



# Everything You Ever Wanted to Know About Graduate School\*

**\*(but were afraid to ask)**

Soo-Young Lee

Professor & Graduate Program Officer

Auburn University

Electrical and Computer Engineering

Department of Electrical and Computer Engineering



# What Questions Should I Ask?

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- What is graduate school?
- Why should I go?
- What degree(s) do I want?
- When should I go?
- Where should I go?
- How do I get in?
- How long will it take to finish?
- How am I going to pay for it?
- What are my opportunities in Auburn's ECE Department?
- Where can I find more information?



# What is graduate school?

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- **Advanced study beyond the bachelors degree**
  - usually focus on a specialized area
  - build on foundation from previous study
  - many programs prepare you to do research
- **“Professional” schools prepare for practice of a specific profession**
  - law, medicine, dentistry, pharmacy



# Why should I go to grad school?

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- **Career/Vocational Goals** (*Study the market!*)
  - Does the job require an advanced degree?
  - improve/update skills & marketability
  - change careers (mobility)
  - higher salary/greater potential for advancement
- **Personal fulfillment**
  - love of the field
  - satisfy intellectual curiosity
  - the challenge of mastering a field
- *Postpone facing the “real world”??*



# What degree(s) do I want?

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- **Masters Degree**
  - higher starting salary
  - increased responsibility (immediate impact)
  - thesis (research) vs. non-thesis options
- **Doctoral Degree**
  - requires a research dissertation
  - needed for university faculty
  - research-oriented company/agency
- **Master of Business Administration (M.B.A.)**
  - if interested in engineering management
- **Professional Degree:** law, medicine, etc.



# Graduate Degrees in ECE at Auburn University

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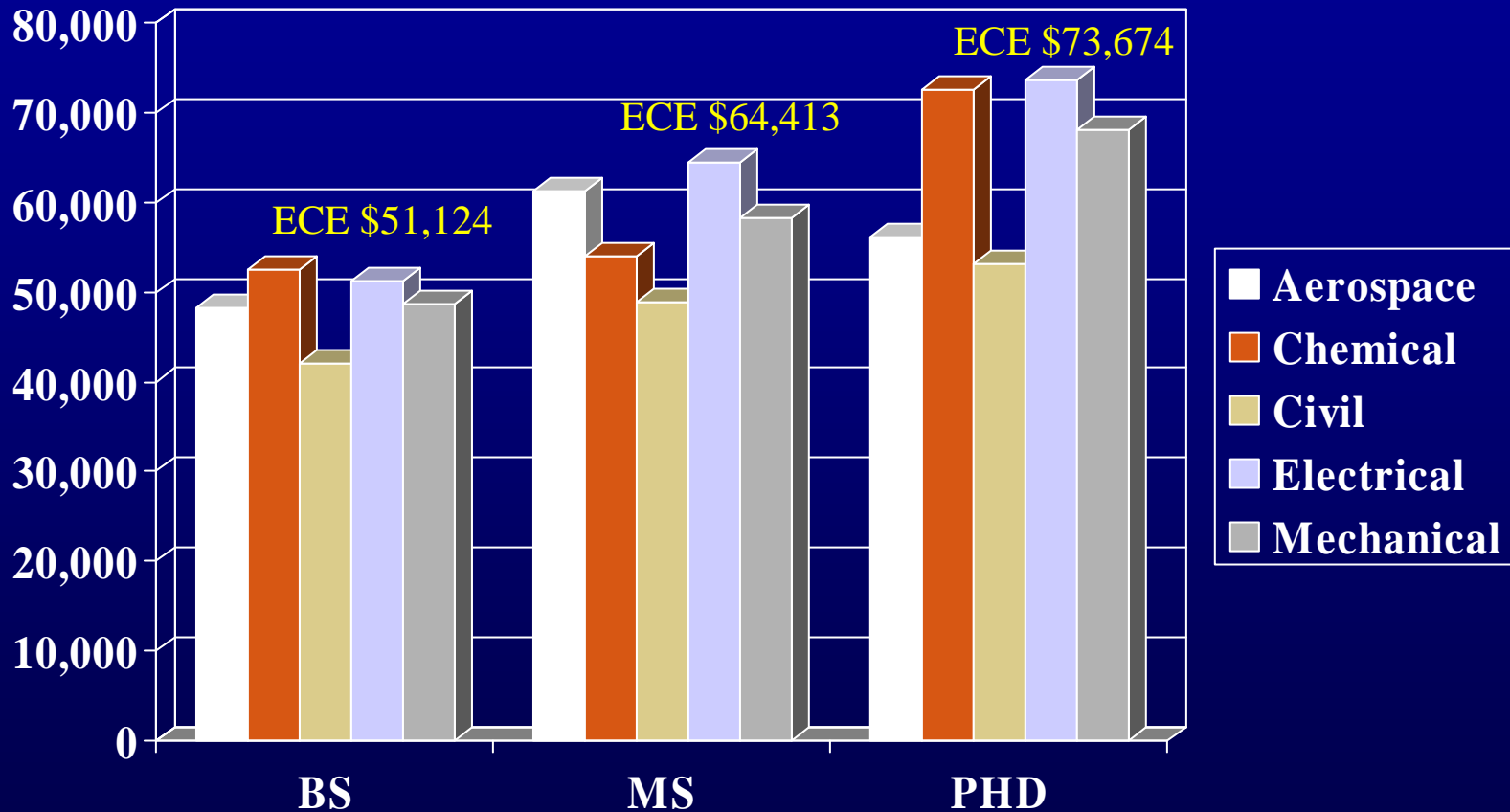
- **Master of Science (MS)**
  - Requires coursework, research & thesis
- **Master of Electrical Engineering (MEE)**
  - Requires coursework & project (non-thesis)
- **Doctor of Philosophy (PhD)**
  - Requires publishable research & dissertation



