UNIVERSITY OF COLORADO DENVER
Electrical Engineering Department
GRADUATE STUDY in ELECTRICAL ENGINEERING

I. INTRODUCTION

The University of Colorado Denver, College of Engineering and Applied Science, offers undergraduate and graduate degrees in electrical engineering, computer science, civil engineering, mechanical engineering, and applied mathematics. The College is a major educational support center in the metropolitan area, where traditional students and working individuals can earn a degree through both daytime and evening classes.

The electrical engineering M.S.E.E. degree offers exciting opportunities to pursue graduate degrees in a number of traditional as well as new areas of emphasis. The electrical engineering web site can be accessed at www.ucdenver.edu/electrical for additional information.

Practicing engineers can extend and update their professional capabilities through credit and/or non-credit courses, as well as earn graduate education in management, public policy, environmental science, computer science, or other areas of engineering through complimentary multi-disciplinary Master of Engineering programs offered by the College.

The Electrical Engineering Department offers graduate programs in electrical engineering with the following areas of concentration:

- Communications and Signal Processing
- Controls and Signal Processing
- Microelectronics and VLSI
- Fields, Waves and Optics
- Computer Engineering and Embedded System Design
- Energy and Power Systems

The Department offers graduate programs leading to the following degrees:

* Master of Science in Electrical Engineering (M.S.E.E.)
* Master of Engineering (M.Engr.)
* Doctor of Philosophy (Ph.D.) through University of Colorado at Boulder

The first two graduate degrees are awarded and administered by the College of Engineering and Applied Science, and the Vice-Chancellor of the Graduate School of University of Colorado Denver in cooperation with the Electrical Engineering Department.

II. ADMISSION TO GRADUATE STUDY IN ELECTRICAL ENGINEERING

Interested students with questions may contact members of the Electrical Engineering Department Graduate Committee by calling the department office at (303) 556 2872 or visiting the web site.

Applicants, who are U.S. citizens or permanent residents, should request an application through Department of Electrical Engineering, University of Colorado Denver, 110UCD, P.O. Box 173364, Denver, CO 80217-3364; telephone 303 556 2872; facsimile (303) 556 2383. Applicants, who are not citizens or permanent residents of the United States, should make application through the University of Colorado Denver, Office of International Education, 185UCD, P.O. Box 173364, Denver, Colorado 80217-3364, U.S.A.; telephone 303 315 2231; facsimile 303 315 2246.

All applicants for admission need to submit complete credentials as outlined in the instruction sheet which accompanies the application materials. Three recommendations are required.

The minimum requirements for “regular” admission to the Masters program are: BS in Electrical Engineering, or equivalent degree in Math, Physics or other engineering disciplines, from a reputable institution, with Grade Point
Average (GPA) at least 3.0, on a 4.0 scale. Satisfaction of minimum requirements does not guarantee admission: The grades obtained in the student’s area of concentration are important factors in the consideration, and so are possible multiple repetitions of fundamental courses. Students who do not meet the requirements for direct admission to the program may be admitted “conditionally”: that is, they may be required to take or repeat certain undergraduate courses before their admission to the program is official.

For those undergraduate students with degrees in science and non-electrical engineering wishing to pursue graduate study in the Electrical Engineering Department there is no restriction or constraint in being admitted into the M.S.E.E. graduate program. However, they must fulfill any pre-requisite course requirements assigned to any graduate course in the department. Students with an undergraduate degree in areas other than electrical engineering must also see their graduate instructor to receive approval before registering for a class in electrical engineering.

Students must plan a program of study in consultation with their departmental advisor(s), during the first semester of study, and submit for approval to the Department.

1. Master of Science (MSEE) Program

Upon acceptance to the MSEE program, each student will be assigned a faculty advisor to help him/her with selecting their courses for the first semester. Subsequently, it is required that a MSEE candidate select a graduate advisor within the first semester of his/her graduate studies at the Electrical Engineering (EE) Department, UC Denver and sign an agreement with this advisor regarding the rules and regulations pertinent to the MSEE degree. The student’s graduate advisor will approve the student’s curriculum, as complying with the rules and conditions in this document, and will supervise the student’s thesis or project (see below for distinction between thesis and project). The list of graduate advisors in the EE Department is included in Section IV of this document.

