A Preview of Graduate Student Orientation
August 2015

Electrical Engineering & Computer Engineering

Prof. Zoran Kostic
MS EE Program Director
Columbia Electrical Engineering

• Founded in 1889 (at Thomas Edison’s suggestion)
• Source of many inventions
  – Transatlantic cables (Pupin)
  – FM radio (Armstrong)
  – MPEG-2 DVD coding (Anastassiou)
• 28 faculty + joint appointments (CS, AP) + adjunct professors
• Students:
  – ~100 undergraduates (juniors + seniors, including Comp.Eng.)
  – >300 MS students
  – ~130 Ph.D. candidates
EE Department Research and Teaching

• 5 main focus areas:
  Networking and Communications
  Signal and Information Processing
  Circuits and Electronics
  Photonics, Solid State Devices, and Electromagnetics
  Systems Biology and Neuroengineering

• 5-10 faculty per area (including overlaps and joint appointments with other departments)
EE MS Program

http://www.ee.columbia.edu/masters-program

Size:
- Fall 2012, 2013, 2014 - incoming number of MS students: ~190
- Out of around 1000 applicants
Recent Initiatives (subset)

• New DOE Energy Frontier Research Center on Photovoltaic Technology
  – 5 years, $19M, Yardley/Heinz EE, Brus Chemistry (PIs), Kymissis, Osgood, Shepard in EE and others as co-PIs
  – Improve photovoltaic efficiency through fundamental understanding and molecule-scale control of the key steps in the photovoltaic process in organic and hybrid materials

• NSF Center on Optical Techniques for Actuation, Sensing, & Imaging of Biological Systems
  – 5 years, $3M, Shepard EE (PI) and 19 faculty members from 9 departments, 6 schools
  – optical methods for biosensing and bioimaging, on-chip biological sensor systems using nanoscale device fabrication capabilities

• DOD MURI on Graphene Research
  – 5 years, $7.5M, Osgood EE (PI), with Mech E, Physics, Chemistry and Cornell U co-PIs
  – explore the unique properties of graphene and new device applications
Recent Initiatives (contd.)

• Energy Harvesting Active Networked Tags for Disaster Recovery
  – Winner of Vodafone Foundation's "Wireless Innovation" competition, new NSF grant
  – Collaborative effort between EE and CS
  – Energy harvesting tags, ultra low power communications, tracking/locating survivors

• Photonics and optical interconnect networks
  – New DOD/DARPA/NSF ERC grants, PI Bergman (EE), co-PIs Zussman (EE) and Carloni (CS)
  – High-performance computing systems, fast future Internet, cross-layer optimized access networks

• Media Informatics
  – DARPA/ONR/NGA/NSF/DOJ grants, large-scale multimedia analysis and search, Chang, Ellis (EE), Attinger (ME), Kender (CS), Sajda (BME)
  – Media NYC 2020 by NYC Mayor office, Columbia STV, EE, CS, NYU-Poly
  – Connect media industry and university research in new media areas
EE Strategic Strength Areas

- Systems Biology & Neuroengineering
- Media Informatics & Communication Systems
- Energy Harvesting, Efficiency & Sustainability
- Ambient Intelligent Cyber-Physical Systems
Research: Networking & Comms

- Basic problem: managing and moving information
- Physical ↔ logical layers
- Mathematical models of traffic
- Internet, ad-hoc, local communications
- Optics, wireless
Research: Signal Processing

- Representing and rearranging information
- Basic mathematics: transforms, filtering
- Audio/Video coding, compression, standards
- Content-based analysis, search/retrieval
- Pattern recognition & machine learning
Research: Integrated Systems/Circuits

- Analog and digital electronics design
- Mixed-signal VLSI
- High-speed, RF
- Power efficiency, control
- Embedded systems & Computer Engineering
Research: Devices, EM, Photonics

- Interface between EE and Applied Physics
- Novel semiconductor devices
- Ultrafast laser techniques
- Quantum structures
Research: Systems Biology

- New area for EE tools & techniques
- Genomics and information
- Biochemical systems and circuits
- Information processing in neural circuits
- Interfacing electronics and biochemistry
EE/CE MS Program

- 30 credits total
  - all at 4000 level or above
  - min. 15 credits at 6000 level (CompEng: all in EE or CS)
  - min. 15 credits in EE
  - CompEng: min. 15 credits from “core” (min. 6 in EE and CS)
  - max. 6 credits for research projects (CompEng: max 9 credits)
  - max. 3 credits for classes outside science/engineering and for non-technical classes within the engineering school
  - no credit for Math/Science classes covering traditional undergraduate material (e.g., basic statistics)
  - minimum 2.5 GPA (at any point in time)
  - complete within 5 years
EE/CE MS Program

• Normal load for full time students: ~12 credits/semester
  – i.e. 3 semesters to complete MS
    • Fall/Spring/Fall or Fall/Spring/Summer (more common among Ph.D./domestic students)
    – 12 credits per semester is a DHS (department of homeland security) limits - for questions refer to Columbia ISSO
• Each student has the responsibility to ensure that his/her selected courses satisfy all requirements, especially if he/she is constrained by a deadline such as that imposed by a student visa
  – We do not verify every semester that the classes that you take satisfy the requirements
  – If there is any doubt, seek advice
# MS Program Checklist

(in the folders)

---

## ELECTRICAL ENGINEERING MASTER OF SCIENCE

### PROGRAM CHECKLIST

**STUDENT:**

**UNI:**

(Please print)

This form serves as an unofficial checklist for the requirements of the M.S in Electrical Engineering.

