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?

- 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?

• **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?

- **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?

• 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

- **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)

Spring 2007 EE-BS $54,915, CPE-BS $55,946
EE-MS $60,000-$70,000
Starting Salaries for ECE
(NACE Salary Survey – 2004)

<table>
<thead>
<tr>
<th>Degree</th>
<th>Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>51,124</td>
</tr>
<tr>
<td>MS</td>
<td>64,413</td>
</tr>
<tr>
<td>PHD</td>
<td>73,674</td>
</tr>
</tbody>
</table>
Average salaries in engineering and related fields

![Bar chart showing average salaries for different degrees.](chart.png)
Where should I go?

• 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

- 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?

- 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?

- 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?

• **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

• 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

- **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?

• “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

• 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

• 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

- 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?

- **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)

• 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

- 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

- 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.)
- ¼-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)

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

### Electrical Engineering

<table>
<thead>
<tr>
<th>Programs:</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auburn University</td>
<td>62nd</td>
<td>55th</td>
<td>49th</td>
</tr>
</tbody>
</table>
ECE Graduate Enrollment
(Fall semesters, 1981-2007)
The ECE “Stems”

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)

- 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

ECE - Funded Research Expenditures per Full Time Faculty Member

---|---|---|---|---|---|---|---|---|---|---
$77,553 | $81,378 | $84,681 | $105,208 | $112,237 | $153,713 | $160,537 | $149,966 | $118,439 | $138,976

ELECTRICAL AND COMPUTER ENGINEERING
<table>
<thead>
<tr>
<th>Government</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFOSR</td>
<td>Diamler/Chrysler</td>
</tr>
<tr>
<td>ARO</td>
<td>Henkel</td>
</tr>
<tr>
<td>DARPA</td>
<td>IBM</td>
</tr>
<tr>
<td>DOE</td>
<td>Motorola</td>
</tr>
<tr>
<td>NASA</td>
<td>Northrup/Grumman</td>
</tr>
<tr>
<td>NIH</td>
<td>Semiconductor Research Corp.</td>
</tr>
<tr>
<td>NSF</td>
<td>Southern Company</td>
</tr>
<tr>
<td>ONR</td>
<td>Texas Instruments</td>
</tr>
<tr>
<td>Sandia National Labs</td>
<td>Whirlpool Corporation</td>
</tr>
</tbody>
</table>
ECE Graduate Faculty

- 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

- 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

- 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

- 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

- 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

- 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)

• 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?

• **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

- 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
- 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)