To fulfill the requirements for the MSEE degree, the EE Department at UC Denver requires that, within a five-year period, a candidate complete an approved program consisting of at least 30 semester hours, while maintaining a grade point average of 3.0 or higher. In compliance with the Graduate School Rules, the minimum grade required for a unit to count towards the 30 semester hours is “B minus” (2.7). It is also recommended that MSEE candidates attend the EE seminar series.

The EE department offers six areas of concentration at the Master level: Controls and Signal Processing; Communications and Signal Processing; Microelectronics and VLSI; Fields, Waves and Optics; Embedded Systems and Energy and Power Systems. The courses offered in each concentration area are listed in Section III of this document.

It is required that a student select a primary area of concentration and a secondary area of concentration among the seven areas listed above, in agreement with the student’s graduate advisor (the list of graduate advisors is included in Section IV of this document). The student must take at least four 3-unit courses in the primary area of concentration and at least two 3-unit courses in the secondary area of concentration, all these six courses being selected from those listed in Section III and being offered by the UCD EE Department. A seventh 3-unit course may be selected from any area of concentration among those in Section III that are offered by the UCD EE Department, or may be an independent study 3-unit course with one of the graduate faculty at the UCD EE Department, where a student may take no more than one independent study courses. At least 21 course units must be taken from the UCD EE Department. To register in any of the above seven (encompassing a total of 21 units) courses, the student must first obtain the signed approval of his/her graduate advisor. To complete the MSEE degree requirements, an additional total of nine more units is required. These nine units may be allocated in two different ways dictated by the two degree options offered: thesis or non-thesis.

- The thesis option allocates six units to the Master’s thesis, completed under the auspices of the student’s graduate advisor, and requires an additional 3- unit graduate course. The latter course may be selected via signed pre-agreement with the student’s graduate advisor.

Typical Degree Construct – Thesis Option
Primary Area (required)  
minimum four courses , Section III, UCD EE Dept.  
12 SH

Secondary Area (required)  
minimum two courses , Section III, UCD EE Dept.  
6 SH

One additional course (required)  
Section III, UCD EE Dept.  
3 SH

Thesis (required)  
6 SH

Other course (required)  
pre-approved by advisor  
3 SH

Total (minimum)  
30 SH

- The non-thesis option allocates three units to a Master’s project completed under the auspices of the student’s graduate advisor, and requires two additional 3-unit graduate courses selected with the signed pre-agreement of the student’s graduate advisor.

**Typical Degree Construct – Masters Project Option**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Courses/Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Area (required)</td>
<td>minimum four courses , Section III, UCD EE Dept.</td>
</tr>
<tr>
<td></td>
<td>12 SH</td>
</tr>
<tr>
<td>Secondary Area (required)</td>
<td>minimum two courses , Section III, UCD EE Dept.</td>
</tr>
<tr>
<td></td>
<td>6 SH</td>
</tr>
<tr>
<td>One additional course (required)</td>
<td>Section III, UCD EE Dept.</td>
</tr>
<tr>
<td></td>
<td>3 SH</td>
</tr>
<tr>
<td>Masters Project (required)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 SH</td>
</tr>
<tr>
<td>Other courses (required)</td>
<td>pre-approved by advisor</td>
</tr>
<tr>
<td></td>
<td>3 SH</td>
</tr>
<tr>
<td>Total (minimum)</td>
<td>30 SH</td>
</tr>
</tbody>
</table>

- The M.S.E.E. major advisor must be a full-time, UCD Electrical Engineering Department, graduate faculty member. Those currently satisfying these requirements are listed in Section IV of this document.

- It is required by the Graduate School Rules that the student defend his/her Thesis or Masters Project in front of a three-member committee of graduate faculty.