# Starting salaries for engineering

(2004 NACE Salary Survey: [www.naceweb.org](http://www.naceweb.org))

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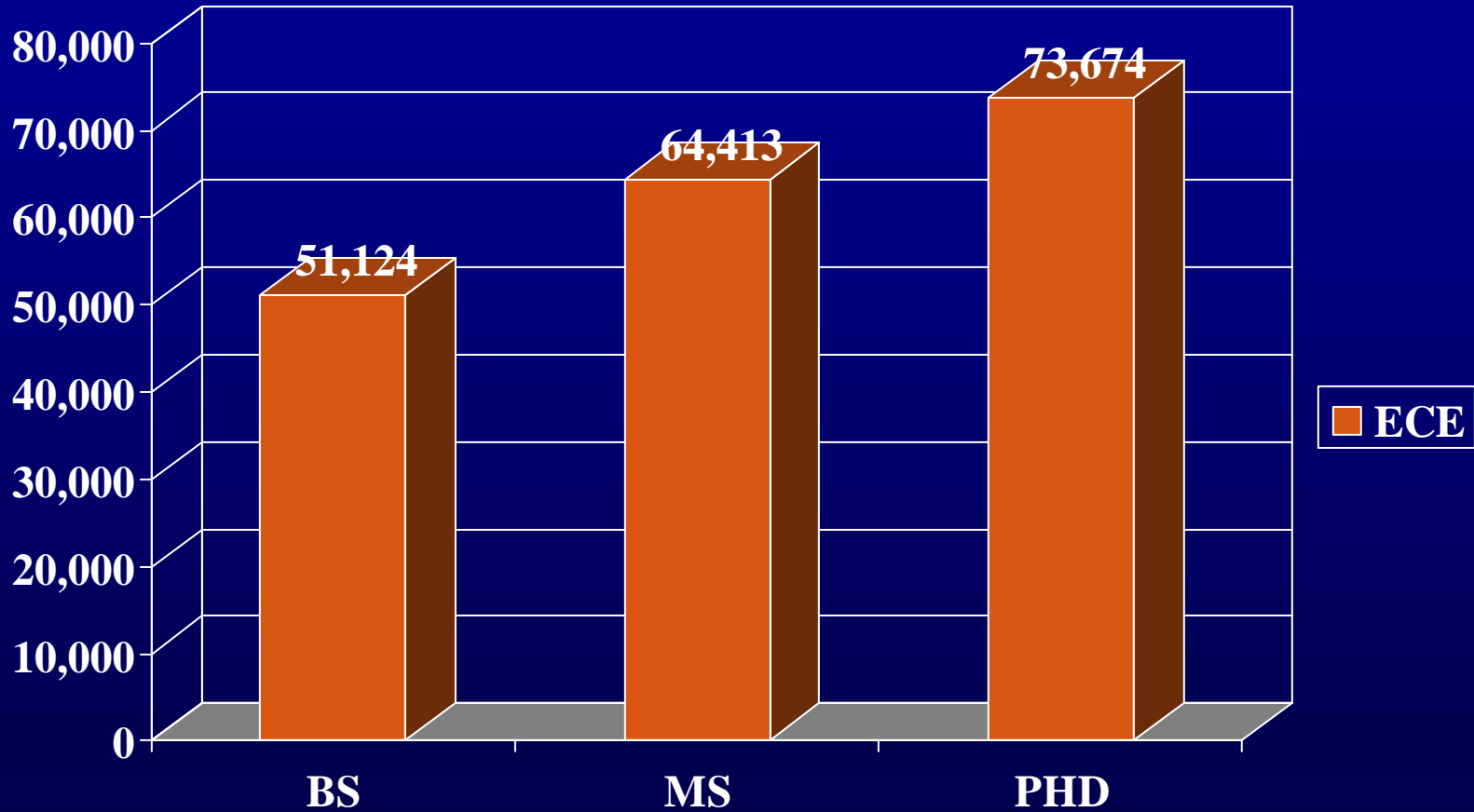
Spring 2007 EE-BS \$54,915, CPE-BS \$55,946  
EE-MS \$60,000-\$70,000



