Electrical and Computer Engineering

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Degree Program(s) Assessed	Assessment Methods	Number of Individuals Assessed
Bachelor of Science in Electrical Engineering Bachelor of Science in Electrical Engineering, Computer Option	Fundamentals of Engineering Exam	31
	Senior Exit Survey	~80
	Course Content Surveys	~200
	Alumni Survey (OSU Assessment Office)	NA
	Instructor Survey	22 (faculty)
	Area of Specialization Reports	NA
	IEEE and HKN Report	NA
	Design II Written Reports (Consultants)	~80
	Design II Oral Reports (Consultants)	~80
	Course Matrix	NA
	Evaluation of Final Exams	~120
	Board of Visitors annual report	NA

Analysis and Findings

ECEN uses a variety of metrics to both evaluate student progress and evaluate the program, which directly impacts students. We present summary data from each of our assessment metrics below then give an overall evaluation of the assessment data:

FE Exam: The FE exam measures a specific subset of students. To verify that this subset represents the student population as a whole we compare the overall GPA of all ECEN juniors and seniors with those that took the FE Exam in 2002 and 2003.

Overall, ECEN students have an average GPA of 3.10. Those who took the FE exam in Spring and Fall 2002 had a mean GPA of 2.96, students that took the FE exam in the Spring and Fall 2003 had a mean GPA of 3.13. We conclude that the students who took the FE exam in 2002 and 2003 are representative of ECEN students.

Summary of 2003 Exam Results (spring semester): ECEN students who took the FE Exam in 2003 did significantly better than the national average in: fluid mechanics and mechanics of materials. ECEN students did significantly worse than average on the general exam in: ethics and electrical circuits. On the PM subject exam students performed below the national average in chemistry. The Fall 2003 data is not included due to an insignificant amount of participants.

Electrical-Electrical Report 5	**OSU**	**State**	**Nat'l**
No. Examinees Taking	17	22	1,239
No. Examinees Passing	16	21	1,041
% Examinees Passing	**94%**	**95%**	**84%**

	Number of Exam Questions	**OSU Avg % Correct**	OSU Number of Exam Questions Correct	OSU Number of Exam Questions Attempted	**Nat'l Avg % Correct**	Nat'l Number of Exam Questions Correct	Nat'l Number of Exam Questions Attempted	**Percent Difference Between OSU & Nat'l**	z-statistic Comparing OSU to Nat'l Nat'l as truth	p-value two-sided not equal test
AM Subject (1 Point Each)										
CHEMISTRY	11	**63.00**	118	187	**71.00**	9,677	13,629	**-8.00**	-1.50	0.13
COMPUTERS	7	**76.00**	90	119	**71.00**	6,158	8,673	**5.00**	-0.84	0.40
DYNAMICS	9	**61.00**	93	153	**60.00**		11,151	**1.00**	-1.45	0.15
ELECTRICAL CIRCUITS	12	**75.00**	153	204	**71.00**	10,556	14,868	**4.00**	-0.72	0.47
ENGINEERING ECON	5	**66.00**	56	85	**59.00**	3,655	6,195	**7.00**	0.13	0.90
ETHICS	5	**78.00**	66	85	**76.00**	4,708	6,195	**2.00**	-1.22	0.22
FLUID MECHANICS	8	**40.00**	54	136	**39.00**	3,866	9,912	**1.00**	-2.20	0.03
MAT SCI/STR MATTER	8	**45.00**	61	136	**44.00**	4,361	9,912	**1.00**	-2.19	0.03
MATHEMATICS	24	**66.00**	269	408	**69.00**	20,518	29,736	**-3.00**	-2.21	0.03
MECH OF MATERIALS	8	**41.00**	56	136	**40.00**	3,965	9,912	**1.00**	-0.66	0.51
STATICS	12	**46.00**	94	204	**43.00**	6,393	14,868	**3.00**	-2.03	0.04
THERMODYNAMICS	11	**39.00**	73	187	**43.00**	5,860	13,629	**-4.00**	-2.66	0.01
PM Subject (2 Points Each)										
ANALOG ELEC CIRCUITS	6	**38.00**	39	102	**38.00**	2,825	7,434	**0.00**	0.59	0.56
CONT SYS THEORY ANAL	6	**54.00**	55	102	**57.00**	4,237	7,434	**-3.00**	-2.51	0.01
COMP HARDWR ENGINRNG	3	**59.00**	30	51	**54.00**	2,007	3,717	**5.00**	-0.30	0.76
COMP & NUM METHODS	3	**22.00**	11	51	**35.00**	1,301	3,717	**-13.00**	-0.83	0.40
COMP SOFTWR ENGINRNG	3	**71.00**	36	51	**62.00**	2,305	3,717	**9.00**	-1.67	0.10
COMM THEORY	6	**33.00**	34	102	**35.00**	2,602	7,434	**-2.00**	-0.36	0.72
DIGITAL SYSTEMS	6	**69.00**	70	102	**63.00**	4,683	7,434	**6.00**	0.49	0.62
ELECTRO THEORY & APP	6	**52.00**	53	102	**50.00**	3,717	7,434	**2.00**	-0.59	0.56
INSTRUMENTATION	3	**51.00**	26	51	**42.00**	1,561	3,717	**9.00**	0.89	0.38
NETWORK ANALYSIS	6	**34.00**	35	102	**40.00**	2,974	7,434	**-6.00**	-0.07	0.94
POWER SYSTEMS	3	**45.00**	23	51	**35.00**	1,301	3,717	**10.00**	0.11	0.92
SIGNAL PROCESSING	3	**24.00**	12	51	**32.00**	1,189	3,717	**-8.00**	-0.97	0.33
SOLID ST ELEC & DEV	6	**56.00**	57	102	**50.00**	3,717	7,434	**6.00**	0.21	0.83

