Assessment Plan for the B.S.E.E. Program

DEPARTMENT OF ELECTRICAL ENGINEERING
UNIVERSITY OF NORTH DAKOTA

School of Engineering & Mines
University of North Dakota
March 2004
Schedule for Assessment Data Collection

The assessment process is an ongoing activity, in which data continues to be gathered and analyzed on a cyclical basis. Assessment material is gathered and analyzed according to the following time schedule:

1. **Placement** – Collect job placement data at the end of May for the previous academic year.
2. **Exit Interviews** – The EE Chair meets with graduating senior students at the conclusion of each semester. The EE Chair then writes a report, describing issues raised by the students. The SEM Dean meets with graduating senior students as a group at the conclusion of each semester and reports the positives, negatives, and suggestions regarding the program back to the EE Chair.
3. **Student/Faculty Meetings** – Faculty and students meet once per semester, near the midpoint of the term, to gather student feedback. EE Faculty Representative documents the meeting, summarizing issues raised by students.
4. **Senior Design** – EE Faculty Representative evaluates at least five capstone Senior Design reports and five capstone design presentations each semester.
5. **Alumni Meetings** – All meetings with EE alumni are documented, including teleconferences (once per academic year) and face-to-face meetings (at least once every three years).
6. **Alumni Surveys** – EE alumni are surveyed during the spring semester of each academic year. Alumni who graduated one and five years ago are surveyed.
7. **Co-op Employer Surveys** – Co-op Employer Surveys are collected for at least five cooperative education students from the past academic year during each spring semester.
8. **Exams** – Exam data are sampled from select courses each semester, according to the schedule detailed below.
9. **Lab Reports** – Five lab reports are collected from each of the following laboratory courses each academic year: EE 306, EE 308, EE 425.
10. **Fundamentals of Engineering (FE) Exam** – Collect scores for all electrical engineering students taking the FE Exam during each academic year.

Exam data are sampled from select courses each semester in the following manner:
1. Exam statistics are calculated for each exam, including the sample mean, standard deviation, minimum, maximum, and a histogram of all exam scores.
2. Collect sample of high, medium and low exams for each exam given in a class.
3. Odd-numbered years:
   a. Fall: EE 206, EE 304, EE 314, EE 451
   b. Spring: EE 313, EE 401, EE 421, EE Elective
4. Even-numbered years:
   a. Fall: EE 101, EE 318, EE 316, EE 321
   b. Spring: EE 201, EE 452, EE 405, EE 409
1. Program Educational Objectives

a) Statement of Objectives

UND Electrical Engineering offers its curriculum and student services in support of the following five Program Educational Objectives:

<table>
<thead>
<tr>
<th>Program Educational Objectives</th>
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<tr>
<td>1. Provide students with a strong foundation in the traditional and contemporary areas of electrical engineering.</td>
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<td>2. Educate students in science and engineering so that they can identify, understand, and solve technological problems in society.</td>
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<td>3. Provide students with the knowledge and opportunity which prepare them for practice or to pursue further education at the graduate level.</td>
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<td>4. Provide students with breadth of knowledge in social and humanitarian issues.</td>
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<tr>
<td>5. Maintain a nationally competitive electrical engineering program.</td>
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Preparing students for engineering practice and the pursuit of graduate/professional education have historically been the unwritten primary objectives of our program for many decades. Furthermore, the University of North Dakota prides itself on being an institution with a strength in liberal arts education. This notion continues to influence the Department’s objective of providing a strong liberal arts educational component. In today’s technological society, the abilities of thinking critically, communicating ideas effectively through writing and speaking, and committing to a lifetime of learning are extremely important. In many ways, the baccalaureate engineering degree has become the “liberal arts degree of the 21st century,” so this emphasis on both technical fundamentals as well as the liberal arts makes the B.S.E.E. degree from the University of North Dakota a very attractive option to both potential students and the employers of our graduates.

The faculty members engage in numerous discussions to establish and review the Program Educational Objectives in light of the career goals of our students and according to industry expectations. The faculty members, collectively, are responsible for developing and adopting these objectives. Consistency with the University and School mission statements is paramount.
b) Relationship of Objectives with Mission

It is important that the published mission statement of UND Electrical Engineering is consistent with the mission statements of both the University of North Dakota and the School of Engineering & Mines. Furthermore, the Program Educational Objectives should be derived from the departmental mission. For these reasons, the University, School, and Department’s Mission Statements are presented in order as follows:

**Mission Statement – University of North Dakota**

The University of North Dakota, as a member of the North Dakota University System, serves the state, the country, and the world community through teaching, research, creative activities, and service. State-assisted, the University’s work depends also on federal, private, and corporate sources. With other research universities, the University shares a distinctive responsibility for the discovery, development, preservation, and dissemination of knowledge. Through its sponsorship and encouragement of basic and applied research, scholarship, and creative endeavor, the University contributes to the public well-being.

The University maintains its original mission in liberal arts, business, education, law, medicine, engineering and mines; and has also developed special missions in nursing, fine arts, aerospace, energy, human resources, and international studies. It provides a wide range of challenging academic programs for undergraduate, professional and graduate students through the doctoral level. The University encourages students to make informed choices, to communicate effectively, to be intellectually curious and creative, to commit themselves to lifelong learning and the services of others, and to share responsibility both for their own communities and for the world. The University promotes cultural diversity among its students, staff and faculty.

In addition to its on-campus instructional and research programs, the University of North Dakota separately and cooperatively provides extensive continuing education and public service programs for all areas of the state and region.

**Mission Statement – UND School of Engineering & Mines**

The primary mission of the School of Engineering and Mines (SEM) is to provide students a broad general education coupled with strong fundamentals that prepare graduates to successfully fill important positions in professional practice in industry and government. Program graduates will have a solid background in technical subjects, (i.e. mathematics, science, engineering science and design), the ability to think and work accurately, breadth and clearness of vision, and high ideals and purposes. SEM’s further mission is to engage in research and scholarly activity that contributes basic and applied discovery to enhance knowledge and student learning while being of benefit to the state, region and nation. The School of Engineering and Mines further provides engineering programs of equal quality, via distance education, to industry and individuals through the Distance Engineering Degree
Continuous and on-going assessment of student learning in accordance with specific program outcomes, including input from program constituents, such as students, alumni, employers and industry advisory groups, provides opportunity to measure success and effect program improvement in meeting the mission of the School of Engineering and Mines. The mission of the School includes engineering programs being accredited by the Accreditation Board for Engineering and Technology (ABET).