# Starting Salaries for ECE

## (NACE Salary Survey – 2004)

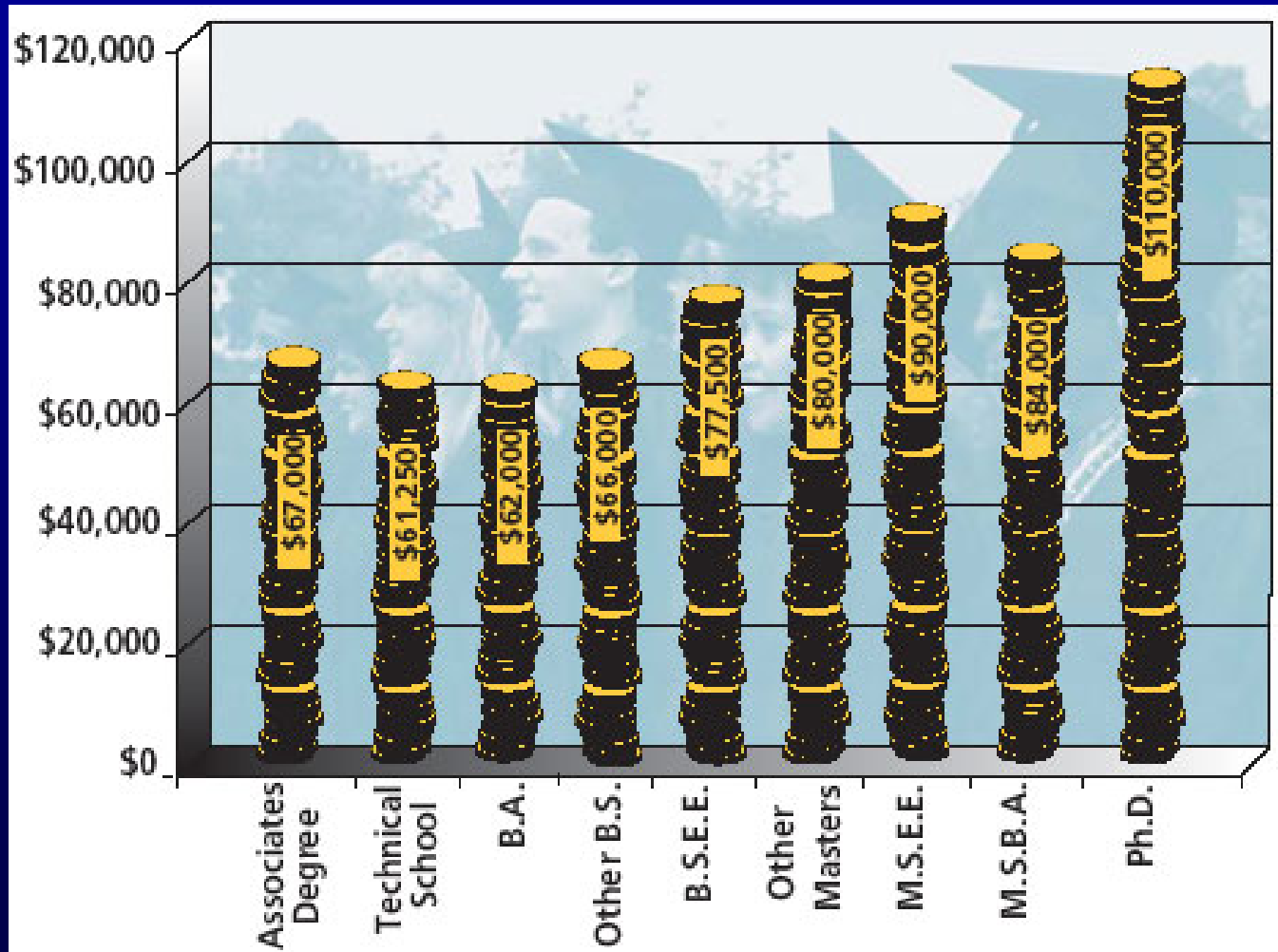
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# Average salaries in engineering and related fields

