### ECE at a Glance

#### Students

<table>
<thead>
<tr>
<th></th>
<th>Enrolled</th>
<th>Degrees Granted</th>
<th>Ranking (U.S. News &amp; WR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE undergrad</td>
<td>267/433</td>
<td>139/184</td>
<td>6</td>
</tr>
<tr>
<td>CE undergrad</td>
<td>166/433</td>
<td>45/184</td>
<td>7</td>
</tr>
<tr>
<td>EE grad MS</td>
<td>67/116</td>
<td>55/102</td>
<td>7</td>
</tr>
<tr>
<td>EE:Systems grad MS</td>
<td>49/116</td>
<td>47/102</td>
<td>7</td>
</tr>
<tr>
<td>EE grad PHD</td>
<td>179/262</td>
<td>34/48</td>
<td>7</td>
</tr>
<tr>
<td>EE:Systems grad PHD</td>
<td>83/262</td>
<td>14/48</td>
<td>7</td>
</tr>
</tbody>
</table>

#### External Research Funding

- FY2008: $28M
- 170 Patents
- 193 Licenses
- 625 Disclosures
- >29 startups

#### Centers

- **Michigan Institute for Plasma Science and Engineering**
- **Center for Ultrafast Optical Science**
- **Center for Microelectronics and Sensors**
- **Center for Wireless Integrated Microsystems**

#### Research Centers

- Michigan Institute for Plasma Science and Engineering
- Center for Ultrafast Optical Science
- Center for Microelectronics and Sensors
- Center for Wireless Integrated Microsystems

#### Faculty, Staff

<p>| | | | |</p>
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<tbody>
<tr>
<td>Professors:</td>
<td>39/63</td>
<td>Res. Sci.: 14</td>
<td></td>
</tr>
<tr>
<td>Assoc. Prof.:</td>
<td>10/63</td>
<td>Post Docs: 27</td>
<td></td>
</tr>
<tr>
<td>Asst. Prof.:</td>
<td>14/63</td>
<td>Visiting Fac.: 4</td>
<td></td>
</tr>
</tbody>
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<tr>
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</thead>
<tbody>
<tr>
<td>GSRAs:</td>
<td>193</td>
<td>Alumni: total – 18,000</td>
<td></td>
</tr>
<tr>
<td>GSIs:</td>
<td>31</td>
<td>Alumni: living – 16,000</td>
<td></td>
</tr>
<tr>
<td>Fellowships:</td>
<td>37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Academic Rankings

- EE undergrad: 6
- CE undergrad: 7
- EE grad MS: 7
- EE:Systems grad MS: 7
- EE grad PHD: 7
- EE:Systems grad PHD: 7

#### Alumni

- Total: 18,000
- Living: 16,000

#### Awards

- 25 CAREER/YIA
- 36 Faculty with 64 Fellows
- 42 Teaching Awards
- 5 Members of the NAE

#### Teaching Awards

- 25 CAREER/YIA
- 36 Faculty with 64 Fellows
- 42 Teaching Awards
- 5 Members of the NAE
New Faculty Since 2007

Tal Carmon
PhD Israel Inst. Tech ‘03
Opto-mechanical effects, photonic MEMS

Robert Dick
PhD Princeton ‘02
Embedded systems, CAD, data compression, VLSI

Ian A. Hiskens
Vennema Professor
PhD U. Newcastle ‘91
Power system analysis, active grid control concepts

Heath Hofmann
PhD Berkeley ‘98
Power electronics and systems

Mona Jarrahi
PhD Stanford ‘07
Terahertz electronics, MMW/RF circuits and MEMS

Mark J. Kushner
George I. Haddad Professor of EECS
PhD CalTech ‘79
Plasma science and engineering

Raj Nadakuditi
PhD MIT ‘07
Statistical signal processing and random matrix theory

Mina Rais-Zadeh
PhD GeorgiaTech ‘08
RF MEMS, MEMS-enabled ICs, packaging, micro/nano-fabrication

Silvio Savarese
PhD CalTech’05
Computer vision, object and scene recognition

David Wentzloff
PhD MIT ‘07
RF circuits and systems, UWB communication, wireless systems

Euisik Yoon
PhD Michigan ‘90
Solid-state integrated sensors, analog and digital circuits

Zhengya Zhang
PhD Berkeley ‘09
VLSI architecture, digital systems, communication and signal processing systems

Zhaohui Zhong
PhD Harvard ’05
Nanoelectronics, nanophotonics, solar cell technology, sensing
Faculty Honors and Awards

EECS/CoE/U-M (2008-09)

Jay Guo, EECS Outstanding Achievement Award
Sandeep Pradhan, EECS Outstanding Achievement Award
Brian Gilchrist, CoE Service Excellence Award
Anatoly Maksimchuk, CoE Outstanding Research Scientist Award
Kurt Metzger, CoE Thomas M. Sawyer, Jr. Teaching Award
Mahta Moghaddam, CoE Education Excellence Award