Candidates with a B.S.E.E. degree from UCD Electrical Engineering Department can count 6 electrical engineering UCD graduate credits toward both undergraduate and graduate degrees, if their undergraduate GPA was at least 3.0. Double-counting applies only to credits earned at 5000-level or higher, and with a “B minus” (2.7) or higher grade.

## 2. Master of Engineering (M.Engr.) Program

A qualified student may enroll in the graduate program of the Department of Electrical Engineering to pursue the degree of Master of Engineering. This program is broad-based and is designed especially for that person who wants to further his/her education in more than just one discipline. An example might be in engineering administration where course work in business management would logically supplement engineering studies.

A minimum of 30 credit semester hours of academic work acceptable to the Advisory Committee (within the rules established by the College of Engineering and Applied Science) will be required for the degree Master of Engineering. In compliance with the Graduate School Rules, the minimum grade required for a unit to count towards the 30 semester hours is “B minus” (2.7). To couple this degree with electrical engineering, at least 15 of these hours must be 5000 level or above in electrical engineering courses, and must be taken in UCD Electrical Engineering Department. As many as 15 credit hours can be taken outside of engineering, including 3 credit hours of Master of Engineering project. The project should cover some area of creative investigation performed by the student and may relate directly to his/her professional work and must be defended orally before the Advisory Committee.

Students may earn up to a maximum of 9 credit hours required for the degree through the Center for Advanced Training in Engineering and Technology Education, CAETE, videotape program or from another accredited institution including CATETE. These credit hours cannot be part of the 15 credit hours required from the UCD Electrical Engineering Department.
3. **Doctor of Philosophy (Ph.D.) Program**

A Ph.D. in Electrical Engineering is available through the University of Colorado at Boulder, Electrical Engineering Department. UCD graduate faculty may serve as research advisors by individual arrangement. For information contact Adam Sadoff, UCB Electrical and Computer Engineering, 303 735 0490.

### III. ELECTRICAL ENGINEERING GRADUATE COURSES AT UCD

(a) **Communications and Signal Processing**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 5230-3</td>
<td>Advanced Linear Systems</td>
</tr>
<tr>
<td>EE 5252-3</td>
<td>Computer Communications Networks</td>
</tr>
<tr>
<td>EE 5248-3</td>
<td>Digital Communication Systems</td>
</tr>
<tr>
<td>EE 5249-3</td>
<td>Space Communications Systems</td>
</tr>
<tr>
<td>EE 5250-3</td>
<td>Information Theory</td>
</tr>
<tr>
<td>EE 5551-3</td>
<td>Pattern Recognition</td>
</tr>
<tr>
<td>EE 5617-3</td>
<td>Random Processes for Engineers (Prerequisite to several other courses in this group) can be taken concurrently with them)</td>
</tr>
<tr>
<td>EE 5637-3</td>
<td>Digital Signal Processing (Prerequisite to several courses in this group can be taken concurrently with them)</td>
</tr>
<tr>
<td>EE 5638-3</td>
<td>Digital Image Processing</td>
</tr>
<tr>
<td>EE 5647-3</td>
<td>Adaptive Signal Processing</td>
</tr>
<tr>
<td>EE 5657-3</td>
<td>Detection and Estimation Theory</td>
</tr>
<tr>
<td>EE 5667-3</td>
<td>Wavelets Theory and Applications</td>
</tr>
<tr>
<td>EE 5687-3</td>
<td>Optical Communication Systems</td>
</tr>
<tr>
<td>EE 5697-3</td>
<td>Optical and Spatial Information</td>
</tr>
<tr>
<td>EE 5xxx-3</td>
<td>Sensor Networks</td>
</tr>
<tr>
<td>EE 5xxx-3</td>
<td>Biomedical Imaging</td>
</tr>
</tbody>
</table>