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# Where should I go?

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- **First decide what you want to study**
  - “electrical engineering” is too general
  - more specific: “wireless network security”
- **Research the school’s reputation/activity in your technical interest area**
  - number of professors in that area
  - publications & research funding in that area
  - courses taught in that area
  - research facilities, computing labs, library
  - industrial partnerships
  - who hires the graduates



# Other considerations

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- Availability of financial assistance
- Level of faculty/student interaction
- Degree requirements (credit hours, thesis vs. non-thesis, time to completion)
- Other – geographic location, extracurricular activities, cost of living, size of school
- Multiple degrees from the same school?
  - grad courses build on lower-level courses
  - different schools provide different perspectives
- *Apply to several schools!*



# When should I go?

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- **Right after bachelors degree?**
  - have academic “momentum” and discipline
  - fewer responsibilities when younger
  - improve marketability for first job
  - hard to give up a job later to return to school
- **After gaining work experience?**
  - work experience provides more perspective
    - better understanding of your field
    - learn what problems need to be solved/researched
  - may be “burned out” after 16+ years of school
  - can save money for school and/or pay off debts
  - **possibly get employer to pay for school**



# How do I get in?

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- Request materials (indicate desired program)
- Submit application and fee
- Other items you may be asked to provide:
  - Official transcripts (have your registrar send them)
  - Graduate Record Exam (GRE) scores
  - Letters of recommendation
    - address your skills, dedication, accomplishments, potential
  - A “statement of purpose”
    - explain your area of interest, experience, reason for applying
  - Your resume



# What is the admissions committee looking for?

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- **Evidence of academic potential**
  - grades\* - especially in math, science and engineering courses
  - reputation of school(s) attended
  - GRE scores\*
  - TOEFL scores\* (if international)

*\*some departments require minimum GPA/GRE*
- **Motivation for graduate study**
  - statement of purpose
  - recommendation letters
  - other scholarly activity (undergrad research, etc.)
- **Background** (areas of previous study)



# Auburn ECE Masters Program Entrance Requirements



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- B.S. degree in ECE or closely-related field from an accredited program
- GPA of accepted applicants usually  $> 3.0$ 
  - lower GPAs can be offset by outstanding GRE scores and/or recommendation letters
- GRE general test
- TOEFL exam (international applicants)



# Graduate school entrance tests

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- **GRE** – engineering & most other disciplines
  - General test has verbal, quantitative, and writing sections (V/Q scored 200-800 on each section, W scored 1-7)
  - Some schools may require a “subject test”
  - [www.gre.org](http://www.gre.org) for test dates/places/info
- **TOEFL** – required for international applicants
  - some allow IELTS – *Int’l English Lang. Test Syst.*)
- **Professional/business schools** (instead of GRE)
  - **GMAT** for Business School
  - **LSAT** for Law School
  - **MCAT** for Medical School
- **Fundamentals of Engineering (FE)** – for professional registration (not a grad school requirement)



# How long will it take?

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- **“It depends...”**
  - degree requirements
  - work responsibilities (assistantship, job)
  - availability of courses
  - time for thesis/dissertation research and writing
  - your level of dedication
- **Time to complete a masters degree**
  - typical time about 2 years if doing a thesis
  - non-thesis programs can take less time if student takes a full load every semester
- **Doctoral degree typically 3-5 years**
  - depends on time to research and write a dissertation