David Blaauw, Dennis Sylvester, CoE Team Excellence Award
Semyon Meerkov, Distinguished Faculty Governance Award
Alfred O. Hero – R. Jamison and Betty Williams Professor
Ian Hiskens – Vennema Professor of Engineering
Mark Kushner – George I. Haddad Collegiate Professor
Kamal Sarabandi – Rufus S. Teesdale Professor
Fawwaz Ulaby – Chen-To Tai Collegiate Professor

National (2008-09)

Tony Grbic – PECASE Award
Mark Kushner – APS Will Allis Prize
Duncan Steel – APS Frank Isakson Prize
Steve Forrest – APS Fellow, Board chair for SPARK
Al Hero – IEEE Board of Directors for Signals and Systems, awarded Digiteo Chaire d’Excellence
Mahta Moghaddam – IEEE Fellow
Thomas Senior – 2010 IEEE Electromagnetics Award

David Blaauw, Todd Austin – 2008 Richard Newton GSRC Industrial Impact Award
Pallab Bhattacharya, Elected Member of the National Academy of Engineering, 2008 John Bardeen Award
Mark Kusher, Stéphane Lafortune, HP Innovation Award
Jerzy Kanicki, Ministry of Education, Science and Technology Award

CAREER/Young Faculty Awards (since 2003)

David Wentzloff – DARPA Young Faculty Award (2009)
Tony Grbic – AFOSR Young Investigator Award (2007)
Domitilla Del Vecchio – CAREER (2007)
Petar Momcillovic – CAREER (2007)
Jamie Phillips – DARPA Young Faculty Award (2007)

New Named Professorships

Alfred O. Hero – R. Jamison and Betty Williams Professor of Engineering
Research: adaptive sensing, inference in sensor networks, bioinformatics, inverse problems, and statistical signal and image processing

Ian Hiskens – Vennema Professor of Engineering
Research: power systems and analysis of nonlinear (hybrid) systems, in particular system dynamics and control, and numerical techniques

Mark Kushner – George I. Haddad Collegiate Professor of EECS
Research: low temperature plasma science and engineering, addressing fundamental transport and reaction chemistry of partially ionized gases and their application to technology

Kamal Sarabandi – Rufus S. Teesdale Professor of Engineering
Research: applied electromagnetics, with an emphasis on antennas, radar imaging and remote sensing

Fawwaz Ulaby – Chen-To Tai Collegiate Professor
Research: microwave and millimeter wave remote sensing, radar systems, radio wave propagation
Featured Research Highlights

• Jay Guo, *Nano Printing Goes Large*, continuous nanoimprinting for displays and solar cells, MIT Technology Review (9/2/09)
• Mark Kushner, *U-M one of first universities to offer formal program in plasma science and engineering*, CoE Press Release (5/29/09)
• Robert Dick, *Bridging the gap between wireless sensor networks and the scientists who use them*, U-M Press Release (4/6/09)
• Wei Lu, *U-M engineer's memristor chip could lead to faster, cheaper computers*, U-M Press Release (3/17/09)
• Pallab Bhattacharya, *Can you see me now? Flexible photodetectors could help sharpen photos*, U. Wisconsin-Madison Press Release (1/13/09)
• Jerry Lynch and various WIMS faculty, *Smart bridges under development with new federal grant*, U-M Press Release (1/14/09)
Featured Research Highlights

- Mohammed Islam, Farnam Jahanian, Distinguished University Innovator Award for 2007 and 2009, respectively
- Jay Guo, *University of Michigan Office of Technology to showcase inventions*, Ann Arbor News (9/30/08), featured Guo’s work in nanoimprint lithography
- Duncan Steel, *Fast quantum computer building block created*, U-M Press Release (8/20/08)
- Tony Grbic, *Pinpoint microwave resolution could lead to wireless power transfer*, U-M Press Release (4/24/08) and in *Science* (4/25/08)
- Victor Yanovsky and HERCULES, *The most intense laser in the Universe*, *Nature News* (2/18/08) and numerous other news outlets
- John Whitaker, *High-tech device uses rays to unveil hidden artwork*, The University Record (2/1/08) and other outlets
ECE Staff Awards

Karen Liska, Human Resources Coordinator for EECS, Judith A. Pitney Staff Service Career Award

Barbara Rice, Senior Research Administrator, 2009 Distinguished Research Administrator Award from the Office of the Vice President for Research

Dennis Schweiger, Facilities Supervisor for the LNF, College of Engineering Staff Excellence Award
Total Research Expenditures (FY09): $28M

- **DoD ($11.87M)**: 42%
- **NSF ($9.27M)**: 33%
- **Other Federal ($3.4M)**: 12%
- **Non Federal ($3.6M)**: 13%

**Non Federal:** Primarily Industry

**Other Federal Depts:**
- NIH (43%)
- Energy (27.5%)
- NASA (20.6%)
- Commerce: NIST (8%)
- Others (1%)
An Integrated Hybrid Recording Array