Mission Statement – UND Department of Electrical Engineering

The mission of the department is to provide students with a strong foundation in the traditional and contemporary areas of electrical engineering. The objective of the undergraduate program is to educate students in science and engineering so that they can identify and solve technological problems in society. Social and humanistic issues are also emphasized in the general education component of the program to provide breadth in education. The program provides graduates with the knowledge, aptitudes, and attitudes which prepare them for corporate and governmental entry level jobs or to pursue further education at the graduate level.

The departmental mission statement is consistent with the School’s mission, and the School’s mission is consistent with the University’s mission. In particular, the emphasis on critical thinking, communication, and life-long learning are pervasive in each of these mission statements. The School and Department mission statements emphasize career preparation, as expected for the engineering profession. Finally, preparation for continued studies at the graduate level is included in the departmental mission, which supports the research and creative mission of the School and University.

Note that the first four Program Educational Objectives were extracted almost verbatim from the UND Electrical Engineering mission statement. The fifth Program Educational Objective, to maintain a nationally competitive electrical engineering program, encompasses the essence of the entire departmental mission statement. This objective instills in the faculty a desire to keep student enrollments at a high level, while also making the undergraduate program both modern and challenging.

The Department is committed to fostering a close student-faculty educational environment which facilitates technical competence in design, self-confidence, and continuous professional development. This commitment extends to providing an excellent undergraduate electrical engineering program encompassing both breadth and depth. The technical and liberal arts components of the curriculum provide students with opportunities for self-development, technical competence, awareness of economic and ethical responsibilities, and a true appreciation of the need for life-long learning. The technical curriculum includes (1) mathematics, basic science, and general engineering science; (2) required coursework in traditional electrical engineering topics such as electric circuits, analog/digital electronics, embedded systems, electromagnetic fields, and control systems; (3) elective coursework, in which junior- and senior-level students may select classes which focus on three primary subdisciplines, namely applied electromagnetics, circuits and systems, and embedded systems; and (4) a two-semester capstone senior design experience, which incorporates aspects of the
entire curriculum and allows the students to practice their technical and communication skills in preparation for their careers.

To prepare students for practice, engineering design and hands-on laboratory experience are emphasized throughout the curriculum and supported by diverse laboratory facilities. Students are introduced to computer-aided design software tools in several required and elective courses in preparation for the capstone senior design experience. Every student is required to complete a comprehensive design project which brings previous diverse knowledge into culmination. Computer applications, statistical methods, and communication skills are also emphasized in the curriculum. The students are required to make a number of oral presentations throughout the senior design experience. They participate in design reviews for project sponsors, such as the Upper Midwest Aerospace Consortium, the National Aeronautics and Space Administration, IBM, Imation Corporation, and the Department of Defense. Furthermore, a number of interdepartmental presentations are delivered among the electrical and mechanical engineering senior design students working on multidisciplinary projects. Cooperative education is strongly encouraged as a vehicle for enhancing students’ oral, written, and interpersonal communication skills, in addition to establishing an awareness of industry practice and technical development. Opportunities to enhance teamwork, written and oral communication, and self-learning skills are available across the curriculum. Furthermore, students are encouraged to promote the electrical engineering profession and to develop leadership skills through involvement in honorary and professional societies, as well as through participation in extracurricular, multidisciplinary design project activities.

The Department has a strong student advising program which facilitates one-on-one faculty interaction with students to help them make sound academic and career-related decisions. Through this program, students and faculty establish personal relationships and enthusiasm toward undergraduate engineering education. Before the advent of Engineering Criteria 2000, UND Electrical Engineering was traditionally very active in assessing student needs in light of the Department’s mission. Input has always been gathered from the Department’s constituencies listed in Section 2.c, resulting in curriculum changes taking place on a regular basis. This is the primary advantage to having a small program – the faculty know their students, and the students know their faculty. While the assessment process was certainly less formal than it is now, it has always produced positive results.

Service to the University is also within the mission of the Department. Several faculty members are active on University-wide committees and faculty governance. The faculty are well represented on professional and technical societies at both regional and national levels.
c) Constituencies

Formal and organized input to the assessment process:
1. Faculty
2. Students
3. Alumni
4. Industry employers

Informal input to the assessment process:
1. Parents of students
2. Companies, organizations, and individuals from the community, region, and the state of North Dakota

Faculty, students, alumni, and industry employers are the program’s primary constituencies who provide a formal, organized input to the assessment process. These primary constituencies are asked for feedback many times throughout the year, both formally and informally, and their input is utilized for continuous program improvement.

The parents of our students and companies, organizations, and individuals from the community and the state provide a more informal input to the process. Although their comments are not always well-documented, interactions with these constituencies through conference calls, e-mail, and attendance at local events and graduation do help improve operations.

The following is a list of activities that take place to collect input from our constituencies regarding the degree program:

1. The Department holds a general student/faculty meeting every semester. The purpose of this meeting is twofold: first, to establish communication channels with the students and to listen to their perceptions of the program and the Department in general; and second, to share changes in the curriculum with the students, and to receive their opinion on changes that have already been instituted.

2. Distance Engineering Degree Program students communicate with their instructors via telephone and e-mail during the academic year. They meet with faculty and the Department Chair during their summer laboratories on the UND campus.

3. Graduating students are invited individually for an exit interview with the Department Chair. Personal reflections and comments are encouraged. At the end of the interview, students are handed a survey form, which is completed and turned in to the departmental administrative assistant.

4. Graduating students are also invited to a group exit interview with the School of Engineering & Mines Dean. The SEM Dean communicates positives and negatives about the program to the EE Chair, as well as suggestions made by the students for improving the program in the future.

5. Faculty make personal observations during their numerous casual visits with on-campus students, prospective students and their parents, and industry representatives who come to
campus to recruit our students for cooperative education positions and permanent employment.

6. The faculty members have made several trips to visit alumni in industry at their corporate sites, particularly at companies in the Upper Midwest which have a large number of UND B.S.E.E. graduates.

7. The Department recently conducted a general Alumni Survey, which was sent to the graduates one and five years after graduation. This survey polled the perspective of recent graduates, who can relay what they wish they would have learned in college to better prepare for their positions in industry, as well as the perspective of more experienced graduates, who can offer their opinions on what is expected of new hires into their companies.

8. Starting in 2002, the faculty host a conference call with the alumni once each academic year to discuss their needs in new engineering hires, as well has how we can improve our program over time.

9. Most of the electrical engineering faculty members belong to the American Society for Engineering Education, and they regularly participate in regional and national engineering education conferences and workshops where relevant contemporary issues are addressed and panels from industry discuss their needs.

