Department of Electrical and Computer Engineering
University of Wyoming

DRAFT ACADEMIC PLAN 2003

Progress on action items from the *1999 Academic Plan*. For brevity, this section simply lists specific actions items from the *1999 Academic Plan* and the progress accomplished in addressing these items. Important background information on the Department of Electrical and Computer Engineering and the context of these plans is contained in the original Department Plan and is attached for reference.

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61. Action Item: In consultation with the Deans of Arts and Sciences, Business, and Engineering, the Vice President for Academic Affairs will assess alternative organizational arrangements that will strengthen the University's presence in computing, information technology, and information management at the undergraduate and graduate level. This effort could include cross-college cooperation for a computer engineering program, the merger of Computer Science and Electrical Engineering, the creation of an inter-college School of Computer and Information Sciences, or other alternatives.

Since adoption of the 1999 plan, the Computer Engineering degree program has been established through a joint effort with Electrical Engineering and Computer Science. Both the program and name change of our department (changed to Electrical and Computer Engineering) was approved by the Trustees in summer of 2000 and now has about 55 students enrolled. The first student graduated with a Computer Engineering degree in December 2001 (this student transferred over from a partially completed electrical engineering program). We have requested accreditation of the Computer Engineering Program by the EAC of ABET and the initial visit is scheduled in the fall of 2003.

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101.   Action Item: Pursuant to the graduate enrollment plan in Section VII, Engineering should implement its plan to increase Ph.D. production. We believe that it is possible to attain the goal of at least 15 Ph.D. graduates per year within four years.

Electrical and Computer Engineering (ECE) has concentrated on increasing Ph.D. enrollment and production. There is a significant lag time from recruiting additional students to graduation, but progress is clear. Currently ECE has 12 active Ph.D. students, with three expected to graduate by December 2003 and an additional three to graduate in 2004.

While these are the only "action items" relating directly to ECE in the 1999 Plan, we note the additional comment about focus taken directly from the *1999 Academic Plan*:

Electrical Engineering.   This department's commitment to three foci is commendable, as is their commitment to increased external funding. These three areas of focus will include:

- ❋   control of electromechanical systems and electrical energy
- ❋   electronics (to include radio frequency applications, power electronics, VLSI design)
- ❋   communications, signal processing, and networks.

The faculty continues to focus on these important specialty areas where we have expertise and recognition, including our most recent new faculty hire, Dr. John O'Brien, who has an excellent reputation in control of electromechanical systems. Research funding has also been increasing steadily, with new

grants of $800K in fiscal year 2003 including awards from DEPSCoR, DOE, NSF, and the NIH. The College also secured a competitive Hewlett grant for $1.15M, written by a team lead by Dr. Jerry C. Hamann.

To summarize, since the submission of this plan in 1999, our progress on the near-term educational objectives has been significant, as follows:

- We have maintained nearly constant enrollment in electrical engineering, with enrollment of 252 in Fall 2002 compared to 249 in Fall 2003. We continue to emphasize recruitment of female and minority students.
- We have adopted a new curriculum that has additional emphasis on engineering design, especially related to communications, control systems and microprocessors
- The Computer Engineering degree as a separate degree program has been approved and has attracted about 55 students, with 18 freshmen this year, indicating it is still growing.
- We have maintained a high level of enrollment and funding for our graduate programs, with an increased emphasis on Ph.D. students. Currently we have 13 Ph.D. students and 41 MS students and are funding 80% of those students.
- The "Doctoral Report" compiled by the Graduate Dean confirms that the Department has increased Ph.D. production, graduating two Ph.D. students per year in 1999 and 2000. It also notes that all but three of our faculty members were either PI or Co-PI on one or more funded research grants. And one of those is now PI on a $340,000 DEPSCoR grant.

Curriculum. The Department of Electrical and Computer Engineering offers three different bachelor degree programs. The three courses of study are:
- Bachelor of Science in Electrical Engineering
- Bachelor of Science in Electrical Engineering/Bioengineering Option
- Bachelor of Science in Computer Engineering

During the previous planning cycle the Department of Electrical and Computer Engineering completed two long-term, far-reaching initiatives: a complete review of existing degree programs and the design and implementation of the Bachelor of Science degree in Computer Engineering.