A fully integrated microsystem for autonomous data gathering

Fabricated micro thermoelectric power generator from environmental sources

Resonators and integrated circuits

RF-MEMS and Wireless Interfaces

Env. Microsystems, Microfluidics and Chemical Sensors

Power Sources & Energy Harvesting

NEMS, Nanosensors and Nanomaterials

Micromachining, Packaging, Microplasma Based MEMS

MEMS and Microsystems

K. Wise/WIMS

K. Najafi

M. Rais-Zadeh

K. Najafi

Z. Zhong

AU-SI eutectic vacuum packaging

Improving solar cells at a nanolevel: terahertz electrical characterization in nanomaterial photovoltaics

K. Najafi
Ken Wise, Director

33 Faculty and Scientists from U-M, Michigan State, and Michigan Tech

Research:
Micropower circuits, wireless interfaces, MEMS, and advanced packaging for applications such as a gas chromatograph, cochlear implants, and neural implants.
Antennas


Terahertz Technology

Antennas

Quasi-CW Terahertz Source

Near-field plate: for high resolution microscopes; lithography systems; chip integration; wireless power transfer

Medical imaging

Ferroelectric Based Frequency Agile RF Circuits


Remote Sensing & Imaging

Radio Frequency (RF), Millimeter-wave, & Terahertz Technologies

Fast Time-Domain Integral Equation Solvers

Plasma Science & Engineering

Computational Electromagnetics

M. Kushner

E. Michielssen
Kamal Sarabandi, Director

18 Faculty from U-M, UC-Berkeley, and U. New Mexico

Research: Small, next-generation autonomous sensor platforms, incorporating power, navigation, communications, sensing, and processing.
Wireless ad-hoc sensor network

Modulation, coding, compression, and multi-terminal techniques

Active ring resonators for sensing and communication applications

New channel coding approaches are being investigated to improve the reliability of data transmission

A. Anastasopoulos, W. Stark, K. Winick

Time-encoding switch abandons standard model of computation

P. Momcilovic

Joint data detection and parameter estimation
Gadara architecture combats software deadlocks

Embedded controller for a haptic interface

Nonlinear control theory helps robotic walking

An automotive energy-management controller for a hybrid electric vehicle
Advanced RF pulse design methods improve fMRI images

Capturing spatial-temporal relationships for object and action categorization

Blind reconstruction of sparse image

Isolating genes in the retina

Video over wireless

Dense low-power sensor networks
Hierarchical control architecture of a hybrid electric vehicle

J. Grizzle

3D object categorization
S. Savarese

In-scale cars avoid collision through feedback algorithms and networked sensors
D. Del Vecchio

The robot MABEL is walking, and being “trained” for running and walking on uneven ground
J. Grizzle

Visual recognition in the three-dimensional world
S. Savarese

MABEL’s powertrain contains springs that act like tendons and store energy.
J. Grizzle
An 8 bit 500MS/S calibrated folding analog-to-digital converter

M. Flynn

Non-transistor based memory and logic devices beyond the end of the roadmap

W. Lu

Phoenix: A 30pW platform for sensor applications

D. Blaauw, D. Sylvester

UWB for short-range wireless communication

D. Wentzloff

A neural interface containing integrated circuitry on the probe

K. Wise, WIMS

Integrated Circuit Design and VLSI

Crossbar arrays

W. Lu

Analog Electronics and ICs

Extreme Low-Power Circuits

VLSI and Digital Circuits & Systems

RF and Wireless Communication Circuits

Circuits for MEMS and Microsystems

Prototype wire-wrap circuit board measures pollutants using a distributed social network of embedded systems

R. Dick
Displays and Detectors

Hexagonal a-Si:H TFTs, a new advanced technology for flat panel displays

J. Kanicki

Magneto-opto-electronic integrated circuits

Electrically-driven quantum dot photonic crystal lasers

P. Bhattacharya

Roll-to-roll nano-imprinting on a flexible plastic web

J. Guo

Solid-State Devices and Nanotechnology

Polymer and Organic Devices and Circuits

Nanotechnology & Nanofabrication & Nanomaterials

Materials, metrology & process control for nano- and opto-electronic devices

Electrically-driven quantum dot photonic crystal lasers

Material Synthesis

Lurie Nanofabrication Facility

J. Phillips

Material Properties

Devices
Electric Vehicles

Renewable Energy (wind and solar cells)

PHEV and the grid
HEV and fuel economy

J. Grizzle, I. Hiskens

Scavenging Power from Low-frequency Vibrations
K. Najafi

White Lighting: Saving energy with organics
S. Forrest

Flow of electrical energy in industrial, residential, and transportation applications

New courses in energy

Power Electronic Systems

Power System Analysis and Control

Renewable Energy (wind and solar cells)

Solid-State Lighting

Electromechanical Energy Conversion

“Smart” Grid
I. Hiskens

I. Hiskens, S. Forrest, J. Phillips, Z. Zhong
Ultrafast Optics & High Field Laser Matter Interactions

HERCULES: Record breaking high intensity laser
Targeting cancerous tumors for treatment

Lasers to manipulate quantum bits, to store and process information

Optics, Lasers, & Photonics

Optoelectronics and Integrated Photonics
BioPhotonics and Nanophotonics
Quantum Optics and Information
Fiber Optics

Optics, Lasers, & Photonics

Hemispherical organic photodetector focal plan imaging arrays

Ultrafast laser pulse generation in optical fibers for next-generation lithography and optical scanning

Highest frequency demonstrated in any type of MEMS – 10GHz

T. Norris
D. Steel
A. Galvanauskas

S. Forrest

T. Carmon
Research: Ultrafast (femtosecond) laser applications include biomedical optics, micromachining, cancer treatment, lithography for chip manufacturing, and scientific study of light-matter interactions.
Determining the power and limits of quantum computation. Applications to cryptography, new paradigm for Moore’s Law.