# Masters degree requirements

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- Typically about 30 semester credit hours
  - might require a set of “core” courses (plus electives)
  - might be entirely elective
- Thesis option:
  - identify a problem, conduct research, write the thesis
  - “defend” the thesis in front of a committee
- Non-thesis option:
  - might require coursework only
  - might require a “project”
  - often requires a comprehensive exam (oral and/or written)



# Auburn ECE Masters Degree Requirements



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- **30-33 credits of 6000/7000 course work**
    - at least 21 credits in ECE & 24 credits at Auburn
    - at least one course in each of three ECE areas
  - **M.S. degree (30 credits) includes:**
    - 4 to 6 hours of research & thesis (ELEC 7990)
    - final oral exam, defending the thesis
  - **M.E.E. degree (33 credits) includes:**
    - 3-credit project (ELEC 7980)
    - written and oral project reports serve as the final exam
- (“Thesis” is published, “Project” report is not)



# Ph.D. Degree Requirements

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- 60 semester hours beyond B.S.
  - At least 30 hours of graded graduate course work (6000-level or higher)
  - At least 30 additional hours of graduate course work (10 hours of 8990, ungraded, etc.)
- At least 18 hours at Auburn
- 9 hours in a minor area
  - Within or outside of ECE
- Dissertation



# How am I going to pay for it?

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- **Graduate assistantship** – receive stipend/tuition for work in the department
  - Teaching (conduct labs, grade papers, etc.)
  - Research
- **Fellowships** (university or external)
  - often grants not tied to specific work obligations
- **Loans** (use wisely – consider level of personal debt)
- **Outside employment**
- **Employer-sponsored**



# Cost of Graduate School (AU)

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- Estimated cost per semester (Fall 2009-Summer 2010)
  - Alabama resident: Total cost = \$10,120\*
    - tuition & fees only = \$3,120
  - Non-resident: Total cost = \$16,360\*
    - tuition & fees only = \$9,360

\* Total cost = including an estimate (\$7,000) of living expenses, insurance, etc.
- GTA/GRA appointments (of at least 1/4 time) include a “tuition fellowship”
  - Graduate School pays tuition for up to 40 credit hours for masters students
  - Beyond 40 credit hours, all GTAs/GRAs are eligible for the in-state tuition rate



# Graduate Teaching Assistants

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- GTAs assist with undergraduate instruction
  - laboratory sessions, grading homework
- Stipend depends on work load
  - typical is 1/6 time work load per lab section (varies with lab/grading assignment)
  - 1/4 time stipend = \$640/month (1st yr. M.S.)
  - 1/3 time stipend = \$853/month (1st yr. M.S.)
- 1/4 -time or higher GTAs qualify for tuition waiver!
  - Up to 40 hours (MS, MEE)
  - Up to 80 hours (PhD)



# Graduate Research Assistants

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- GRAs assist faculty in research activities
- Appointed by faculty with funded projects
- Stipend is a function of work load, as assigned by the appointing faculty member
  - 1/3 time = \$1122/month (1st yr. M.S.)
- 1/4-time or higher GRAs qualify for Graduate Research Fellowships (tuition waiver)
  - Up to 40 hours (MS, MEE)
  - Up to 80 hours (PhD)



# Samuel Ginn College of Engineering

## Fellowships (new for 2008)



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- **Dean's Fellowship:**
  - Offered by the college of engineering.
  - Minimum stipend of \$32,000 per year plus tuition fellowship and are renewable.
- **College Fellowship:**
  - Awarded to outstanding applicants throughout the college.
  - Minimum stipend of \$24,000 per year plus tuition fellowship and are renewable.
- **Departmental Fellowship:**
  - Offered to top candidates in each engineering department
  - Minimum stipends of \$20,000 per year plus tuition fellowship and are renewable.