No clear trends are yet evident in this data, but ECEN is carefully watching scores in computer software engineering, computer hardware engineering, and basic circuits, which may be problem areas in the curriculum.

Recent results can be viewed at http://www.ece.okstate.edu/ABET/Assessment/Program

%20Level/FE%20Exam/fe_exam.htm

Senior Exit Survey: From spring semester, 2000, students have been asked to fill out an exit survey evaluating their preparation and the quality of instruction and facilities in many areas of ECEN as well as the core curriculum using a Likert scale. On one survey form, students are asked about their educational

outcomes by rating their ability and the perceived importance of a variety of topics. On a second form, students are asked to rate aspects of their educational experience at OSU.

In analyzing data on educational outcomes, we have looked for values of perceived ability, perceived importance or the ability/importance ratio, which show long-term trends over several semesters. We also look for values, which fall far outside the mean response for all questions. The data on educational experience are analyzed similarly. Overall, few areas raise concerns most measurements remain constant with time and within reasonable ratings of student satisfaction of experience, ability, or perceived importance. This report only highlights areas which data indicates are potential concerns.

The main concern is in computer science. Students rating of ability/importance are consistently lower than in other courses. Recently the data has been trending upwards, however this bears watching. ECEN is also considering recommending that students take alternative courses if the ratings don't approve. Student ratings of computer science instructors and TA's are significantly lower than their ratings of instructors or TA's in any other subject. Overall ECEN faculty are rated 3.5, TA's at 3.1.

Other areas of concern are students' ratings of their ability to understand the environmental aspects of engineering (ability/importance 0.5 to 0.8). This is significantly below the mean ability/importance ratio of approximately 0.8. Similarly low ability/importance ratios are found on the question asking students about their understanding of the relation of engineering to society.

Within ECEN there has been a recent precipitous drop in the student rating of laboratory facilities for the senior design laboratories. Note that these laboratories have *never* received a rating above 3.0 (average). Smaller drops have occurred for ECEN computer facilities and other laboratories. Since the senior design capstone course is a critical component of the ECEN degree program the facilities issue should be addressed immediately.

Recent results can be viewed at http://www.ece.okstate.edu/ABET/Assessment/Program%

20Level/program_assessment.htm

Course Content Surveys (coverage and ability surveys): The coverage and ability surveys are aids to individual faculty members and areas to better evaluate data in their courses and area. In every course this metric surveys faculty and students on the coverage and student ability on specific topics each semester. Results are tabulated for the department as a whole and for each area of specialization. Each instructor or area is asked for a list of topics taught each semester in each course. The faculty supplied topics are used as the basis for survey questions in each course. Faculty were asked to rate the depth of coverage of topics in a given course and their perception of student abilities. Ratings are on a scale from 1 (least coverage/ability) to 3 (most coverage/ability). For each course, students are asked both to rate the coverage of topics as well as their perceived abilities on the same one to three scale.

The data from each course is presented as a table. Values that vary by one standard deviation from the course mean are in boldface to aid each instructor in evaluating his/her course. Results from individual courses are supplied to instructors and area coordinators. They are not made public and will be provided on request.