J. Hayes, I. Markov, Y. Shi
Plasma materials processing of MEMS devices produces micro-plasma based sensors for pollutants to monitor the health of our environment.

Fundamental studies of plasmas through dense gases and liquids will lead to new technologies to remove toxins from water.

Improvements in combustion for transportation using advanced plasma ignition will reduce our carbon footprint.

High-energy-density plasmas produced by pulsed power are the basis of technologies ranging from laser particle accelerators to health-care.

Plasmas for functionalizing micro-fluidic ‘labs-on-a-chip’ and treating human tissue could revolutionize healthcare.

Simulations of advanced plasma-based spacecraft propulsion systems are bringing us closer to the stars.
Michigan Institute for Plasma Science and Engineering (MIPSE)

Mark Kushner, Director

27 Faculty and Researchers from 11 departments across the University

Research:
Fundamental processes and technological applications of ionized gases for applications including MEMS devices, microelectronics fabrication, space applications, biotechnology, and energy sources.
ECE Research on Journal Covers

**JAN 2009**

Al Hero
A new method for clinical flow cytometry

**MAY 2009**

Kamal Sarabandi
Special issue, remote sensing of building interiors

**JAN 2009**

Pallab Bhattacharya
Flexible photo-detectors on plastic substrates

**FEB 2008**

Stephen Forrest
Solid-state lighting

**MAR 2008**

Wei Lu
Nanowires for sensor applications

**AUG 2008**

Ken Wise
Cochlear implants

**APR 2008**

The laser named HERCULES established a new world record for on-target laser intensity.

**SEP 2007**

Special issue on Quantum-Dot Optoelectronic Devices, Pallab Bhattacharya, guest editor.

**AUG 2006**

WIMS research, article by Joe Giachino.

**SEP 2005**

Yogesh Gianchandani, Ken Wise
New Stentenna

**OCT 2003**

Jessy Grizzie
His work on the robot RABBIT
• Lurie Nanofabrication Facility
• Optics Labs (HERCULES)
• Anechoic Chamber
• Computing resources & support (DCO, CAEN, ITD)
• Individual faculty labs
Serving ECE, CoE, U-M, Michigan high-tech companies, government, other colleges and universities.

11,000 sq. ft class 10/100 cleanroom with equipment for:
- Thin-film deposition and growth
- Optical and e-beam lithography
- Nanoimprinting
- Wet and dry etch
- Electrochemical deposition
- Chemical mechanical planarization
- Wafer bonding
- Wafer dicing
- Wire bonding
- Metrology, etc.

Annual Stats
- 250 Lab Users
- 200 K-12 Students
- 3-5 Workshops
- $3M Budget
NNIN: National Nanotechnology Infrastructure Network

Serving the needs of nanoscale science, engineering, and technology researchers across the country.
Users of the LNF

>250 users
71% Internal
29% External

- Continental Automotive
- Dexter Research Center
- Discera
- Energy Conversion Devices
- e-Pack
- Evigia Systems
- First Solar
- Global Photonic Energy Corporation
- IMRA America
- Integrated Sensing Systems
- Klabs
- MEMS Touch
- Midwest Micro Devices
- Nanoselect
- Neuronexus Technologies
- Optical Filter Source
- PicoCal
- Picometrix
- Promerus
- Silicon Solutions
- Sonetics Ultrasound
- Stryker
- Vachette Pathology

Cornell University
Kent State University
Michigan State University
Oakland University
Ohio State University
Rensselaer Polytechnic Institute
University of Minnesota
University of Nebraska - Lincoln
Wayne State University
Western Michigan University

Large Company 5%
Small Company 14%
Other University 14%
Electrical Eng
Mechanical Eng
Chemical Eng
Nuclear Eng
Biomedical Eng
Material Science Eng
Aerospace Eng
AOSS
Physics
Chemistry
Molec, Cell & Dev Biology

Local
Academic
71%
LNF Users Technical Areas

- Electronics: 27%
- Optics: 5%
- Materials: 18%
- MEMS: 9%
- Physics: 29%
- Chemistry: 1%
- Life Sciences: 3%
- Medicine: 2%
- Process: 6%
- Other Research: 0%
Industrial Programs

- IP
- Disclosures
- ECE Startups
- Entrepreneurs
- Connecting with ECE
- Patents
TOTAL: 170 Patents
193 Licenses
625 Disclosures