The Department completed a three-year review of these curricula in November 2002. The action items identified from the review were to:
- Provide a balance between breadth and depth in each curriculum.
- Provide an introductory course in electrical and computer engineering in the freshman year.
- Ensure the curricula were current.
- Ensure the curricula met the needs of our constituents.
- Provide flexibility so the individual student could tailor their studies to the area of electrical and computer engineering of their interest.
- Provide additional computer programming coursework.

In Fall 1999, the Department of Electrical Engineering (EE) and Computer Science (COSC) were jointly charged with the development of a Computer Engineering curriculum by a university-level directive. That directive was an action item in the previous academic plan and resulted from suggestions in the EE Department Academic Plan. In response to this directive, the Department Heads of EE and COSC established a joint working group to establish this new curriculum. During the 1999-2000 academic year, the working group explored EC2000 guidance, computer engineering curricula at other universities, and solicited input from alumni constituents. From this input and considerable development a Computer Engineering curriculum was created. Curriculum committees at both the College and University levels then reviewed the curriculum. At the same time the curriculum was reviewed by each of the participating

department faculties. The University Trustees approved the curriculum in Summer 2000. Students began enrolling in the curriculum in Fall 2000. The first student graduated with a Computer Engineering Degree in December 2001. Since its inception in Fall 2000, faculty in both ECE and COSC have worked to improve the program. These initiatives are documented in our assessment program self-study.

In addition to these initiatives, the Department has also developed **interdisciplinary activities** with other departments and programs at the university:
- Neuroscience/Electrical Engineering – biomedical engineering projects
- Physics/Electrical Engineering - materials
- Mathematics/Electrical Engineering – control systems
- Mechanical/Electrical Engineering – undergraduate senior design projects sponsored by the NSF
- Internationalization – College level activities

Future Plans. MFIII encourages all departments to move to 128 hours or less for all degree programs, if possible. We recommend that the programs within the ECE department maintain a 132-hour curriculum. It would be extremely difficult, if not impossible, to maintain the quality of instruction at the undergraduate level with a reduction of semester hour count.
- A hallmark of our undergraduate program of study is the emphasis on practical, hands-on laboratory experience in many of our courses. This requires four credits for these courses – three for classroom instruction and one for the laboratory aspects of the course. The extensive laboratory work attracts students and better prepares them for engineering practice, facts confirmed by our advisory board, employers, and graduates.
- In addition to broad general education, our accreditation body and our constituents value an education with technical breadth. This requires courses in other engineering areas such as statics and dynamics. This allows our graduates to be effective members of interdisciplinary design teams in industry.
- The general education requirements associated with the new University Studies program has added credit hours that were already scarce in a 132-hour engineering program.
- The Department Advisory Board recommended not reducing credit hours without having strong statistics that justify it is beneficial to do so.

To maintain a quality, student-oriented undergraduate degree program, we believe the following are essential:
- A faculty with a breadth of knowledge and experience in many areas of electrical and computer engineering.
- Enough faculty members to offer required and elective undergraduate and graduate coursework on a regular, recurring basis.
- A curriculum with enough breadth and depth to meet national accreditation and University Studies guidelines.
- Continued emphasis on quality undergraduate education characterized by dedicated, student-oriented faculty; solid foundation in engineering fundamentals, and continued innovative offerings in upper-level coursework.

Assessment. The Department of Electrical and Computer Engineering has a very intensive, ongoing continuous assessment program at both the undergraduate and graduate levels. The overall goal of the program is to provide for systematic and continuous improvement of all department associated programs and activities.

Undergraduate Program Assessment. Our undergraduate assessment activities are based upon the guidelines provided by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). In Fall 2003, our undergraduate electrical and computer

engineering degree programs will be evaluated for continued accreditation for electrical engineering and initial accreditation for computer engineering. The degrees will be evaluated under ABET Engineering Criteria 2000 (EC2000). The EC2000, in Criterion 3, emphasizes measuring student outcomes and developing a process for continuous program improvement. Our goal is to obtain the maximum six-year accreditation for both programs. Details of our undergraduate assessment program is contained in "Program Self-Study Report for Electrical Engineering" and "Program Self-Study Report for Computer Engineering."