Summary of coverage vs. ability surveys, Spring 2004

Course	STUDENT COURSE SURVEY RESULTS					Faculty:Student Ratios	
	Coverage		Ability		Ability/ Coverage	Student Coverage	Student Ability
	Mean	Variance	Mean	Variance		Faculty Coverage	Faculty Ability
ECEN2011*	2.32	0.31	2.54	0.30	1.16		
ECEN3021*	2.45	0.33	2.45	0.38	1.00	1.18	1.68
ECEN3021T*	2.33	0.55	2.51	0.41	1.08	0.85	1.03
ECEN3031*	2.19	0.32	2.15	0.40	0.98		
ECEN3031T*	2.75	0.25	2.50	0.22	0.91	1.02	1.04
ECEN3113*	2.30	0.40	2.07	0.30	0.90	0.93	0.96
ECEN3233*	2.63	0.25	2.40	0.42	0.91	0.91	0.97
ECEN3233T*	2.31	0.38	2.22	0.46	0.98	1.04	1.34
ECEN3313*	2.37	0.34	2.09	0.43	0.88		
ECEN3313T*	2.67	0.25	2.43	0.35	0.91	1.28	1.55
ECEN3513*	2.26	0.42	2.08	0.42	0.92	1.64	1.07
ECEN3513T*	2.82	0.16	2.35	0.33	0.84	1.09	1.11
ECEN3613*	2.07	0.38	1.69	0.47	0.83		
ECEN3613T*	2.24	0.42	2.07	0.47	0.93	0.87	0.82
ECEN3623	2.52	0.34	2.23	0.33	0.88	0.97	1.21
ECEN3713*	2.50	0.35	2.27	0.41	0.91	1.08	1.21
ECEN3913*	2.10	0.27	1.95	0.39	0.93		
ECEN4023*	2.29	0.46	2.47	0.39	1.09	0.76	0.97
ECEN4023T*	2.49	0.61	2.51	0.63	1.01	1.03	0.89
ECEN4153	2.15	0.40	1.87	0.37	0.88		
ECEN4243*	1.83	0.41	1.82	0.39	1.01	0.74	1.03
ECEN4243T*	2.58	0.30	2.33	0.38	0.90	1.11	1.31
ECEN4413	2.38	0.44	2.37	0.36	0.99	1.37	1.36
ECEN4503*	2.13	0.45	2.02	0.45	0.95	1.24	1.18
ECEN4533	2.61	0.35	2.50	0.37	0.96	1.01	1.25
ECEN4533T	2.89		1.67		0.57	1.11	0.83
ECEN4703	2.44	0.64	2.36	0.34	0.97	0.81	0.95
ECEN4703T	2.72	0.20	2.79	0.19	1.03	0.91	1.11
ECEN4813	2.64	0.25	2.47	0.28	0.93	1.05	1.29
All ECEN Courses							
Mean	**2.41**	**0.36**	**2.25**	**0.38**	**0.94**	**1.04**	**1.14**
Variance	**0.062**	**0.013**	**0.076**	**0.007**	**0.010**	**0.042**	**0.048**
Required Courses							
Mean	**2.36**	**0.36**	**2.23**	**0.40**	**0.95**	**1.05**	**1.14**
Variance	**0.059**	**0.011**	**0.061**	**0.007**	**0.007**	**0.049**	**0.056**

The data collected by the survey is used by individual faculty and areas for program improvement. This is the primary mechanism by which ECEN assures curricular content and coverage remain constant over time.

Recent results can be viewed at http://www.ece.okstate.edu/ABET/Assessment/Area%20

Level/Course%20Surveys/CourseSurveyInfo/course_surveys.htm.

Alumni Survey: Alumni Survey was not performed this year. However, past results can be accessed at http://www.ece.okstate.edu/ABET/Assessment/Program%20Level/Alumni%20

Survey/AlumniResults.htm

Instructor Survey: Each semester instructors are asked to identify up to three areas in which students have poor preparation, and three areas in which students are well prepared for their course. These items listed by faculty are tabulated in appendix 3.1.A.