- 59 Patents
  49 Licenses
  150 Disclosures
- 34 Patents
  47 Licenses
  157 Disclosures
- 10 Patents
  6 Licenses
  61 Disclosures
- 11 Patents
  9 Licenses
  57 Disclosures
- 46 Patents
  21 Licenses
  86 Disclosures
- 10 Patents
  61 Licenses
  114 Disclosures

MEMS & Microsystems
Circuits & Systems
Optics & Lasers
Nano & Solid State
Applied Electromagnetics
Systems

IP 1998-6/2009
U-M Invention Disclosures: FY 2008

- ECE: 58
  Leading all Individual Departments at U-M
- Medical: 126
- Other U-M Departments: 49
- Engineering: ECE: 58
- Engineering: non ECE: 73
>29 Companies Have Been Spun Off By ECE Faculty & Students, Or Based On ECE Technologies
The Making of a Student Entrepreneur: Resources

• U-M CoE Center for Entrepreneurship
  – Workshops, contests, guest speakers, joint ventures and contests with the Business School, extensive networking opportunities

• Student Organizations
  – MPowered, Maize Ventures, Entrepreneurial Ventures Club, AAGeeks, etc.

• Special Courses
  – Patent Fundamentals for Engineers (EECS410), High-Tech Entrepreneurship (EECS406)

• ECE Alumni and Guest Speakers
  – Larry Page, Tony Fadell, Alan Steremberg, Lee Boysel, and others returning to campus
Contact ECE Chair, Prof. Khalil Najafi

**U-M Business Engagement Center for Engineering**

- Student Recruiting, Joint Research Projects, Student Design Projects/Team Projects
- Technology Utilization/Commercialization, Faculty Consulting
- Professional Development (short courses, distance learning, special programs)
- Speaking Opportunities

**Engineering Career Resource Center**

**Tech Talks and information sessions with HKN, IEEE, and SWE student groups**
Graduate Programs

M.S. and Ph.D. degrees in:

Electrical Engineering
  Applied Electromagnetics and RF
  Circuits, Circuits & Microsystems,
  Optics and Photonics, Solid State,
  VLSI

Electrical Engineering: Systems
  Control, Communications, Signal
  Processing. New areas under
  development: Computer Vision,
  Power & Energy

Undergraduate Programs

B.S.E. degrees in:

Electrical Engineering
Computer Engineering

Minors and Special Programs:
  Electrical Engineering (for non-
  EECS students)
  International Minor
  Multidisciplinary Design
  Eng. Global Leadership Honors
  Program
  Entrepreneurship Certificate
  Systems Engineering Certificate
BSE in Electrical (EE) and Computer (CE) Engineering
Major Areas of Concentration

- Circuits and Microsystems
- Applied Electromagnetics and RF Circuits
- Optics and Photonics
- Solid-State Electronics
- VLSI and Computer Engineering
- Control Systems
- Communications
- Signal Processing
- Power/Energy
VLSI Design: design a 16-bit RISC microprocessor using industry-standard design tools.

Digital Signal Processing: design and implement a real-time software package or hardware device.

Radiowave Propagation and Link Design: design, build, and characterize a practical radio link.

Advanced Lasers and Optics Lab: design and set-up a practical optical system.

Integrated Microsystems Lab: design and fabricate an integrated microsystem in the LNF.

Monolithic Amplifier Circuits: analysis and design of BJT and MOS multi-transistor amplifiers.

Microwave Circuits: design and fabricate microwave-integrated circuits.

Computer Architecture: build a synthesizable out-of-order processor using Alpha architecture.
Four Years to Your EE Degree

### Year 1
**The Foundation**
- Intro to Eng.
- Programming
- Chem
- Physics
- Math
- Math
- Hum./SS
- Hum./SS

### Year 2
**Intro to EE**
- Circuits
- Signals & Systems
- Physics
- Programming
- Math
- Math
- Hum./SS
- Hum./SS

### Year 3
**Define Your Area**
- Electromagnetics
- Prob. Methods
- Semiconductors
- Elective
- Elective
- Elective
- Elective
- Elective
- Elective
- EE/CE Courses

### Year 4
**Plan your Career**
- Elective
- Major Design Course
- Technical Comm.
- Elective
- Elective
- Elective
- Elective
- Elective
- Elective
- Choice of EE and other courses

Required for all Programs
Humanities/Social Sciences
EE/CE Courses
EE Courses
Choice of EE and other courses
Four Years to Your CE Degree

**Year 1**
**The Foundation**
- Intro to Eng.
- Programming
- Physics
- Chem
- Math
- Math
- Hum./SS
- Hum./SS
- Elective

**Year 2**
**Intro to CE**
- Discrete Math
- Circuits
- Physics
- Programming
- Logic
- Math
- Hum./SS
- Elective

**Year 3**
**Define Your Area**
- Signals & Systems
- Prog./Math/or Stat
- Computer Org.
- Elective
- Math
- Elective
- Hum./SS
- Elective

**Year 4**
**Plan your Career**
- Elective
- Major Design Course
- Technical Comm.
- Elective
- Elective
- Elective
- Elective
- Elective
- Elective