<table>
<thead>
<tr>
<th>Courses</th>
<th>Pts.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### M.S.E.E. Degree requirements:

1. __ 30 points of credit, all 4000-level or above and taken for a letter grade (i.e., no P or R grades).
2. __ 15 points at or above 6000 level.
3. __ 15 points in EE (including joint courses).
4. __ No more than 6 points research (e.g., ELEN E4998, ELEN E6001, ELEN E6002).
5. __ No more than 3 points total for courses that are:
   a. Outside of SEAS and the Math & Science departments and approved by the MS Committee. Or
   b. Non-technical courses within SEAS and the Math & Science departments and approved by the MS Committee (e.g., IEOR E4702 Human Factors). *Economics and Business courses fall in category a.*
6. __ No credit for Math & Science courses covering traditional undergraduate engineering topics (e.g., STAT W4105 Probability).
7. __ Out of the first 24 credits completed, 12 credits have to be from EE or (joint EE) courses.
8. __ 2.5 GPA minimum.
9. __ Completion within 5 years.

### Important Notations:

1. All coursework must be approved by a faculty advisor if there is any question about items 5-6.
2. Each student has the responsibility to ensure that their selected courses satisfy all requirements, especially if he or she is constrained by a deadline such as that imposed by a student visa.

---

Last updated April 2015. Students whose program started before Fall 2012 can use the checklist that was in effect when their program started.
Concentrations

• MSEE can have an optional ‘concentration’
  – a particular set of coordinated courses to cover a certain field
• Bulletin lists several options
  – Multimedia Networking, Telecommunications Engineering, Lightwave Engineering...
• These are just suggestions!
  – You are free to put together your own program
Selecting your Classes

- In the folders (and online) – lists of EE, CS, and APAM classes
- Depth-area flowcharts (in the folders and the website) indicate dependencies and sequences
  - If in doubt regarding a pre-requisite – discuss with the instructor
- The classes in the different areas will be discussed later today
- Do not limit yourself only to EE classes – explore other departments
Classes Example Chart
Selecting your Classes

Attend many classes during the first week

Academic calendar:

http://ce.columbia.edu/calendars/academic-calendar/fall-2015

Registration for all other new M.S. students* Aug. 25–Aug. 29

• Registration for all other new M.S. Students* Aug. 31–Sep. 4
• Classes begin Sep. 8
• Late registration/change of program** Sep. 8–Sep. 18
• Last day to add or drop a class without financial penalty*** Sep. 18
• Last day to drop an individual class Oct. 13
• Waiting lists for some COMS and CSEE classes
Advising

• An MS student should meet a faculty advisor once a semester to discuss class registration
  – a useful resource for other topics
  – any EE faculty member
  – ideally, talk to a single faculty in your area of interest
  – This afternoon – matched students with faculty in their area

• Talk to students during the open lab session
• Talk to the EE ambassadors
Research

- Videos of the 2011 Research Overview Day: http://www.ee.columbia.edu/research-overview
- The MSEE program allows up to 6 units of research
  - ELEN E4998/ELEN E6001
  - typically 3 units/semester max.
  - (CompEng: 9 units)
  - Paid position are usually available during the summer
- Requires faculty supervisor
  - .. a significant time commitment
- No formal structure
  - .. just need to establish a relationship
  - .. e.g. through coursework, discussion with Ph.D. students
- Open labs today are a good source of information
- Doing well in classes and looking for a spring project is usually a good idea
Doctoral Qualifying Exam

- Oral/written exam required of students on Ph.D. track
  - MS students may take as evidence of their abilities
  - .. but they must still apply to the Ph.D. program (and be accepted)!
  - .. which means finding a willing Ph.D. supervisor
- Held in January every year
  - best taken at earliest opportunity
- Written exam covers undergraduate-level material at graduate-level sophistication
  - 6 areas
  - more details on EE web site
- Oral exam consists of three 15 minute one-on-one interviews
Lab Assistant and Grader Positions

• A limited number of Lab Assistant and Grader positions are available
• Application form available in the website:
  • http://www.ee.columbia.edu/pages/jobs/for_students/index.html

• CE students can also apply for CS dept. positions:
  ta.cs.columbia.edu

• EE students can also try (may be more relevant in the spring)
• Tesla students:
  – http://www.ee.columbia.edu/tesla-leadership-circle-program
  – Tesla Course Assistant, Tesla Research Position
Internships and Curricular Practical Training (CPT)

• A summer internship is an important step towards finding an industry position
• Presentation by the Center for Career Education later today
• Apply in time

• For international students – requires registering for CPT
  – Requires an advisor
  – A 0.5, 1, 1.5 credit class
  – Total of 1.5 credits for the duration of MS studies
  – Submit a report and employer evaluation at the end of the summer
• Under some conditions can also be done in the last semester
• Summer research positions are also available
Career Advising

Columbia University career advising – multiple resources:
• http://www.columbia.edu/content/students.html
• http://www.careereducation.columbia.edu/findajob

MS EE career advising changes:
• Useful information on the web: http://www.ee.columbia.edu/for-students
• There will be changes in the process
Information Resources

- Attend other orientation events, go over SEAS orientation package
- Ask students in the open labs
- EE, CE web sites
  - http://www.ee.columbia.edu/masters-program
- The SEAS Bulletin
  - http://www.engineering.columbia.edu/bulletin/
- Ask the faculty/staff:
  - MS advising committee (Professors: Zoran Kostic, Predrag Jelenkovic, Harish Krishnaswamy, John Wright, Debasish Mitra, Javad Ghaderi)
  - Elsa Sanchez, Stella Tan-Torres, Student Affairs Coordinators