10. Faculty regularly peruse the published literature on trends in engineering education, including the *ASEE Prism*.

d) Processes to Establish and Review Educational Objectives

The process listed in our 1998-1999 ABET Self-Study Report has been modified substantially, because the Program Educational Objectives were established for the first time in 1998 to satisfy the newly-created EC2000 outcomes-based assessment requirements. Now that the Program Educational Objectives are in place and the UND Electrical Engineering outcomes-based assessment process of data gathering, evaluation, and continuous program improvement has matured, the process used to establish and review the educational objectives has also been modified. The emphasis of the revised process is for fine-tuning the existing objectives, adding new objectives to keep pace with modern educational trends, and retiring objectives which have become less relevant as engineering education dynamically changes over time.

**Process:**

1. The departmental Mission Statement is reviewed once every three years by the UND Electrical Engineering faculty and the Dean of the School of Engineering & Mines, to determine whether or not modifications are required to reflect the Department’s evolving priorities. Consistency with the University’s and the School of Engineering & Mines’ Mission Statements will be ensured.

2. The Program Educational Objectives are reviewed once every three years by the UND Electrical Engineering faculty and the SEM Dean, to ensure that the existing objectives truly represent the departmental educational mission at that point in time.
3. Faculty ask alumni for any input on modifications to the Mission Statement and Program Educational Objectives once every three years.

4. Faculty ask students for any input on modifications to the Mission Statement and Program Educational Objectives once every three years.

5. Faculty vote on any proposed changes.

   **The next revisit of the program objectives is scheduled for the 2005-2006 academic year.** This process is scheduled to be repeated every three years thereafter. The Department Chair is responsible for initiating and overseeing the process implementation.

   **i. Involvement of Constituencies**

   All departments and schools at the University of North Dakota were involved in creating a strategic plan during the 2001-2002 academic year. In faculty meetings that year, the UND Electrical Engineering Mission Statement and Program Educational Objectives were reviewed carefully, and the consensus was that both the mission and the objectives did an excellent job of representing the degree program. These issues were also brought up for discussion during informal meetings with alumni in that same academic year.

   The Department Chair met with a group of five UND Electrical Engineering students on May 1, 2002, to discuss the Mission Statement, the Program Educational Objectives, and the Program Outcomes. The students thought that the objectives covered the electrical engineering program quite well. One student suggested that Objective 1 be modified slightly to read “Provide students with experiences and a strong foundation in the traditional and contemporary areas of electrical engineering,” to better exemplify how much hands-on laboratory experience is emphasized in the UND B.S.E.E. program.

   The faculty, students, and alumni all agreed that the Program Educational Objectives originally established for the B.S.E.E. program at the University of North Dakota in 1997 to satisfy the EC2000 requirements do indeed reflect the current mission of the Department. No modifications have been made to either the Mission Statement or the Program Educational Objectives since 1997.

   **ii. Documentation of Success**

   The Program Educational Objectives are in place, and they are working. These objectives have provided satisfactory guidelines for improving teaching, learning, and project-based opportunities within the Department. At the present time, the constituents are in agreement that no objectives require modification, and no additional objectives should be included.

   Revision of the Program Educational Objectives will continue to be an integral part of the program assessment plan. However, changes in the curriculum and the Program Outcomes listed in Section 2 are expected to take place more frequently than modifications to the broader, more mission-oriented Program Educational Objectives.
e) Relationship of Curriculum to Educational Objectives

Preparing students for engineering practice in electrical engineering requires a well-rounded curriculum to provide students with the opportunity to acquire breadth and depth of technical knowledge, hands-on experience, proficiency in computer applications and relevant technologies, and open-ended problem solving. Written and oral communication and multidisciplinary teamwork are skills that are also emphasized in the curriculum; these are often the first skills that alumni mention when they discuss their desired needs in new engineering hires. Awareness of life-long learning and exposure to engineering design across the curriculum and through a capstone experience bring technical knowledge and other skills to culmination. The majority of students participate in the co-op program, which provides them with the opportunity to understand engineering practice and industry needs. This experience also helps them examine their options for a technical focus and to observe real-world engineering in action.

The required and the elective electrical engineering curriculum are presented in the 2003-2004 B.S.E.E. Self-Study Report, and the mathematics, basic science, and general education components are discussed separately in this same report. The relationship of how these courses help to satisfy the program outcomes is also provided in the departmental Self-Study, with a specific justification provided for each electrical engineering course. The fundamental assumption that the Department makes is that if the curriculum helps to first satisfy the 11 program outcomes, then these program outcomes in turn help to measure how well the five overall educational objectives are being satisfied.
f) Process to Ensure Achievement of Educational Objectives

The Department uses the following instruments on a regular basis to monitor the effectiveness of the educational objectives:

1. The Department’s Mission Statement is evaluated in light of the University of North Dakota and the School of Engineering & Mines Mission Statements for consistency.
2. Faculty, student, and alumni focus groups are utilized to determine how close the established objectives are to the constituencies’ perceived views.
3. Graduates’ placement records and admission to graduate/professional programs are monitored as a measure of the program’s competitiveness (Objective 5) and readiness for practice or the pursuit of graduate/professional education (Objective 3).
4. Since the program objectives essentially generated the outcomes listed in Section 2, the assessment process and evaluation instruments used in Section 2.d are integral components of monitoring the effectiveness of the five objectives. In this manner, all objectives are monitored with high confidence.


g) Data to Illustrate the Process, Results, and Program Improvement

Since we are using the satisfaction of the program outcomes to justify the satisfaction of the program educational objectives, then the program outcomes data presented in Section 2.e for the specified assessment instruments is also relevant to the five educational objectives. The UND Electrical Engineering Reading Room has meeting minutes on hand for the Chair’s meeting with students in 2002, which reviewed the Department’s mission, educational objectives, and program outcomes. Furthermore, the UND Electrical Engineering Strategic Plan is available, so that the evaluators can see the relationships between the University’s priority/action areas and the Department’s program educational objectives.
2. Program Outcomes and Assessment

a) Statement of Outcomes

The Program Outcomes were originally developed by the faculty of the Department for our first experience in the outcomes-based assessment of student learning in 1996. The following 11 outcomes were originally designed in the 1996-1997 academic year to measure the effectiveness of the educational objectives in preparation for a 1997 ABET Accreditation Visit. Because of the 1997 spring flood, the Department was not reviewed until the 1998-1999 Accreditation Cycle, which allowed us to slightly refine our outcomes. These outcomes have been discussed among the faculty, the students, and the alumni both informally and formally during the past five years, with very few suggested modifications. During University-wide strategic planning in the 2000-2001 academic year, the faculty reviewed these outcomes for consistency with the educational objectives and the departmental mission. By consensus, the faculty felt that the outcomes did not require modification at that time. Additionally, the Chair hosted a meeting with a small group of students in 2002 to review the Department’s mission statement, educational objectives, and program outcomes. The students felt that the outcomes accurately represented the expectations of the faculty, of potential employers, and of themselves after graduation from UND with a B.S.E.E. degree.