Graduate Program Assessment. At the graduate level, we measure our program success using the metrics listed below. We are in the process of collecting data to support these metrics.
- Faculty involvement – All faculty members other than the Department Head are currently advising graduate students, and most are advising both MS and Ph.D. students.
- Number of graduate degrees awarded
- Research funding levels
- Graduate job placement
- Research publications

Areas of Distinction. Electrical engineering is a very expansive discipline. Evidence of this is clear. Of all the engineering jobs in the United States, over half are in electrical and computer engineering. Moreover, the electrical and computer engineering professional society, IEEE, has more members than the combined total membership of the other engineering professional societies. Within IEEE, there are 36 sub-societies covering a wide range of areas. In no way does the ECE Department try to focus on such a broad array of specialties. The Department is committed to offering undergraduate degrees in Electrical and Computer Engineering including an option in Bioengineering. These degree offerings require a certain amount of breadth to satisfy accreditation. At the graduate level, the Department has candidly evaluated existing resources and expertise, resulting in three focus areas of distinction for MS and PhD studies.

The three focus areas align well with the University's areas of distinction. *Moving Forward III* encourages departments to "refine their own long-range foci and to participate in the cross-disciplinary synergy that allows UW to compete with much larger institutions." Our plan addresses these issues. These focus areas encompass all of the Department faculty expertise, and there is natural overlap between these areas. The three areas also have excellent interconnections to other disciplines outside of ECE, making them well suited to interdisciplinary research. **In addition to our three research focus areas, the Department is committed to excellence in graduate and undergraduate education, where the Department is nationally recognized.**

The three focus areas and their relationships to the University's areas of distinction are as follows:
- *Control Systems.* Control systems is a discipline that has broad overlap with other areas in the Department, where many of the faculty have been involved in energy research, including intelligent system configuration and precision control. This focus area matches well with the University's focus on energy and natural resources as well as the computational science category of critical areas of science and technology. The Department has been and will continue to be a major contributor to technology solutions for State electrical energy issues. The nationally recognized control systems development based around the Hexapod Laboratory is included in this focus area, with growing interdisciplinary ties to the Departments of Mathematics and Mechanical Engineering.
- *Electronics Systems and Devices.* This focus area matches well with the University's focus on materials and computational sciences as critical areas of science and technology. Electronics is key to computational science and is the enabling technology in many interdisciplinary projects, including activities combined with Physics and Chemical Engineering.

- *Signal Processing and Computer Networks.* This focus area matches well with the University's focus on computational sciences. Specifically listed as categories of critical areas of science and technology in Moving Forward III are information sciences, telecommunication, networking, biomedical sciences, and computational biosciences. The Department currently has research related to each of these areas and is planning to augment that research with additional interdisciplinary efforts. Current interdisciplinary collaborations include faculty from Statistics, Computer Science, Chemical Engineering, Mechanical Engineering, and Zoology/Physiology. Excellent opportunities are present for additional collaborations as periodic consulting is undertaken with faculty and students from Atmospheric Science, Chemical Engineering, Civil Engineering and Kinesiology and Health. Regionally, the Department has strong ties to technology businesses that have funded Department labs and graduate student projects in this focus area.

Issues in MFIII that are germane to the Department, including College-level issues.   *MFIII - Premises and Principles*. The ECE Department aligns well with MFIII's five premises about the nature of UW and the eight principles that shape the contour of the plan. The department is dedicated to the premise that as a land grant university we are committed to excellence in undergraduate education, nationally recognized research, and a committed service to the state. The sixth planning principle states, "The pursuit of distinction is most effective when it furnishes opportunities for many members of the academic community to participate." The Department's areas of distinction are broad enough to allow all faculty to participate but narrow enough to align with the University wide areas of distinction.