Semester	# of Areas of Poor Preparation	# of Areas Well Prepared In
Fall 2002	29	18
Spring 2003	59	46
Fall 2003	42	30
Spring 2004	44	30

More specific results can be viewed at http://www.ece.okstate.edu/ABET/Assessment/Area %20Level/Instructor%20Surveys/instructor_surveys.htm

Capstone Design Written Reports: Written project reports from the capstone design course are given to an independent panel of faculty and graduate students from the OSU technical writing department. The reports were evaluated using a rubric with a Likert (1-5) scale. ECEN has set a goal that all student teams will achieve a score of three or greater for the capstone design report. Data for one semester evaluated ten student teams. While the mean score for all teams was 2.98, six teams scored between 2 and 3, three teams were between 3 and 4, and one team scored over 4. The assessment of the written reports in Fall 2003 brought about a new rating system of 0-3.

0 = fails to demonstrate competency
1 = indicates a low level of competency; (needs extensive revision)
2 = indicates an acceptable level of competency; (needs more revision)
3 = indicates a high level of competency; (needs little revision)

Based on the restructuring of the rating system, Fall 2003 results average 1.37 with mechanics and style averaging 2.14, audience accommodation of 1.14, genre development of .71, document design of 1.79, and report visuals of 1.07.

This demonstrates that teams need to place more emphasis on the written communication portion of the design laboratory. The written report is 10% of the grade, which may lead to some teams not putting forth sufficient effort on this portion of the project.

Capstone Design Oral Reports: Oral communications in the capstone design course have been evaluated by members of the OSU Speech department. Evaluators attended required oral presentations in the ECEN capstone design course (ECEN 4023). Teams were evaluated on their overall presentation as well as organization, credibility, visual aids, eye contact, and elocution on a 1-5 scale using a rubric. Overall, the average team score for Spring 2003 was 2.89 with overall impression averaging 2.83, climate/credibility of 2.97, transmission/eye contact/elocution of 2.49, and organization/visual aid of 3.29. The average team score for Fall 2003 was 2.98 with overall impression averaging 2.80, purpose of 3.50, climate/ creditability of 3.00, transmission/eye contact/ elocution of 2.50, reception/awareness/ communication barriers of 2.80, and organization/visual aid of 3.30. Recommendations submitted by the evaluators focused mainly on elocution, eye contact, and presenting material in a dynamic manner. These skills are gained with practice, which other ECEN courses do not generally provide. The evaluators also stressed teaching students how to better structure presentations. Since the course outcome matrix indicates in Spring 2003 only 3.3% (unnormalized) or 0.9% (normalized) and in Fall 2003 2.6% (unnormalized) or .8% (normalized) of the curriculum is spent on oral communication, there is room to improve this skill.

Course Matrix: To ensure that all students are given sufficient skills in the ECEN curriculum such that they are able to meet all objectives, ECEN has tabulated required and elective courses for each program objective. To determine the numerical rating of each course faculty are surveyed (or CEAT assessment documents are used for core engineering classes). Data is analyzed using two methods to ensure adequate measurement of coverage of each of the program objectives. Only required ECEN courses are discussed in this analysis to ensure that we account only for the subset of courses taken by all students. Students are guaranteed to exceed these scores at graduation having taken seven additional ECEN and technical electives.

Of the five major ECEN objectives, ECEN objective #1 is covered extremely well with the exception of advanced discipline specific topics which are covered in elective courses and are therefore not included in the overall total. The total reported coverage of the sub-outcomes in ECEN courses is 68%/52% in Spring 2003 and 63%/45% in Fall 2003 of the curriculum devoted to objective #1. Similarly ECEN objective #3 is extremely well covered; this objective amounts to approximately 17%/27% in Spring 2003 and 19%/33% in Fall 2003 of the ECEN curriculum. Of the remaining 15%/20% in Spring 2003, about 3%/6.5% is devoted to ECEN objective #2, 1%/3.3% to ECEN objective #4, and 11%/11% to all topics which make up ECEN objective #5. The remaining percentages in Fall 2003 are distributed as follows: Objective #2: 4%/8%; Objective #4: 2%/1.5%; and Objective #5: 12%/12%. This analysis shows that ECEN needs to address the final three objectives directly, especially objective #4. ECEN program objectives are available on request.