The current outcomes for the University of North Dakota B.S.E.E. program are provided as follows:

Outcome 1: Students possess a **breadth** of knowledge in **electrical engineering** covering the fundamentals of DC and AC electricity and electric power circuits, analog and digital electronics, electromagnetic fields and applications, and signals and systems. They are **able to apply knowledge of mathematics, science and engineering**.

Outcome 2: Students have a strong foundation in basic **science, mathematics**, and a **guaranteed exposure to statistics**.

Outcome 3: Students have a basic understanding of **non-electrical engineering subjects** and breadth in engineering and **applied mathematics and physical science**.

Outcome 4: Students acquire **depth** in at least one of several subjects in **electrical engineering** to establish confidence in applying previous knowledge and to enhance their competence in identifying problems and formulating solutions.

Outcome 5: Students have valuable **hands-on experiences** and are prepared to conduct experimental work needed to substantiate theoretical developments.

Outcome 6: Students are able to understand and formulate solutions of **open-ended engineering design problems**.

Outcome 7: Students are literate in using **computers** for solving engineering problems including computations, data acquisition, controls, programming, design, information retrieval, and graphics.

Outcome 8: Students possess written and oral **communication skills** that will help them communicate their ideas effectively to their peers and the public.
Outcome 9: Students are able to function within multidisciplinary teams to accomplish goals of interest to the collective group.

Outcome 10: Students are made aware of global, societal, humanitarian, and contemporary issues in their broader sense including professional and ethical responsibilities.

Outcome 11: Students are made aware of the need for and are prepared to engage in life-long learning.

Only two substantive changes were made to our outcomes since the last ABET Accreditation Visit in 1998. First, the word “multidisciplinary” was added to Program Outcome 9 to satisfy the change in EC2000 Criterion 3(d). This was modified by the faculty in order to measure the ability of students to function effectively on teams which not only consist exclusively of electrical engineers, but also teams which are multidisciplinary in nature. This has become the norm in engineering practice, and thus it should become the norm in undergraduate engineering education. Second, “Breadth and depth are achieved” was removed from Program Outcome 10, because the School has removed its depth requirement (two courses in the same department) for either the Social Sciences or the Arts & Humanities general education courses.

b) Relationship of Outcomes to Objectives

Table 1 is a matrix which shows how the Program Outcomes listed in the previous section support the Program Educational Objectives defined in Section 1.a. In this matrix, a dark gray element signifies a Program Outcome which supports the corresponding Program Educational Objective. If all outcomes supporting a particular objective are satisfied, we consider the objective to be satisfied as well. A fair amount of redundancy exists for determining how well Objectives 1, 2, 3, and 5 are met, because there are at least four outcomes that determine how well each of these objectives is satisfied. In the case of Objective 4, however, only one outcome measures the students’ and the graduates’ appreciation of the liberal arts and the ability to understand social and humanistic issues. Thus, we have much less confidence that Objective 4 is satisfied given the specified outcomes. We must rely on the overall strength of the University of North Dakota’s general education requirements, as well as the University’s tradition as a first-rate public liberal arts institution.
Table 1: Relationship of UND Electrical Engineering Outcomes to the Program Educational Objectives

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<tr>
<th>Educational Objective/Outcome</th>
<th>Objective 1: Foundation in Traditional &amp; Contemporary Areas of EE</th>
<th>Objective 2: Science &amp; Engineering Education</th>
<th>Objective 3: Engineering Practice &amp; Graduate Education</th>
<th>Objective 4: Knowledge of Social &amp; Humanitarian Issues</th>
<th>Objective 5: Nationally Competitive EE Program</th>
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<tr>
<td>Outcome 1 Breadth in EE</td>
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<td>Outcome 2 Basic Science, Math, and Statistics</td>
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<td>Outcome 3 Breadth in Engineering Subjects (non-EE)</td>
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<td>Outcome 4 Depth in EE</td>
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<td>Outcome 5 Hands-On Experience</td>
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<td>Outcome 6 Open-Ended Problems</td>
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<td>Outcome 7 Computer Skills</td>
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<td>Outcome 8 Communication Skills</td>
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<td>Outcome 9 Multidisciplinary Teams</td>
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<td>Outcome 10 General Education Requirements</td>
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<td>Outcome 11 Life-Long Learning</td>
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A more detailed description of how the outcomes contribute to the five Program Educational Objectives is provided as follows:

**Objective 1** — *Provide students with a strong foundation in the traditional and contemporary areas of electrical engineering.*

This objective is accomplished directly via Outcomes 1 through 4, in which basic science fundamentals (Outcomes 2 and 3), breadth in electrical engineering (Outcome 1), and depth in electrical engineering (Outcome 4) are ensured.

**Objective 2** — *Educate students in science and engineering so that they can identify, understand, and solve technological problems in society.*

Outcomes 2, 3, and 6 demonstrate students’ competence in utilizing applied science to identify and solve open-ended engineering problems. Outcome 7 ensures competitiveness in
using modern computer-aided design technologies to help solve these problems with high quality, low cost, and fast turnaround.

**Objective 3** – Provide students with the knowledge and opportunity which prepare them for practice or to pursue further education at the graduate level.

Outcomes 1 and 4 through 9 ensure the necessary technical and communication-oriented skills for effective engineering practice. Breadth and depth of knowledge (Outcomes 1 and 4), hands-on experience (Outcome 5), and open-ended problem solving (Outcome 6) are essential technical attributes needed for engineering practice or advanced studies. Outcomes 8 and 9 monitor the important business skills of oral/written communication (Outcome 8) and multidisciplinary teamwork (Outcome 9), which are essential to the successful practice of engineering in modern firms with short product and service development schedules. Outcome 7 ensures competence in using computational tools which are needed for either engineering design or advanced studies. Life-long learning (Outcome 11) is necessary to sustain a productive career in any field, especially one as dynamic as electrical engineering.

**Objective 4** – Provide students with breadth of knowledge in social and humanistic issues.

Outcome 10 is directly relevant to this objective. This outcome monitors students’ exposure to the liberal arts, which in turn helps them make informed ethical and socially-responsible decisions. Engineers probably learn to appreciate the need for Outcomes 10 and 11, exposure to the liberal arts and life-long learning, respectively, as their interests broaden after they graduate.