MFIII - Areas of Distinction. The undergraduate and graduate programs of the Department of Electrical and Computer Engineering represent disciplines of study and professional training which are vital to the advancement of several aspects of the Institution identified areas of distinction.
- Environment and Natural Resources: The technologies utilized for monitoring environmental systems rely heavily upon basic electronic instrumentation systems as well as computer and communication facilities which our graduates design. Natural resource utilization, including alternative energy sources, and pollution abatement processes include control systems technologies and electronic techniques which are founded in our core disciplinary studies. Synergistic research projects currently exist with Department faculty and other College faculty wherein the enabling technology is the electronics.
- Life Sciences: The Bioengineering option of the Electrical Engineering BS degree continues to be popular both with students seeking careers in clinical systems engineering (medical technology product design or facilities-based deployment) as well as those seeking an applied engineering path to subsequent professional programs in Medicine. At the graduate level, cooperative research in life sciences is currently underway with Department faculty and associates across the University, including participation in NIH and NSF-funded programs.
- Critical Areas of Science and Technology: Electrical engineering is the fastest growing area of future demand for young engineers. Computer and communications technologies are driving the information systems which are the foundation for our worldwide economy. The reliability and safety of public infrastructure elements, including power systems, communication and public transportation, are dependent upon the technologies at the core of the undergraduate programs in the Department. The long-standing "hexapod" controls research program is part of a national effort in smart structures and materials that fits UW's materials efforts. An offshoot from that program has recently been funded to perform work in aircraft control via computational fluid mechanics. In addition, the ECE Department and the recently created computer engineering program, is a central focus for the computational sciences expertise at UW. Indeed, MFIII mentions that the new program in computer engineering is "among UW's more visible accomplishments since the 1999 Academic Plan."
- Professions and Issues Critical to the Region: A major portion of our undergraduates find employment in the Rocky Mountain region and Pacific Coast. Growth of the Colorado Front Range

technology corridor has included a large number of our graduates at all levels. Small business opportunities in Wyoming are growing with a notable increase in electrical and computer engineering technologies, including support by University of Wyoming alumni as well as Department faculty and students.

- The Department will continue to support technology growth and development through both excellent undergraduate programs attune to the demands of regional and world economies as well as graduate programs focused on the areas of distinction noted.

MFIII - Scholarship and Graduate Education. The department is dedicated to Graduate Education, Scholarship, and Research. All of the faculty in the department are advising graduate students with most advising Ph.D. students. Most of the faculty are involved in externally funded research projects with yearly expenditures averaging over $700K and $800K of new research funding for fiscal year 2003.

- MFIII encourages the examination of "fast track" master's programs. As a first step in this direction the department has decided to emphasize Plan B masters where appropriate. This change has been initiated for three reasons: 1) most ECE departments at research universities emphasize the non-thesis MS, 2) this is a very marketable degree, 3) this frees up more faculty time to work with Ph.D. students.

- MFIII stresses the importance of successful Ph.D. programs. Since inception of the 1999 academic plan, the department has place an emphasis on the Ph.D. program. There are currently 12 active Ph.D. students, both externally and internally funded, in the department with approximately six anticipated to graduate before the end of next year. The average GRE scores for our Ph.D. students are consistently higher than the College average and approximately 200 points higher than the University average.

- MFIII promotes interdisciplinary endeavors. Electrical Engineering is well suited to interdisciplinarity because many other fields deal with physical measurements which are made electronically and processed. Current and future interdisciplinary partners include Mathematics; Statistics; Physics; Mechanical, Civil and Chemical Engineering; Computer Science; Geology, Zoology; and Physiology and Speech Pathology.

- MFIII comments that "the small size of UW's graduate programs imposes some constraints." The ECE Department leverages off of interdisciplinary course offerings in Statistics, Math, Computer Science, Mechanical Engineering, Chemistry, and Physics, which help to provide the required depth for our Ph.D. program.

- MFIII discusses the importance of externally funded GA's and having national and international graduate students. During the last semester (spring 03), the ECE Department funded 27 externally funded GA's and a total of 54 graduate students (30 US, and 24 International).

Other issues that are germane to the Department.

Fundamental Principles. The ECE Department feels it is critical to maintain a focus on excellence in undergraduate education. As clearly stated in the section of MFIII on planning premises, UW's first priority is undergraduate education. Any academic plan for the ECE department should honor the following basic principles:

- Small class size is fundamental to high quality instruction, and makes the UW ECE department distinctive relative to other departments in the region such as CSU and CU.

- To provide the highest quality education possible, the faculty should represent expertise in basic areas of electrical engineering. In particular, areas relevant to Wyoming industries and environmental and natural resources should not be ignored.

- Efforts to enhance research output with existing resources should not be at the expense of excellence in undergraduate education.

- Wyoming citizens understandably expect that experts in the field will teach their children. Although professors occasionally fill in to teach courses in areas outside their expertise, they cannot provide the depth of knowledge and experience required for excellent and thorough coverage.