**Required for all Programs**
- Intro to Eng.
- Programming
- Physics
- Chem
- Math
- Math
- Hum./SS
- Hum./SS

**Humanities/Social Sciences**
- Elective
- Hum./SS

**CE/EE Courses**
- Discrete Math
- Circuits
- Physics
- Programming
- Logic
- Math
- Signals & Systems
- Prog./Math/or Stat
- Computer Org.
- Elective
- Math
- Elective
- Hum./SS

**CE Courses**
- Hum./SS

**Choice of CE and other courses**
- Elective
- Elective
- Elective
- Elective
- Elective
- Elective
- Elective
- Elective

ELECTRICAL AND COMPUTER ENGINEERING @ MICHIGAN

HOME UG
Student Teams & Competitions

Solar Car Team
MRacing Team
Mars Rover
Feel the Music Competition
1,000 Pitches

Directed Study

Faculty Research

CoE SURE Program

MDE's / Class Projects

NNIN REU

UG Student Research

Summer Undergraduate Research in Engineering (SURE)
Build an Anechoic Chamber
Low-temperature plasma on wounds
Camera positioning system
Carbon Nanotube Transistor
van der Pol Oscillators
Ultrasound Imaging System
Metamaterials
Lasers for Medical Applications
Nanosatellite Power Systems

National Nanotechnology Infrastructure Network (NNIN) REU
High Sensitivity Photodetectors
Microfluidic Chip for Cancer Test
Carbon nanotube composite beams
Next generation optoelectronics
Inks for Printed Photovoltaics
Plasmonic Focusing of Light
Computer modeling of the effect of low-temperature plasma on human skin

*Goal*: Healing of Wounds and Skin Diseases through Low-temperature Plasmas

(Advisor: Prof. Mark Kushner)
Camera Positioning System for a Semi-Autonomous Roundabout Project

(Advisor: Prof. Del Vecchio)

Goal: Implement various collision-free systems that can adapt to the presence of human drivers.
Carbon Nanotube Field-Effect Transistor  

(Advisor: Prof. Zhong)

Goal: Develop electronic detection techniques as an alternative to current biological sensing techniques that rely on optical detection principles.
Embedded Implementation of van der Pol Oscillators

(Advisor: Prof. Freudenberg)

Goal: Employ computer hardware and software techniques to ensure that harmonic oscillators run more stably.
Integrated Microwave-Ultrasound Imaging System

(Advisor: Prof. Moghaddam)

Goal: Improve breast cancer imaging with a microwave ultrasound imaging system.

Lai Wei, EE major
Metamaterial Phase Shifting Lines

Goal: Build, test, and compare designs made through applying NRI metamaterial concepts to phase shifting lines, applied to antennas.

Steve Joseph, EE major
Mid-Infrared Medical Lasers for Dermatology and Cardiovascular Applications

(Advisor: Prof. Islam)

Goal: Use mid-infrared lasers to successfully treat acne and heart disease with little collateral damage to surrounding tissue.
Nanosatellite Pipeline Power Systems  
(Advisor: Prof. Gilchrist)

**Goal:** Develop high volume nanosatellite research at U-M by streamlining the design process, especially the electrical power system.

**Electrical Power System**
- Critical component to all satellite mission
- Historically high failure rate
  - Most failed spacecraft suffered power failures
- Rapid development cycle needed
  - RAX needs to be delivered in the Fall
  - M-Cubed will hopefully deliver soon after

Tammy Wang, EE major
Feel the Music Competition: Helping the deaf and hearing-impaired appreciate music

First Place
Interdisciplinary Team
with one EE student

Second Place
Team of 3 EE sophomores

Rishi Daftuar, 3rd from left, Undergrad in EE

Ryan Garrone, Steven Joseph, Mike Huang
Recent Projects by UG Students

Medical Data Logger: used to conduct clinical drug trials in ambulances. The 6-member team of students won the contract, and the data logger is being manufactured for trial use.

Computer engineering undergraduate students Keegan Reilly, Ray Smith and Dan Lagreca show off the medical data logger kits they helped to invent.
Undergraduate student Michael Shin (CE, left) was a member of the team to design portable, palm-sized metal detectors designed to be part of a wireless sensor network. The team earned first place in a competition between U-M and Ohio State U. sponsored by the Air Force.

There are talks with the Air Force about incorporating some of the hardware and software into their own projects in the future.
EE graduate student Anne Itsuno won one of 7 prizes awarded to the students who participated in 1,000 Pitches, named for the more than 1,000 ideas put forth by students for new businesses, inventions and non-profit groups.

Ms. Itsuno won in the category Global Business, for her concept of a one-stop-shop web service for prospective graduate students.
Student Groups - Multidisciplinary Teams

Apply your knowledge to real-world projects
Learn with others
Have fun!