**Objective 5** – Maintain a nationally competitive electrical engineering program.

Maintaining a nationally competitive electrical engineering program requires educating the graduates to perform at a professional level, both technically and interpersonally. Breadth (Outcomes 1 and 3) and depth (Outcome 4) of knowledge must be ensured. Hands-on experience (Outcome 5), open-ended problem solving abilities (Outcome 6), and technology literacy (Outcome 7) are deciding attributes when national programs are compared. The success of our graduates in assuming leadership roles as they compete with graduates of other programs is also dependent on their ability to communicate effectively (Outcome 8) and to work with people having a wide array of professional abilities (Outcome 9). Finally, the graduates need to understand that their learning is not complete once they receive their diplomas. Electrical engineering is a highly dynamic field, which requires life-long professional development (Outcome 11) in order to build a successful career.
c) Relationship of Outcomes to Criterion 3

Recall ABET Engineering Criterion 3, Program Outcomes and Assessment:

Engineering programs must demonstrate that their graduates have:

a) an ability to apply knowledge of mathematics, science, and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to design a system, component, or process to meet desired needs
d) an ability to function on multi-disciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
i) a recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Each program must have an assessment process with documented results. Evidence must be given that the results are applied to the further development and improvement of the program. The assessment process must demonstrate that the outcomes important to the mission of the institution and the objectives of the program, including those listed above, are being measured. Evidence that may be used includes, but is not limited to the following: student portfolios, including design projects; nationally-normed subject content examinations; alumni surveys that document professional accomplishments and career development activities; employer surveys; and placement data of graduates.
The UND Electrical Engineering program outcomes will now be restated, in order to correlate UND Program Outcomes 1 through 11 with ABET Engineering Criterion 3 letters (a) through (k). The relevant Criterion 3 requirements are denoted by their respective letters, shown immediately after the UND Electrical Engineering outcome number:

Outcome 1 (a, h): Students possess a breadth of knowledge in electrical engineering covering the fundamentals of DC and AC electricity and electric power circuits, analog and digital electronics, electromagnetic fields and applications, and signals and systems. They are able to apply knowledge of mathematics, science and engineering.

Outcome 2: Students have a strong foundation in basic science, mathematics, and a guaranteed exposure to statistics.

Outcome 3: Students have a basic understanding of non-electrical engineering subjects and breadth in engineering and applied mathematics and physical science.

Outcome 4 (e): Students acquire depth in at least one of several subjects in electrical engineering to establish confidence in applying previous knowledge and to enhance their competence in identifying problems and formulating solutions.

Outcome 5 (b): Students have valuable hands-on experiences and are prepared to conduct experimental work needed to substantiate theoretical developments.

Outcome 6 (c, e): Students are able to understand and formulate solutions of open-ended engineering design problems.

Outcome 7 (k): Students are literate in using computers for solving engineering problems including computations, data acquisition, controls, programming, design, information retrieval, and graphics.

Outcome 8 (g): Students possess written and oral communication skills that will help them communicate their ideas effectively to their peers and the public.

Outcome 9 (d): Students are able to function within multidisciplinary teams to accomplish goals of interest to the collective group.

Outcome 10 (f, h, j): Students are made aware of global, societal, humanitarian, and contemporary issues in their broader sense including professional and ethical responsibilities.

Outcome 11 (i): Students are made aware of the need for and are prepared to engage in life-long learning.

The two UND Electrical Engineering outcomes without associated letters (Outcomes 2 and 3) are required by the program to meet its additional objectives and the electrical engineering-specific program criteria.
d) Processes to Assess Each Outcome

UND Electrical Engineering ensures that its graduates achieve the defined program outcomes by first offering a modern curriculum that provides an opportunity for learning. Second, assessment instruments have been developed, along with standards that are used to determine the success of our graduates in achieving these program outcomes.

It is the Department’s policy to demonstrate continuous quality improvement in accomplishing outcomes as the assessment process is iterated. Our target during each iteration is to demonstrate where our graduates stand with respect to each outcome, and hopefully show improvement. Both qualitative and quantitative assessment techniques are used throughout the process. It must be noted that constituencies, especially the new faculty, are on a steep learning curve, and they must establish standards for themselves over time. This inherent uncertainty in the assessment process is expected to become less significant with faculty experience and the maturity of the assessment process over the years. Additionally, there is inherent variability in quantifying the outcomes which are much more subjective in nature, such as Outcomes 10 and 11.

UND Electrical Engineering has established a comprehensive process to assess student learning according to the aforementioned program outcomes. The main purpose of this process is to further develop and improve the program to ensure that graduates have achieved the desired outcomes. Although the process was originally designed for the first EC2000 outcomes-based assessment Accreditation Visit in 1998 and further refined after experience provided some important lessons learned, it is actually the result of many years of informally-applied assessment instruments which have continued to feed back into the program. Our process has not evolved significantly since the last Accreditation Visit; for the most part, it has worked quite well to measure the effectiveness of the curriculum and student/faculty interactions. However, the ten assessment instruments that are used today have evolved a great deal since the last Accreditation Visit, primarily because the faculty now has practical experience in continuous program improvement based on outcomes-based student learning. The outcome assessment process takes the following steps:

**Step 1** – Establish/revise the course objectives to support learning outcomes. Course objectives are listed on each syllabus. Student evaluation forms pertaining to the program outcomes have been designed to assess course effectiveness in meeting the overall program educational objectives. Evaluation forms and samples of student work are available for review in the UND Electrical Engineering Reading Room.

**Step 2** – Revise the evaluation and survey forms. Evaluation forms were originally designed to facilitate applying certain assessment instruments listed in Table 2.

**Step 3** – Collect data according to the time schedule outlined in Section 2.d.iii. The faculty work collectively on reviewing available assessment data and on filling out evaluation forms where appropriate. Student evaluation forms based on the program outcomes are also filled out by students in their respective classes. The quantitative and qualitative data gathered using the evaluation forms provide:
a) Faculty perspective through senior design reports, regular course exams, lab reports, and the FE exam;
b) Students’ perspective through statements made during the student/faculty meeting each semester and course program outcome evaluation forms;
c) The graduating class perspective through exit interviews with the Department Chair and the SEM Dean;
d) The alumni perspective through alumni meetings, conference calls, and surveys; and
e) The industry perspective through placement data, alumni meetings, alumni conference calls, alumni surveys, and co-op employer surveys.

Important sources of additional input to the assessment process are educational conferences and workshops, industry contacts, the semester advising process, and informal visits with students.

**Step 4** – Analyze the data collected in Step 3. The compiled data is analyzed to assess achievement of outcomes and to establish a point of reference for future evaluations.

**Step 5** – Determine action items and make the appropriate changes in the program. Effectively, this utilizes feedback to close the loop on the process, for continuous program improvement.

The general philosophy in analyzing the available data is to examine the faculty perspective in light of the perspective of the students and overall graduating class to determine an opportunity for curriculum development. Repeated concerns by students supported by faculty perspectives are considered high priority items for program improvement. The alumni and industry perspectives are considered to support long-term changes.

**i. Instruments**

The following ten assessment instruments are rank-ordered according to their perceived information content by the faculty, primarily based on the potential for program change that is inspired by the instrument. The level of significance of each instrument was determined by the faculty members’ perception of its effectiveness through consensus.