# Auburn University

## Electrical & Computer Engineering

### Graduate Faculty and Programs

Department of Electrical and Computer Engineering



# *U.S. News & World Report* Graduate Program Rankings

ELECTRICAL AND COMPUTER ENGINEERING

Electrical Engineering

Programs:

2004

2005

2006

Auburn University

62<sup>nd</sup>

55<sup>th</sup>

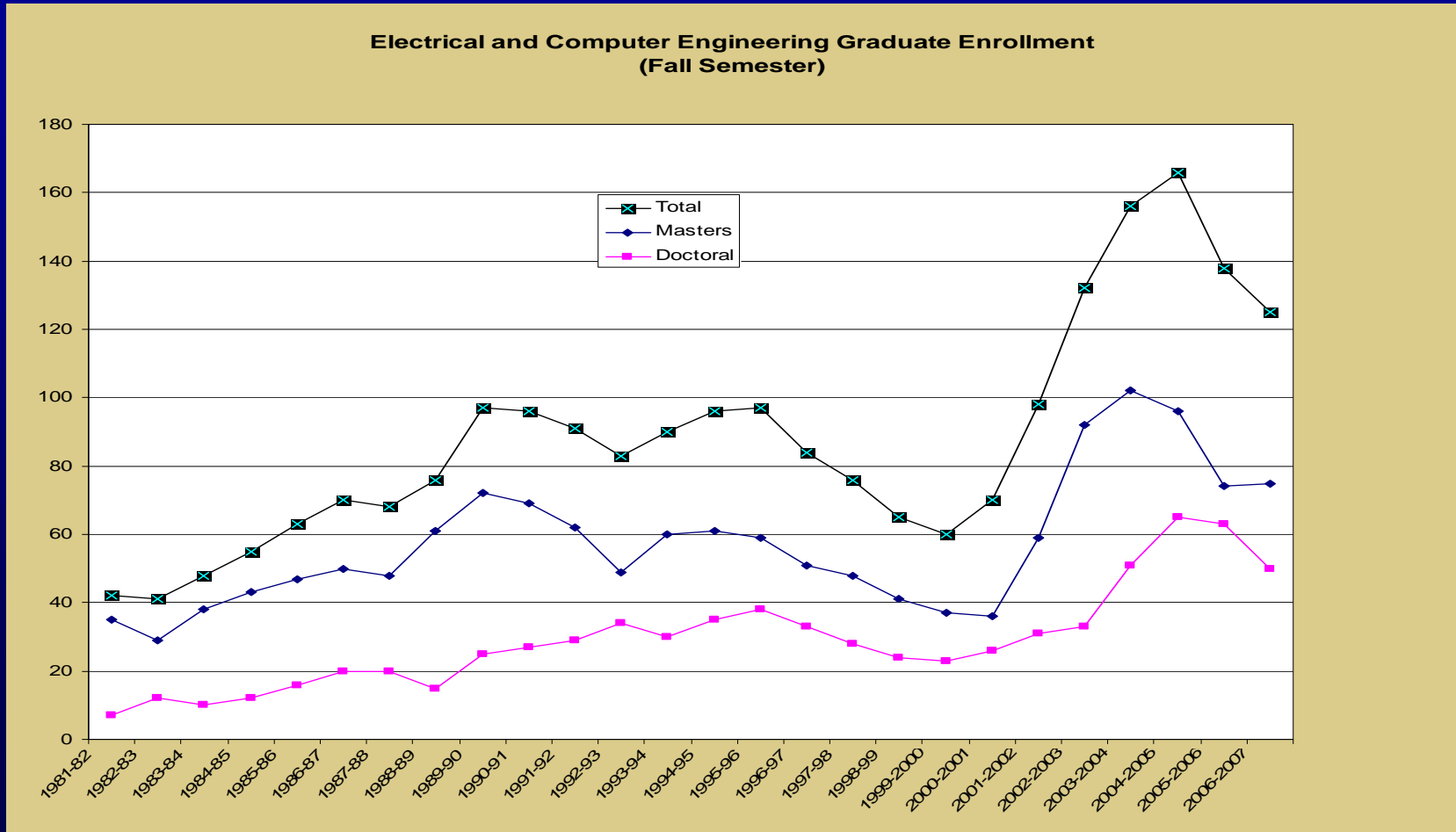
49<sup>th</sup>



# ECE Graduate Enrollment (Fall semesters, 1981-2007)



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# The ECE “Stems”

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## **Electronics:**

microelectronics, amplifiers, analog, digital, and RF integrated circuits, MEMS ...

## **Digital Signal Processing & Communications:**

massage of complex electrical signals for information extraction, compression, correction ...

## **Wireless:**

wired and wireless data transmission, signal modulation, coding theory, information theory ...

## **Automatic Control Systems:**

electronic feedback techniques for process control, motor control, aerodynamics ...

## **Electromagnetics:**

generation and reception of electromagnetic waves, antennas, lasers, radar ...

