering at Rice. This group conducts research and development in quantum electronics, in particular laser spectroscopy applied to sensitive, selective and real-time trace gas detection, and laser applications in environmental monitoring, chemical analysis, industrial process control, and medical diagnostics. Rice University’s Laser Science Group is one of five core partner institutions with Princeton in an Engineering Research Center, which is expected to revolutionize sensor technology, yielding devices that have a unique ability to detect minute amounts of chemicals found in the atmosphere, emitted from factories or exhaled in human breath.

**Mid-Infrared Technologies for Health and the Environment (MIRTHE)**

Work performed by the Mid-Infrared Technologies for Health and the Environment center (MIRTHE) will span from fundamental science to applied technology. The research will transform aspects of the way doctors care for patients, local agencies monitor air quality, governments guard against attack and scientists understand the evolution of greenhouse gases in the atmosphere.

**Rice Computer Architecture**

The Rice Computer Architecture group focuses on the design, analysis, and implementation of high-performance computing systems for such demanding tasks as networking, communications, multimedia, and scientific computing. Our group draws faculty and students from the Computer Science and Electrical and Computer Engineering departments.

**Rice Efficient Computing Group (RECG)**

The Rice Efficient Computing Group (RECG) develops efficient technologies for future computing, communication and interfacing for mobile and embedded computing and design automation of digital systems.

**Rice Networks Group (RNG)**

Rice Networks Group (RNG) focuses on designing a high-performance, scalable and widely deployed wireless Internet that facilitates services ranging from radically new and unforeseen applications to true wireless “broadband” to residences and public spaces. Through a partnership with Technology for All, the Rice Networks Group has designed and built a wireless mesh network that provides high-speed Internet access to residents in one of the most economically disadvantaged neighborhoods of Houston. Another vision of this group is to cost-effectively provide households and small business with a network infrastructure for greater interconnection speed, more services, and higher security.

**TeraNano PIRE: Terahertz Dynamics in Nanostructures**

Directed by Prof. Junichiro Kono, the TeraNano PIRE project at Rice University is a unique U.S. – Japan partnership focused on research on terahertz dynamics in nanostructures. This PIRE project seeks to (a) advance our quantitative understanding of THz dynamics in nanostructures, (b) fabricate novel nanostructures for THz study and applications, (c) advance cutting-edge experimental techniques in THz spectroscopy and imaging, and (d) provide new knowledge useful for developing novel THz devices. The projects explore THz dynamics in carbon nanomaterials, namely, nanotubes and graphene. The U.S. and Japan are global leaders in both THz research and nanotechnology and stimulating cooperation is critical to further advance THz science and develop commercial products from new ideas in the lab. The key educational initiative of TeraNano PIRE is the NanoJapan: International Research Experience for Undergraduates program which has been nationally recognized as a model for international education programs for science and engineering students. TeraNano PIRE Graduate Research Assistants at Rice may also apply to participate in the TeraNano PIRE International Research Experience to conduct 1 – 2 month research internships with collaborating research laboratories in Japan.

**Value of Information-Based Sustainable Embedded Nanocomputing (VISEN)**

VISEN’s guiding philosophy is to take advantage of the limitations in our ability to perceive quality of information from a computer, and when we do perceive it, our willingness to tolerate it if in return, we are able to have access to devices with much lower cost, energy consumption, heat dissipation and an ability to cope with fluctuations in the “quality” of the transistors. Thus, value of information can be used to guide the design of computing devices, while treating many of the impediments as “features” modeled using probability and randomness, with the goal of sustaining the explosive growth of embedded computing in the nanoscale regime, and be increasingly friendly to the energy footprint of computing systems on a global scale.
Rice is a leading American research university—small, private and highly selective—distinguished by a collaborative, interdisciplinary culture and a global perspective. Only a few miles from downtown Houston, it occupies an architecturally distinctive, 285-acre campus shaded by nearly 4,000 trees. State-of-the-art facilities and laboratories, internationally renowned centers and institutes and one of the country’s largest endowments support an ideal learning and living environment.

The university attracts a diverse group of highly talented students and faculty with outstanding graduate and professional programs in the humanities, social sciences, natural sciences, engineering, architecture, music and business. With just 2,324 graduate students and 3,708 undergraduates, it offers an unusual opportunity to forge close relationships with eminent faculty scholars and researchers and the option to tailor graduate programs to specific interests.

Houston offers all the expected educational, cultural and commercial advantages of a large urban center, and more. It’s home of the Texas Medical Center, the largest concentration of medical schools, hospitals and research facilities in the world, as well as several other universities. Rice has cooperative programs with the University of Houston, Baylor College of Medicine, the University of Texas Health Science Center and Texas Southern University. Houston is one of the few U.S. cities with resident companies in all four major performing arts—drama, ballet, opera and symphony. It also boasts a museum district featuring exhibits of national and international prominence.

As urban as it is, Houston also is a surprisingly green city. Houstonians enjoy the outdoors in more than 300 municipal parks and 120 open spaces, and many frequent the beach at Galveston Island, only a 45-minute drive away. Other short trips include Austin, the state’s capital, and historic San Antonio, both of which are a little more than three hours away.

HOW TO APPLY

Applicants to the ECE Ph.D. and nonthesis programs, go to ecegradapps.rice.edu to apply online. If the link is unavailable, the application deadline has passed.

Deadline for fall admission of Ph.D. and M.E.E. students is January 5, 2015.
Deadline for spring admission of M.E.E. students only is October 15.

Students must submit the following materials online with their completed application:

• Transcripts from all colleges and universities attended, including first semester grades for senior year
• The results of the GRE, taken within the last three years
• At least three letters of recommendation from faculty who are familiar with the applicant
• If English is a second language, test scores from the Test of English as a Second Language (TOEFL) are required
• An application fee of $85

For further information about the department, contact the Graduate Program Coordinator at 713-348-5081 or:
Department of Electrical and Computer Engineering – MS 366
Rice University
PO Box 1892
Houston, Texas 77251-1892
E-mail: elec@rice.edu
ECE Web site: www.ece.rice.edu

FOR ADDITIONAL INFORMATION:
Rice University homepage: rice.edu
Rice University Office of Graduate and Postdoctoral Studies homepage: graduate.rice.edu
Graduate Student Association homepage: gsa.rice.edu
City of Houston homepage: www.houstontx.gov
Houston information from the Houston Chronicle: chron.com
Houston information from the Greater Houston Partnership: houston.org
Houston information from Citysearch: houston.citysearch.com