**Assessment Instruments to Monitor Program Outcomes:**
1. Placement
2. Exit Interviews
3. Student/Faculty Meetings
4. Senior Design
5. Alumni Meetings
6. Alumni Surveys
7. Co-op Employer Surveys
8. Exams
9. Lab Reports
10. Fundamentals of Engineering (FE) Exam
These ten instruments, some of which passively measure the performance of several outcomes and others which are based on active relationship-building with constituents, are described as follows:

1. **Placement** records demonstrate that the graduates possess attributes of importance to industry and graduate/professional schools, and that the program has a well-regarded reputation among regional and national engineering firms. This is considered to be one of our strongest assessment instruments – if our graduates are in high demand, this reflects positively on our program. The attributes of importance to industry which can be measured by this instrument include breadth and depth in electrical engineering (Outcomes 1 and 4); hands-on experience (Outcome 5); the ability to utilize computer tools to aid in the design process (Outcome 7); the ability to communicate effectively (Outcome 8) and work on multidisciplinary teams (Outcome 9); and an understanding of the need for life-long learning (Outcome 11).

2. **Exit Interviews** with the Department Chair and the School of Engineering & Mines Dean help the program evolve, particularly with respect to curriculum changes, faculty performance, and understanding the changing needs of the students. The need for equipment/software maintenance, as well as new equipment and computer-aided design tools, are also discovered from the senior exit interviews each semester. By the time the students approach graduation, they have learned to think critically for themselves, and they are very interested in helping improve the program for future generations of electrical engineering students by stating their opinions. All of the program outcomes are monitored by this assessment instrument, to varying degrees.

3. **Student/Faculty Meetings** provide opportunities to communicate program changes to the entire electrical engineering student body, as well as to gather feedback from the students about what is going well and what needs improvement from their perspective. Typically, these meetings last between 60 and 90 minutes, and they are very productive because they are highly interactive. On-campus UND Electrical Engineering students are not shy about sharing their opinions about the program or even individual courses – they take great pride in helping the faculty improve the quality of their education and related project opportunities. These semester meetings have been used to measure breadth in electrical engineering (Outcome 1); the basic science and mathematical competency and course needs of the students (Outcome 2); breadth in general engineering topics (Outcome 3); depth in electrical engineering (Outcome 4); hands-on experience (Outcome 5); the ability to solve open-ended design problems (Outcome 6); the ability to utilize computer tools and the need for the maintenance and upgrade of course software (Outcome 7); and the ability to communicate effectively (Outcome 8).

4. **Senior Design** may provide the richest source of information about the degree program, since the capstone design projects tie together all of the coursework in the curriculum. Implicitly, the two-semester capstone senior design sequence measures oral, written, and interpersonal communication skills, creativity, and the ability to work on multidisciplinary teams better than any other assessment instrument. Explicitly, senior design provides strong indicators for Outcomes 1 and 5 – 9, where breadth in electrical engineering, hands-on experience, open-ended problem solving, computer-aided design, and communication and multidisciplinary teamwork skills are monitored. To a lesser degree, knowledge of basic
science, math, and statistics (Outcome 2), breadth in general engineering subject matter (Outcome 3), and depth in electrical engineering (Outcome 4) are utilized in the design process. The skills required to converge on a working design solution from among a large set of possibilities contribute to life-long learning (Outcome 11).

5. **Alumni Meetings** are considered important to continuous program improvement, because new alumni inform the faculty about what they were lacking when they started their engineering careers, and experienced alumni educate the faculty about their expectations in new electrical engineering employees. A diverse set of outcomes are monitored using this instrument, including breadth and depth in electrical engineering (Outcomes 1 and 4); breadth in general engineering (Outcome 3); hands-on experience, open-ended problem solving, computer skills, communication skills, and multidisciplinary teamwork (Outcomes 5 – 9); and an appreciation of the need for life-long learning (Outcome 11).

6. **Alumni Surveys** are used in conjunction with Alumni Meetings to monitor learning attributes of direct interest to industry. These surveys address the same outcomes as Alumni Meetings, as well as the graduates’ appreciation for their liberal arts education (Outcome 10), which becomes more and more important over time as the program graduates advance in their careers.

7. **Co-op Employer Surveys** are used to monitor student performance in the cooperative education program. They are administered by UND Cooperative Education, with the data provided to the Department for evaluation purposes. Co-op employer surveys are valid indicators of the design of electronic circuitry and systems through computer software simulation (Outcome 7), communication skills (Outcome 8), and multidisciplinary teamwork (Outcome 9). Hands-on, open-ended problem solving (Outcomes 5 and 6) can also be monitored. To a lesser degree, breadth (Outcome 1) and depth (Outcome 4) in electrical engineering are measured, in addition to breadth in general engineering (Outcome 3) and the ability of our students to learn for themselves outside the classroom (Outcome 11).

8. **Exams** are used to evaluate student learning in most required and elective undergraduate courses, to provide the instructor with some feedback regarding how well the students grasp the course objectives. Exams provide a strong indicator for breadth (Outcome 1) and depth (Outcome 4) in electrical engineering. Knowledge in basic science (Outcome 2) and general (non-electrical) engineering subjects (Outcome 3) are also moderately monitored through course exams. In courses with a significant computer-aided design component, exams are capable of monitoring the students’ computer skills (Outcome 7).

9. **Lab Reports** are generally required for all students in the 300- and 400-level lab classes. Obviously, these reports are strong assessment tools for monitoring hands-on experience (Outcome 5) and technology utilization (Outcome 7). Since the students must convey the concepts and results in the form of written reports, effective communication skills are also monitored (Outcome 8). Furthermore, breadth (Outcome 1) and depth (Outcome 4) in electrical engineering are monitored, as is knowledge in basic science, math, and statistics (Outcome 2).

10. **Fundamentals of Engineering (FE) Examination** results are accessed to compare the knowledge and critical thinking abilities of our graduating students to national norms. FE Exam results give an indication of breadth in both electrical and general engineering
(Outcomes 1 and 3). Depth in electrical engineering (Outcome 4) and computing skills (Outcome 7) are also partially assessed through student performance on the FE exam. Since ethics in engineering appears on the FE exam, Outcome 10 is also monitored to some degree. Since electrical engineering students are encouraged but not required to take the FE exam before graduation, this assessment instrument is only effective if utilized over several semesters of results.