Solar Car
MRacing
Mars Rover
And Many Others!
MClimber
Blue Lab
<table>
<thead>
<tr>
<th></th>
<th>Enrolled</th>
<th>BS</th>
<th>MS</th>
<th>PhD</th>
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<tr>
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<td>267</td>
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<tr>
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<td><strong>Graduate Students</strong></td>
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<td>132</td>
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## Students in ECE: Diversity

**Fall 2008**

<table>
<thead>
<tr>
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<th>Female</th>
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<tr>
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<td>8%</td>
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<td>Electrical Engineering</td>
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Special Programs

- International Minor for Engineers
- Multidisciplinary Design Minor
- Program in Entrepreneurship Certificate
- Global Leadership Honors Program
- Study Abroad
- Systems Engineering Certificate
- Electrical Engineering minor (for non-EECS students)
- CUGS: Get your UG and Grad degree in 5 years
Student Groups - Organizations

• Eta Kappa Nu (HKN) – the national honor society for electrical and computer engineers
• IEEE – Student branch of the professional society
• Girls in Electrical Engineering and Computer Science (GEECS)
• National Society of Black Engineers (NSBE)
• U-M Amateur Radio Club
• Society of Women Engineers (SWE)
• Tau Beta Pi (CoE Honors Society)
• More than 1,000 U-M Student Organizations!
Student Life: U-M, Ann Arbor, Michigan

• University of Michigan
  – IM and U-M sports (GO BLUE!), Recreation facilities close to campus
  – Close proximity to the Music School for many free concert recitals

• Ann Arbor
  – Big city culture in friendly Ann Arbor, including excellent restaurants and clubs, University Musical Society, Art Museum, Arthur Miller Theatre
  – Beautiful environment: the Arboretum, local parks and rivers, Botanical Gardens

• Michigan
  – Many large and small parks and camping destinations, including Sleeping Bear Dunes, Ludington State Park, and Mackinac Island
  – Water! Nearby lakes, trails and rivers. Surrounded by 4 Great Lakes
Sample Activities

- Design, development, and implementation of electronic devices or systems, such as power generators, computer systems, space systems and satellites, lighting systems, medical technology
- Design and improve systems for automobiles, including sensors, anti-lock brakes, etc.
- Design and improve wireless communication provided by cell phone systems and GPS devices
- Work on the electronic and systems areas of cars, robots, cell phone systems, lighting and wiring in buildings, radar and navigation systems
- Research and development
- Teaching the next generation!
Top 10 Reasons to Come to Michigan

1. You will be a U-M Alum!
2. Learn from the best: world-class faculty and students!
3. Breadth and depth of study
4. Excellent facilities (LNF, CAEN labs, Laser labs, RadLabs)
5. Entrepreneurial opportunities
6. Interdisciplinary study, take advantage of other top ranked programs at Michigan
7. International opportunities
8. Ann Arbor – One of the best places to live!
9. Culture – professional and student artists
10. Sports – Recreation Buildings, IM sports, be a fan
Electrical Engineering Program

• Major Areas of Concentration
  – Circuits and Microsystems
  – Applied Electromagnetics and RF Circuits
  – Optics and Photonics
  – Solid-State Electronics
  – VLSI
  – Also: Certificate in Plasma Science and Engineering
Major Areas of Concentration

- Control
- Communications
- Signal Processing

New areas under development:

- Computer Vision
- Power/Energy
## Students in ECE

### Fall 2008

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Recent Honors and Awards

2009 DAC Student Design Contest
Mingoo Seok, Scott Hanson, Yu-Shiang Lin, Zhiyoong Foo, Daeyeon Kim, Yoonmyung Lee, Nurrachman Liu. First place in the operational chip design category for their project, *Phoenix: An Ultra-Low Power Processor for Cubic Millimeter Sensor Systems*

2009 Clock Network Synthesis Contest at ISLPD
First place, Dongjin Lee, graduate student in electrical engineering

SEMCAD X Student Research Award
First Place Michael Theil, graduate student in electrical engineering, for his research project, “Analysis of Human Backscattering in Buildings for Through-wall Radar Applications.”

2008 Raith Micrograph Award
First Place, Sung Hyun Jo, graduate student in electrical engineering

Special Certificate from the President of Bulgaria
Tzeno Galchev, graduate student in electrical engineering, for his achievements in the field of computer engineering and information technology

Best Paper, 2009 International Symposium on Low Power Electronics and Design
Daeyeon Kim, Yoonmyung Lee, Dennis Sylvester, David Blaauw


2nd Paper Prize, 2008 URSI General Assembly, Adel Elsherbini
Competitive Fellowships

Earth System Science Fellowship Program, Michael Benson, 3-year fellowship to study the surface of the earth with Prof. Kamal Sarabandi

Intel Foundation/SRCEA Fellowship, Matt Fojtik (BSE, EE '08), 5-year fellowship to study ultra-low power integrated circuits with Prof. Dennis Sylvester

NSF Graduate Research Fellowship, Luis Gomez, 3-year fellowship to investigate a new treatment for neurological disorders with Prof. Eric Michielssen, Prof. Tony Grbic, and Prof. Luis Hernandez (Bioengineering).