(b) **Controls and Signal Processing**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 5230-3</td>
<td>Advanced Linear Systems</td>
</tr>
<tr>
<td>EE 5436-3</td>
<td>Nonlinear Control Systems</td>
</tr>
<tr>
<td>EE 5446-3</td>
<td>Introduction to Modern Control Theory</td>
</tr>
<tr>
<td>EE 5456-3</td>
<td>Sampled Data and Digital Control Systems</td>
</tr>
<tr>
<td>EE 5466-3</td>
<td>Adaptive Control System Design</td>
</tr>
<tr>
<td>EE 5476-3</td>
<td>Optimal Control Systems</td>
</tr>
<tr>
<td>EE 5486-3</td>
<td>Modeling and System Identification</td>
</tr>
<tr>
<td>EE 5496-3</td>
<td>Robust Control Systems</td>
</tr>
<tr>
<td>EE 5551-3</td>
<td>Pattern Recognition</td>
</tr>
<tr>
<td>EE 5617-3</td>
<td>Random Processes for Engineers (Prerequisite to several other courses in this group) can be taken concurrently with them)</td>
</tr>
<tr>
<td>EE 5637-3</td>
<td>Digital Signal Processing (Prerequisite to several courses in this group can be taken concurrently with them)</td>
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<td>EE 5638-3</td>
<td>Digital Image Processing</td>
</tr>
<tr>
<td>EE 5647-3</td>
<td>Adaptive Signal Processing</td>
</tr>
<tr>
<td>EE 5667-3</td>
<td>Wavelets Theory and Application</td>
</tr>
<tr>
<td>EE 5800-3</td>
<td>Biomedical Imaging</td>
</tr>
<tr>
<td>EE 5xxx-3</td>
<td>Biomedical Signal and Image Processing</td>
</tr>
</tbody>
</table>
(c) Microelectronics and VLSI:

EE 5005-3  VLSI Device Modeling
EE 5025-3  Device Electronics
EE 5455-3  Numerical Analysis of Semiconductor Devices
EE 5522-3  VLSI System Design
EE 5555-3  VLSI Circuit Simulation
EE 5xx5-3  Fabrication Lab
EE 5xxx-3  Quantum Electronics
EE 6xx5-3  Device Electronics II

(d) Fields, Waves and Optics

EE 5xxx-3 Quantum Electronics
EE 5373-3 Optical Engineering
EE 5xxx-3 Introduction to Biomedical Photonics
EE 5230-3 Advanced Linear Systems
EE 5xxx-3 Nonlinear Biophotonics
EE 5800-3 Biomedical Imaging
EE 5xxx-3 Biomedical Signal and Image Processing
EE 5xxx-1 Biophotonics Laboratory
EE 5133-3 Electromagnetic Radiation and Antenna
EE 5832-3 Applications and Fundamentals of Plasmas
EE 5638-3 Digital Image Processing
EE 5637-3 Digital Signal Processing
EE 5551-3 Pattern Recognition
EE 5688-3 Nondestructive Testing(Deng)
EE 5xxx-3 Numerical Electromagnetics Course (Deng and/or Golkowski)

(e) Computer Engineering and Embedded System Design

EE 5501-3  Microprocessor-based Design
EE 5511-3  Hardware-Software Interface
EE 5521-3  Design & Test of Digital Systems
EE 5593-3  Advanced Computer Architecture

(f) Energy and Power Systems:

EE 5174-3  Power Electronic Systems
EE 5xxx-3  Advanced Power Electronic Systems
EE 5184-3  Power Systems Analysis
EE 5774-3  Power Systems Dynamics and Protection
EE 5813-3  Energy Systems Planning
EE 5xxx-3  Power System Operation and Control
EE 5xxx-3  Electric Drive System
EE 5xxx-3  Advanced Electric Drive Systems
EE 5xxx-3  Advanced Electric Machinery
EE 5xxx-3  Practical Electric Drive Systems
EE 5808-3  Renewable Energy Systems
EE 5xxx-3  Special topics in energy and power systems

Selected Math Courses

EE 5210-3  Optimization Methods in Engineering
EE 5220-3  Methods of Engineering Analysis
**Remark:** The EE department occasionally offers special topics courses, numbered EE58xx, which may count towards the satisfaction of the M.S.E.E.major/minor area requirements, as advised by the candidate’s major advisor.