Table 2 depicts a matrix which cross-references each assessment instrument with its level of confidence in monitoring each outcome. This table represents the essence of our assessment plan, and it describes the confidence that the UND Electrical Engineering faculty have regarding how well each outcome is satisfied. A decision was made by the faculty to display how well a specific outcome is measured by a particular assessment instrument by shading the corresponding matrix element appropriately. By examining a particular row of the matrix, it becomes apparent that some outcomes are measured with more confidence than others. As expected, the more quantifiable outcomes, such as breadth (Outcome 1) and depth (Outcome 4) in electrical engineering, are measured redundantly by all instruments, while the more qualitative outcomes, such as an understanding and appreciation of ethics and taking a global world-view (Outcome 10) are relatively sparse in the number of instruments which appear in the matrix. From this matrix, it is easy to visualize that all assessment instruments monitor at least five outcomes, and that all outcomes are measured by at least three assessment instruments.
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<thead>
<tr>
<th>Assessment Instrument/Outcome</th>
<th>Placement</th>
<th>Exit Interviews</th>
<th>Student/Faculty Meetings</th>
<th>Senior Design</th>
<th>Alumni Meetings</th>
<th>Alumni Surveys</th>
<th>Co-op Employer Surveys</th>
<th>Exams</th>
<th>Lab Reports</th>
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**Note:** The shading denotes the amount of confidence that the faculty have in using the assessment instrument to evaluate a particular program outcome: Dark Gray = High-level confidence; Light Gray = Medium-level confidence; Empty = Not considered relevant to a particular outcome.
ii. Level of Achievement Desired for Each Outcome

To demonstrate that graduates satisfy the learning outcomes, a holistic approach is taken where each faculty member in the Department was assigned at least one assessment instrument, and then asked to develop a method of either quantitatively (via an evaluation form) or qualitatively (via a narrative description) demonstrating the achievement of the outcomes and identifying areas for program improvement. The assessment instruments have been categorized into four quantitative tools, which have corresponding quantitative levels of achievement; three qualitative tools based on relationship-building with the constituents, which are used to gather suggestions for program improvement; and three tools which are both quantitative and qualitative in nature.

**Level of Achievement Desired for Each Quantitative Program Outcome:**

1. **Placement** – Quantitative – The Department has set a placement rate of 85% or more for its graduates, which includes either employment or enrollment in graduate school within six months of graduation.
2. **Exit Interviews** – Quantitative and Qualitative – For Questions 4 through 10 on the Senior Exit Interview Survey, an average of 3.0 for all quantitative questions is deemed acceptable, 3.5 or above is highly desirable, and 4.0 and above is exceptional (scale: 1 = weak and 5 = strong).
3. **Student/Faculty Meetings** – Qualitative – N/A
4. **Senior Design** – Qualitative – N/A
5. **Alumni Meetings** – Qualitative – N/A
6. **Alumni Surveys** – Quantitative and Qualitative – For Questions 10 through 17 on the Alumni Survey, an average of 3.0 for all quantitative questions is deemed acceptable, 3.5 or above is highly desirable, and 4.0 and above is exceptional (scale: 1 = weak and 5 = strong).
7. **Co-op Employer Surveys** – Quantitative – Less than 20% of the co-op students face notable difficulties (e.g., too much idle time, supervisor too busy, housing, etc.).
8. **Exams** – Quantitative and Qualitative – The major course objective topics from the syllabi should appear within the exams for each course.
9. **Lab Reports** – Quantitative – Both laboratory work and technical writing are evaluated from the reports, in which a subjective level of achievement greater than 75% is desired. In addition, improvement in the achievement level is expected as the students progress from their freshmen to their senior years of study.
10. **Fundamentals of Engineering (FE) Exam** – Quantitative – The pass rate for UND Electrical Engineering students who take the FE Exam should be equal to or greater than the national pass rate, averaged over at least three years of results.
iii. Data Analysis

The assessment process is an ongoing activity, in which data continues to be gathered and analyzed. Recognizing that the assessment process can be extremely demanding on the workload of the faculty – especially for a small group of only eight overextended individuals – data is collected for each instrument in a cyclical nature. The devised schedule is realistic, and it permits fulfilling the objectives of the assessment process. Assessment material is gathered and analyzed according to the following time schedule:

11. **Placement** – Collect job placement data at the end of May for the previous academic year.
12. **Exit Interviews** – The EE Chair meets with graduating senior students at the conclusion of each semester. The EE Chair then writes a report, describing issues raised by the students. The SEM Dean meets with graduating senior students as a group at the conclusion of each semester and reports the positives, negatives, and suggestions regarding the program back to the EE Chair.
13. **Student/Faculty Meetings** – Faculty and students meet once per semester, near the midpoint of the term, to gather student feedback. EE Faculty Representative documents the meeting, summarizing issues raised by students.
14. **Senior Design** – EE Faculty Representative evaluates at least five capstone Senior Design reports and five capstone design presentations each semester.
15. **Alumni Meetings** – All meetings with EE alumni are documented, including teleconferences (once per academic year) and face-to-face meetings (at least once every three years).
16. **Alumni Surveys** – EE alumni are surveyed during the spring semester of each academic year. Alumni who graduated one and five years ago are surveyed.
17. **Co-op Employer Surveys** – Co-op Employer Surveys are collected for at least five cooperative education students from the past academic year during each spring semester.
18. **Exams** – Exam data are sampled from select courses each semester, according to the schedule detailed below.
19. **Lab Reports** – Five lab reports are collected from each of the following laboratory courses each academic year: EE 306, EE 308, EE 425.
20. **Fundamentals of Engineering (FE) Exam** – Collect scores for all electrical engineering students taking the FE Exam during each academic year.

Exam data are sampled from select courses each semester in the following manner:
5. Exam statistics are calculated for each exam, including the sample mean, standard deviation, minimum, maximum, and a histogram of all exam scores.
6. Collect sample of high, medium and low exams for each exam given in a class.
7. Odd-numbered years:
   a. Fall: EE 206, EE 304, EE 314, EE 451
   b. Spring: EE 313, EE 401, EE 421, EE Elective
8. Even-numbered years:
   a. Fall: EE 101, EE 318, EE 316, EE 321
   b. Spring: EE 201, EE 452, EE 405, EE 409

iv. Action

The Department has always been active in maintaining a competitive electrical engineering program by “closing the loop” based on information gathered from its students,
faculty, and alumni in industry. Prior to establishing our assessment process for Engineering Criteria 2000, program evaluation and curriculum changes took place regularly based on the recommendations of the constituencies, but in a much less formal manner than that used today. This long-standing tradition of improving the curriculum laid a strong foundation for EC2000 outcomes-based student learning and continuous program improvement. Conclusions and concerns determined through data collection and analysis contributed directly to program and curriculum changes. The following are the recent program changes carried out over the 1998-2003 accreditation review period, with the primary constituents responsible for driving each change noted in parentheses:

1. A number of prerequisite and corequisite changes have been made recently, to better represent the required background for each class. (Faculty, Students)