MIT Lincoln Lab Fellowship, Yuriy Goykhman, to support his work in the development of new radar remote sensing instruments, techniques, and processing algorithms with Prof. Mahta Moghaddam

NSF Graduate Research Fellowship, Pelumi Osoba, 3-year fellowship to investigate optimization methods for designing platform-mounted antennas with Prof. Eric Michielssen

IEEE MTT-S Graduate Fellowship, Scott Rudolph, to support his work in metamaterials with Prof. Tony Grbic.
Financing your education

ECE Assistance
- Fellowships
- Graduate Student Instructor (GSI) positions
- Graduate Student Research Assistantships

U-M Assistance
- Rackham Graduate School (http://www.rackham.umich.edu/funding_resources/)

Outside Assistance
- Many sources – ECE staff can assist in finding the best options for you
Employment: Where are they now?

Recent Grads at Companies
Northrop Grumman, Qualcomm, Naval Research Lab, TI, KLA-Tencor,
AMD, Broadcom, Synopsis, Intel, Samsung, Raytheon, IBM Research Labs,
MIT Lincoln Labs, GE, Motorola, RF Micro Devices, Sandia National Labs,
Microsoft  Local: General Dynamics, Sonetics Ultrasound, Mobius
Microsystems

Recent Grads in Academia
UC Santa Cruz, UC San Diego, CalTech, Texas A&M, Virginia Tech, Case
Western Reserve, UCLA, U. British Columbia, NC State U, Arizona State,
Ohio State, U. Pennsylvania, Harvard, U Washington, U South Florida
Activities

Student teams include graduate students (Solar Car, Amateur Radio Club, etc).
IM and U-M sports, Rec Buildings, the Arb, local parks and rivers, Botanical Gardens, nearby lakes.
Big City culture in friendly Ann Arbor (including clubs, University Musical Society, Art Museum, Arthur Miller Theatre on North Campus).

Continuous opportunities for learning
seminars, discussion groups, invited speakers, faculty and fellow students

Housing
all the information you need at www.housing.umich.edu

Transportation
get around easily and cheaply: www.pts.umich.edu
WIMS K-12 Outreach Development

(49% under-represented and 51% female students)

1999

- DAPCEP and HSEI (150)
- WIMS ERC
- WIMS for Teens Summer (50)/Spring DAPCEP (30)
- Women In Engineering (30)
- First Lansing Area LEGO Robotics Team (140)
- Shell SITES/14 First LEGO league (FLL) Teams (200)
- Spartan Challenge FLL – East Lansing Tourney
- Summer LEGO Robotics for beginners (60)
- Grandparents University (120)
- Design Day for Middle & High School (800)
- NEMO: Navigating Electro-Active Polymer controlled Module for High School Design Day Competition
- Research Experiences for Teachers (8)
- LEAD at UM ENGR (6)
- MS Research Experiences (10)
- HS Research Experiences (10)

2010
WIMS Education and Outreach

Has impacted more than 1,200 K-PhD Students

WIMS Center developed the Integrated Microsystems Enterprise (2007-09)

The DAC (Data Acquisition Cube) experiments for High Schools was delivered to 7 MI School Districts

WIMS Center developed the specialized Research Experience for Teachers (RET) Program
NNIN: National Nanotechnology Infrastructure Network

Offering educational outreach for K-12 students and adult professionals.

NanoCamp – serving K-12 students

Research Experience for Undergraduates – serving UG’s at Michigan and across the country

Workshops – serving adult professionals
NNIN NanoCamp

Education and outreach for middle and high school students during the summer

Teaching nanotechnology and everyday uses of microelectronics

Activities inside and outside the Lurie Nanofabrication Facility
ECE Alumni

Staying Connected

Business Leaders

Academia

Entrepreneurs

Industry

Staying Connected
Total alumni since 1891: 18,003  (All) 15,847  (Living)
Undergraduate Degrees: 13,705  (All) 11,773  (Living)
Master’s Degrees: 5,959  (All) 5,487  (Living)
PhD Degrees: 1,472  (All) 1,398  (Living)

Network of Living Alumni (rounded)
U-M 480,000
CoE 65,000
ECE 16,000
Alumni Entrepreneurs and Business Leaders

Entrepreneurs

Larry Page (BSE CE) Founder, Google
Bill Joy (BSE CE) Founder, Sun Microsystems
Lee Boysel (BSE MSE EE) Founder, Four-Phase Systems
Michael McCorquodale (MSE PhD EE) Founder, Mobius Microsystems
Nader Najafi (MSE PhD EE) Founder, ISSYS
Wan-Thai Hsu (PhD EE) Founder, Discera

Business Leaders

Jerry Levin (BSE EE) Former CEO, Sunbeam, Revlon
James Mellor (BSE EE) Former CEO, General Dynamics
John Tishman (BSE EE) CEO, Tishman Realty & Construction Corp.
Rick Bolander (BSE MSE EE) Gabriel Venture Partners, Founder and Partner
Peter Fuss (BSE CE) Tellabs International, Former President
Tony Fadell (BSE CE) Apple, former Senior VP, iPod Division
EECS Alumni are:

Helping to solve critical societal problems
Game changing entrepreneurs
Educating the next generation
International Leaders
Doctors and lawyers
Successful!
Happy!
Just Like You!