## **Power Engineering:**

generation, transmission, distribution of electricity for commercial and residential ...

## **Logic & Computing Devices:**

architecture, VLSI design, testing, hardware, and software for computers and peripherals ...

## **Circuits & Systems:**

basic electrical circuit network theory, analysis of electrical signals ...



# Major Research Focus Areas in ECE

*(2005-2006 expenditures = \$4.4M)*



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- MEMS (MicroElectroMechanical Systems)
- SiGe (Silicon-Germanium)
- VLSI design and test
- NanoTechnology
- High-performance computing
- Electric power engineering
- Electronic packaging
- Wireless networks
- Security
- Signal processing
- Smart antennas

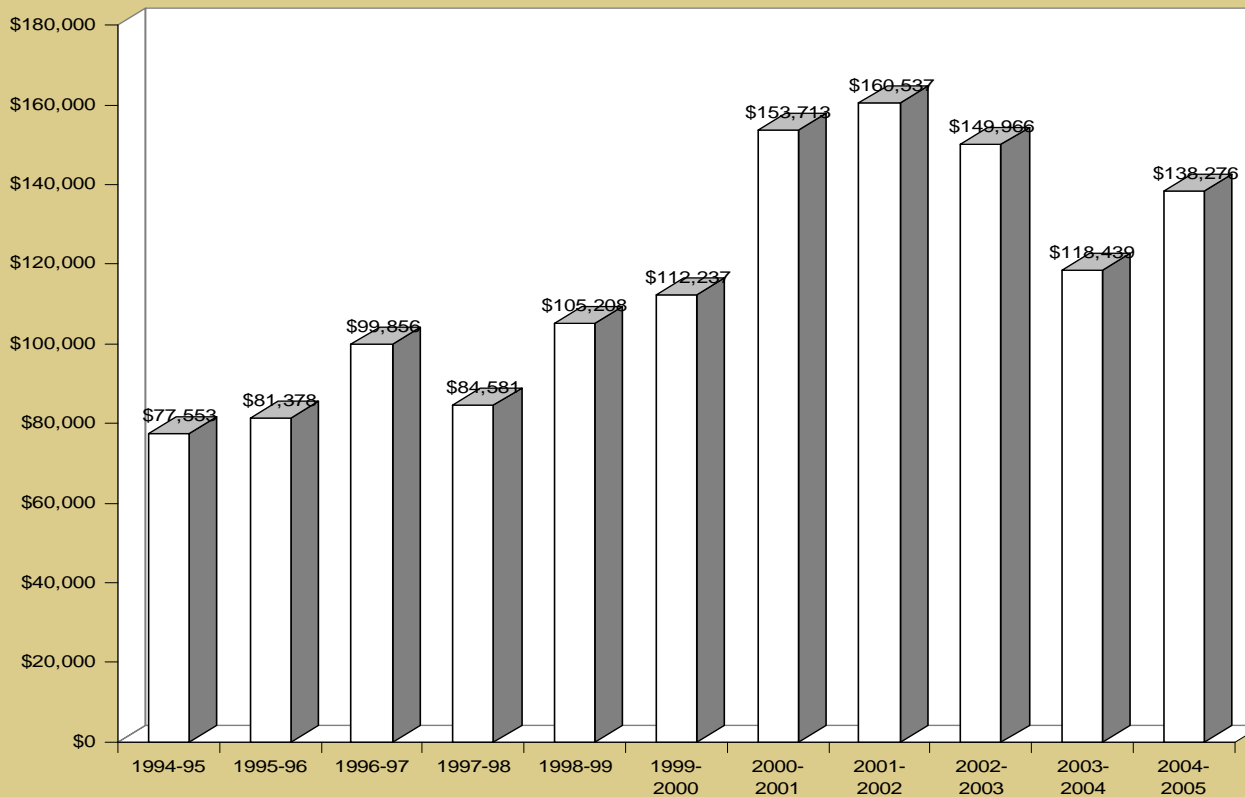


# ECE Research Expenditures Per Faculty Member



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ECE - Funded Research Expenditures per Full Time Faculty Member





# ECE Research Sponsors

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## Government

- AFOSR
- ARO
- DARPA
- DOE
- NASA
- NIH
- NSF
- ONR
- Sandia National Labs

## Industry

- Daimler/Chrysler
- Henkel
- IBM
- Motorola
- Northrup/Grumman
- Semiconductor Research Corp.
- Southern Company
- Texas Instruments
- Whirlpool Corporation