2. EE 206 Circuit Analysis for Nonmajors has been eliminated from the curriculum, beginning in the 2003 fall semester. It was decided that the Department was expending too much effort in providing this service course to the other engineering disciplines, with no reciprocation with respect to new general engineering service course offerings. Non-electrical engineering students will be allowed to enroll in one of the following regular electrical engineering course offerings as engineering science electives: (1) EE 201/202 Introduction to Digital Electronics with Laboratory (2 credits for the lecture course, 1 credit for the lab); (2) EE 206 Circuit Analysis for electrical engineering majors (3 credits for the lecture course); or (3) EE 304 Computer Aided Measurement and Controls (3 credits for the lecture course). (Faculty, Students)

3. EE 316 Electric and Magnetic Fields (3 credits) has been changed from four semester credit hours to a three-credit course starting in the 2003 fall semester, in order to balance the required curriculum in applied electromagnetics and to make scheduling easier in the fall. (Faculty)

4. EE 409 Distributed Networks (3 credits) has been changed from two semester credit hours to a three-credit course starting in the 2004 spring semester, in order to balance the required curriculum in applied electromagnetics and to make scheduling easier in the spring. (Faculty)

5. EE 403 Controls Laboratory (1 credit) was converted from a one-credit open-ended senior laboratory experience to a one-credit laboratory tied closely to industrial control system applications. This was done in response to negative student feedback regarding the senior laboratory, the increase in the number of credits allocated to the senior design sequence, and the request by alumni for more hands-on experience in industrial control systems and programmable logic controllers. (Students, Alumni)

6. EE 452 Microprocessor Hardware (3 credits) was converted from an elective course to a required course since the last ABET Accreditation Visit. The students that had enrolled in the elective course encouraged the faculty to include more computer programming and hardware content in the curriculum, especially in the area of embedded systems. (Students)

7. EE 480 Senior Design I (3 credits) was increased from a one-credit hour course to a three-credit course since the last ABET Accreditation Visit, in order to award the appropriate amount of credit to the students for the expected level of effort. (Faculty, Students, Alumni)
8. EE 481 Senior Design II (3 credits) was increased from a two-credit course to a three-credit course since the last ABET Accreditation Visit, in order to award the appropriate amount of credit to the students for the expected level of effort. (Faculty, Students, Alumni)

9. EE 480/481 Senior Design I and II essentially absorbed EE 482 Technical Presentation and Portfolio, which previously was a required course. EE 481 Senior Design II was actually approved as a UND general education requirement in communications by the University-wide GER committee to reflect its substantial oral and written communications content. (Faculty, Students)

10. A number of EE 490 Electrical Engineering Problems course offerings have been developed recently by the faculty, to better reflect new research interests and expertise housed in the Department. Courses in Avionics, Cellular Communications, Signal Integrity, and Spacecraft Systems Engineering have all been developed and offered for the first time since the last Accreditation Visit. An additional course in Renewable Energy Systems is planned for the 2003 fall semester. The students have requested a larger variety of elective coursework, and the faculty are excited to have the opportunity to teach in their areas of expertise. (Faculty, Students)

11. Based on positive student feedback, two of the EE 490 courses have been approved as regular elective course offerings. These courses include EE 507 Spacecraft Systems Engineering (3 credits) and EE 509 Signal Integrity (3 credits). (Students)

12. The number of required electrical engineering courses has been increased for both the Computer Science Focus program and the Aerospace Focus program since they were initiated, so that the graduates of these programs will complete almost all of the courses within the required UND Electrical Engineering core curriculum. Originally, Computer Science and Aerospace Focus program students were not required to take EE 421/425 Electronics II with lab and EE 409 Distributed Networks. However, the faculty felt that these topics were important to all electrical engineers, especially when the B.S.E.E. degree is awarded in all cases. (Faculty)

13. The allowable elective computer science course offerings have been broadened for the Computer Science Focus program, to include most elective courses numbered 300 and above. Previously, Computer Science Focus students were restricted to taking only a handful of electives, and this made it very difficult for the students to complete the program in a timely manner because of scheduling conflicts between departments. This became apparent through student advisement each semester. (Students)

14. A three-credit math elective was incorporated into the curriculum to replace Math 353 Engineering Mathematics III. Since the Department started offering EE 318 Engineering Data Analysis (3 credits) as a required course each fall, the statistics component of Math 353 has since become redundant. To enhance the students’ mathematical background, a number of mathematics courses numbered 300 and above are now eligible as math electives in the curriculum. (Faculty, Students)

15. EE 318 Engineering Data Analysis (3 credits) was changed from two-credits to three-credits, in order to cover more of the probability and statistics topics from Math 353 Engineering Mathematics III and to make scheduling easier in the fall semester. This course has the
added benefit of introducing the students to probability and statistics applications in electrical engineering. (Faculty, Students)

16. A total of six credit hours of EE 397 Cooperative Education may now count towards a student’s technical electives, if that individual is enrolled in the traditional B.S.E.E. program. This was increased from only three credits to better represent the importance that cooperative education has in the overall program. Only one three-credit hour technical elective is required for students enrolled in the B.S.E.E. with a Computer Science Focus program, while no technical elective credits are required for students enrolled in the B.S.E.E. with an Aerospace Focus program. (Faculty, Students)

17. EE 397 Cooperative Education was changed from letter grading to S/U grading since the last ABET Accreditation Visit, because student performance in the course was often difficult to evaluate. In this manner, the student’s grade point average is not affected positively by a satisfactory (passing) grade. Since the letter grade granted to students in this course was almost always high, S/U grading prevents “grade inflation” from occurring on the students’ transcripts. (Faculty, Alumni)

18. One computer science elective course was eliminated from the B.S.E.E. with a Computer Science Focus degree requirements, in order to reduce the number of credits from 141 to 138. However, students still satisfy the requirements for a computer science minor, even without this additional elective course. (Students, Faculty)

19. The total number of credits required for the B.S.E.E. with an Aerospace Focus program was reduced from 142 to 139, in order to bring it more in line with the traditional and Computer Science Focus programs. (Students, Faculty)
e) Data to Illustrate the Process, Results, and Program Improvement

Next, the data collected for each instrument is analyzed by the departmental faculty members. Action items stemming from the data analysis are identified. For each assessment instrument, the data evaluation should be presented in the following order:

1. Description of Assessment Instrument
2. Faculty Member(s) Responsible for Data Analysis and Interpretation
3. Level of Achievement Desired (if applicable)
4. Data Collection Timeline
5. Data Presentation
6. Evaluation & Interpretation
7. Closing the Loop for Continuous Program Improvement
8. Justification of Outcome Measurement Confidence Levels

Examples of how to compile the data for each assessment instrument are included in the 2003-2004 B.S.E.E. EAC/ABET Self-Study Report.