Critical Mass. The addition of new faculty positions is vitally important to maintain our gains and continue to grow our graduate and research programs, as well as to deliver quality undergraduate degrees in Electrical and Computer Engineering. Most of the faculty desire to offer at least one graduate course per year, and to see that their PhD students acquire enough course work depth to support a quality program. The Department does leverage off of interdisciplinary offerings in other departments, and we have exhausted this avenue of increasing efficiency of our program in that regard. Additional faculty hiring in our focus areas would allow for reasonable coverage of the undergraduate programs, a solid offering of graduate courses, and continued growth of our research program. It would also enhance research collaboration and help to sustain critical mass in our research programs.

According to the OIA data, the number of faculty in the Department has been in steady decline (see the attached memo for details) while enrollments have not decreased. The Department has been particularly hit hard by the retirements or resignations of six faculty since the spring of 2000. These faculty were an integral part of the Department and contributed immensely, especially to the teaching mission of the Department. Since the departure of these six faculty members, the Department has only been authorized two positions. This reduction in resources, especially while the Department was introducing a new degree program and increasing our graduate and research programs, has greatly strained the Department.

An additional concern is the appointment of one of our best teachers (Jerry Hamann) as director of the UWCE[3], funded by the Hewlett Foundation. While this is a fortuitous opportunity for the College of Engineering, it represents a reallocation of a vital Department resource. Dr. Hamann is involved in research projects and is a major contributor in teaching Computer Engineering as well as Electrical Engineering courses. Receiving a million dollar grant should be a winning situation for the principle investigator and Department, as well as the University and College, yet the Department and Dr. Hamann will suffer unless the situation is somehow rectified.

Action Items for 2004-2009. The action items for the Department of Electrical and Computer Engineering are categorized below into four general groups associated with the resources and functions of the programs overseen by the Department.

Undergraduate Degree Programs and Instruction
• Complete the integration of international study opportunities into the undergraduate curricula of electrical, computer and bioengineering. The curricular modifications will be summarized in a set of Department guidelines published for student and advisor use.
• Initiate curricular efforts to enhance opportunities for business administration and economics coursework. The curricular modifications will be summarized in a set of Department guidelines published for student and advisor use.
• Complete a restructuring of the Senior Design course sequence to better integrate team-based and multidisciplinary projects as well as redefine the faculty and staff resources and responsibilities for conducting the sequence. The course structure, requirements and staffing guidelines will be summarized in a Department policy document.
• Complete a restructuring of the Electronics coursework to address the diversity of core knowledge requirements across electrical and computer engineering curricula.
• Complete a self-study of Department curricula, personnel resources and projected course enrollments to identify ways to maintain acceptable enrollment caps. Issues will include programmed utilization of fulltime faculty and teaching assistants as well as the potential integration of adjunct and academic professionals.
• Nominate faculty and students for appropriate awards.

Graduate Degree Programs and Instruction

- Complete program adjustments to migrate bulk of MS programs of study to fast-track, non-thesis format. The modifications and guidelines will be published in the Department Graduate Student Guidelines and edited into the Graduate Bulletin material for the Department.
- Complete a self-study of Department and affiliated personnel resources to identify ways to ensure adequate quality, quantity and variety of graduate coursework. The recommendations and mechanisms will be summarized in a Department policy document.
- Complete program adjustments to identify mechanisms for enhancing PhD enrollment and completion. The mechanisms will be accompanied by projected enrollment growth goals and summarized in a Department policy document.
- Complete inventory of coursework to formally adjust listed offerings, for example, eliminate graduate level VLSI studies.
- Nominate faculty and graduate students for appropriate awards.

Resources

- Recruit the best possible faculty candidates in concert with the Department focus areas and programmatic needs.
- Complete guidelines for Department level evaluation of interdisciplinary research efforts, to assist participants and colleagues in the fair compensation and reward for such work. The guidelines will be published in a Department policy document.
- Evaluate and identify degree of personnel salary deficit in comparison to comparators across campus and in region. Forward evaluation and suggested actions to administration.
- Complete evaluation of resource redistribution and effects associated with Hewlett Foundation UWCE[3] efforts. Forward evaluation and suggested actions to administration.
- Assist and participate in the implementation of the SEM materials research center, and other interdisciplinary activities.
- Evaluate library resources and department library needs and forward suggestions to administrators.

Assessment

- Design and implement coordinated system for tracking publication quality and quantity of Department personnel and students.

Design and implement coordinated system for collecting and summarizing exit interview data for graduate and undergraduate students.