**IV. MSEE and MEngr FACULTY ADVISORS and AREAS OF SPECIALTY**

Atkinson, Brian, M.S. Electrical Engineering, University of Colorado Denver.
System design methodology, microprocessor-based systems, electronic and digital system design, digital and embedded systems and their application to robotic systems.

Bialasiewicz, Jan, Ph.D. and D.Sc. Electrical Engineering, Silesian University of Technology, Poland.

Connors, Daniel, Ph.D. Electrical and Computer Engineering, University of Illinois at Urbana-Champaign.
Systems (computer architecture, embedded system design and fault tolerance), Software (programming languages, parallel processing, compilers), Scientific Computation (high performance computing).

Deng, Yiming (Jerry), Ph.D., Electrical Engineering, Michigan State University.
Biomedical imaging and medical physics, applied electromagnetics and electromagnetic imaging, signal and image processing, mathematical modeling and simulation, pattern recognition and nondestructive evaluation.

Fardi, Hamid, Ph.D. Electrical Engineering, University of Colorado at Boulder.
Solid State Electronics: device modeling, VLSI, measurements and characterization.

Golkowski, Mark, Ph.D. Electrical Engineering, Stanford University.
Electromagnetic waves, interactions of fields and matter, plasma discharges, waves in plasmas, phenomena of the ionosphere and magnetosphere.

Grabbe, Robert, M.S. Electrical Engineering, University of Colorado Denver.
System design methodology, microprocessor-based systems, real-time software design, digital and embedded systems and their application to robotic systems.

Lei, Tim C., Ph.D., Electrical Engineering, University of Michigan, Ann Arbor.
Ultrafast and nonlinear optics, biophotonics, advanced spectroscopic and microscopic techniques for biomedical applications, disease diagnostics and treatments with optical techniques.

Mancilla-David, Fernando A., Ph.D. Electrical Engineering, University of Wisconsin Madison.
Power system engineering, advanced power electronics.

Papantoni, Titsa, Ph.D. Electrical Engineering, University of Southern California.

Park, Jae-Do, Ph.D., Electrical Engineering, Pennsylvania State University.
Electric machine modeling and control, drive system design, energy conversion system applications.

Radenkovic, Miroje, Ph.D. Electrical Engineering, Belgrade University, Yugoslavia. Systems and Control Theory: robust control systems, stochastic control and system identification, adaptive systems in control and signal processing, control of large-scale systems, intelligent control.
V. OTHER GRADUATE FACULTY and AREAS OF SPECIALTY


Fermelia, Al, Ph.D. Mechanical Engineering, University of Missouri-Rolla. Attitude control, advanced systems engineering

Geissinger, Gary, M.S. Electrical Engineering, University of Colorado at Denver; Chief Electrical Engineering, DigitalGlobe (EarthWatch, Inc.), Longmont, Colorado. Digital systems, hardware-software interface, satellite communications systems.


Malmedal, Keith, Ph.D., P.E., Colorado School of Mines, Engineering Systems, M.S. University of Colorado Denver, Civil Engineering; President and Chief Engineering, NEI Engineering. Commercial and industrial power distribution design at low and medium voltages, renewable energy design and integration, short circuit studies, harmonic studies, protection design, commercial lighting design, and fire alarm system design.

Oh, Hyungseon, Ph.D., Electrical and Computer Engineering, Cornell University, New York. Electric power systems planning and design, economic impact analysis of renewable energy.


Shen, Tzung-Sz, Ph.D. Mechanical Engineering, Ohio State University Columbus. Control system analysis, servo-mechanical systems.

Solomonow, Moshe, Ph.D., University of California Los Angeles, Engineering Systems and Neurosciences. Biomedical engineering.