# ECE Graduate Faculty



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- 29 faculty loosely organized into 7 “stems”
  - Communications & signal processing
  - Control systems
  - Digital systems & computer engineering
  - Electromagnetic modeling & analysis
  - Microelectronics
  - Power systems
  - Wireless engineering



# Named Professorships in ECE

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- **Prathima Agrawal**, *Sam Ginn Distinguished Professor*
- **Vishwani Agrawal**, *James J. Danaher Professor*
- **Mark Halpin**, *Alabama Power Distinguished Professor*
- **J. David Irwin**, *Earle C. Williams Eminent Scholar*
- **Richard Jaeger**, *Distinguished University Professor*
- **R. Wayne Johnson**, *Information Technology Peak Dir.*
- **Adit D. Singh**, *James B. Davis Professor*
- **Jitendra Tugnait**, *James B. Davis & Alumni Professor*
- **Bogdan M. Wilamowski**, *AMSTC Director*



# IEEE Fellows

ELECTRICAL AND COMPUTER ENGINEERING

- Prathima Agrawal
- Vishwani Agrawal
- S. Mark Halpin
- David Irwin
- Richard Jaeger
- R. Wayne Johnson
- R. Mark Nelms
- Adit Singh
- Charles E. Stroud
- Jitendra K. Tugnait
- Bogdan Wilamowski
- Chwan-Hwa (John) Wu



# ECE Faculty



## National/International Awards

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- Eta Kappa Nu National Outstanding Teacher Award
- (2) IEEE Undergraduate Teaching Award
- (2) IEEE Power Engineering Outstanding Educator Awards
- (2) IEEE McGraw Hill/Jacob Millman Awards
- (4) IEEE Third Millennium Medals
- (2) International Microelectronics and Packaging Society Technical Achievement Awards
- IEEE Computer Society Outstanding Contribution Award
- IEEE Richard M. Emberson Award
- (13) IEEE Fellows



# ECE Faculty Scholarship & Professional Service



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- Editors of International Journals—11
- Associate Editors of International Journals—40
- Books Published—38
- Book Chapters Published—32
- Patents—122
- Average Journal Papers Published/Faculty/Year—2
- Presidents of Technical Societies—10
- Chairs of Technical Conferences—40
- Technical Society Governing Board/AdCom Positions—31



# Graduate School Application Time Table

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- During undergraduate studies, consider participating in a research project with faculty/grad students
- **Junior year** – begin investigating
  - browse guides, catalogs, web sites
  - talk to faculty, friends
  - sign up for GRE and/or other entrance tests
- **September/October of senior year**
  - take GRE and/or other tests
  - write statement of purpose
  - request recommendation letters from faculty

(continued)



# Graduate School Application Time Table (continued)

ELECTRICAL AND COMPUTER ENGINEERING

- **November/December**  
(applications typically due in December/January)
  - submit applications (on-line or mailed)
  - order official transcripts from Registrar's Office
  - apply for fellowships, grants, assistantships
- **January/March**
  - ask about visiting and/or /interviews
- **March/April**
  - consider acceptances, rejections, career options
- **August/September – Get to work!**



# Where can I find information?

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- **Informal Sources:**
  - Your professors
  - Academic advisor or college career center
  - Current grad students (email or web pages)
  - Friends who have gone to graduate school
  - Department web sites & university bulletins
  - Education resources on engineering professional society web sites (IEEE, ASME, ASCE, AIChE, IIE, AIAA, etc.)



# World-Wide Web Resources

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- Peterson's guides: [www.petersons.com](http://www.petersons.com)
- GradSchools.com: [www.gradschools.com](http://www.gradschools.com)
- GradView: [www.gradview.com](http://www.gradview.com)
- American Society of Engineering Education (ASEE)  
[www.asee.org](http://www.asee.org) – profiles of colleges/universities
- U.S. News & World Report annual rankings & articles  
<http://www.usnews.com/usnews/edu/grad/grhome.htm>
- GradNet ([www.gradnet.iec.org](http://www.gradnet.iec.org))
- ACM Graduate Assistantship Directory  
([info.acm.org/gad/](http://info.acm.org/gad/))
- Government agency & private foundation web sites  
(fellowship information)