The goal of ECEN is to correct the disparities between the outcomes, particularly the underrepresented outcomes. A graph of the outcomes as a function of semester can be found at http://www.ece.okstate.edu/ABET/Assessment/Program%20Level/Course%20Matrix/

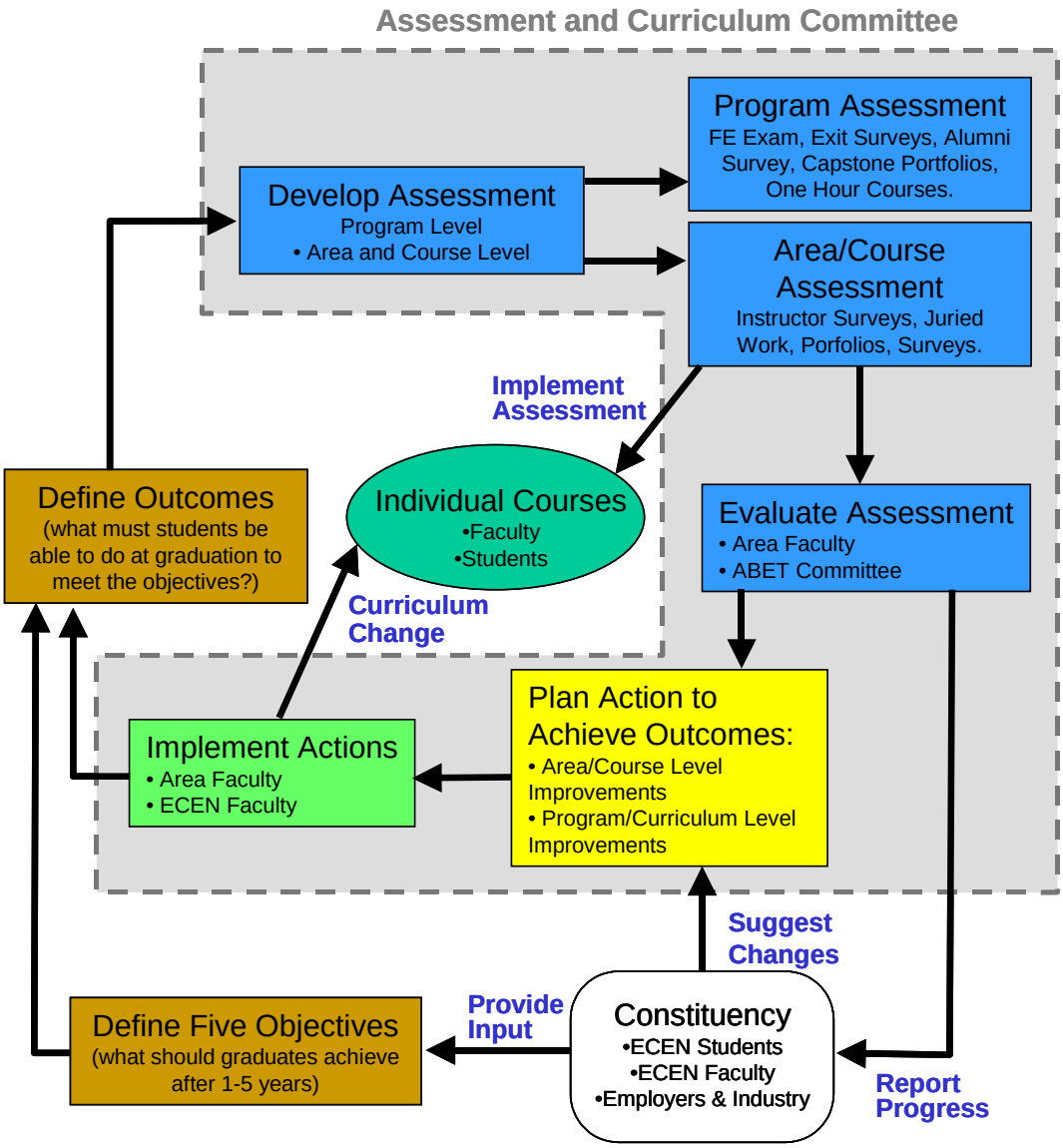
MatrixInfo.htm

Board of Visitors, Area of Specialization Reports, IEEE and HKN Report: ECEN additionally uses reports from its external advisory board, reports from each individual area of specialization, and reports from student professional societies to evaluate its program. Since these do not directly measure student achievement or the program, they are not included in this report, but are available on request.

Use of Assessment Results

Description of Assessment Process: This section outlines the process by which ECEN assesses and acts to improve achievement of objectives and outcomes. This process is outlined in the figure below. This section outlines the process as envisioned.

The evaluation and assessment process, the process of acting on the assessment to plan curriculum change, and the process of implementing proposed changes all fall under the aegis of the ECEN Curriculum and Assessment Committee (C&AC). The C&AC is divided into three working groups corresponding to the three aforementioned processes. The Assessment Working Group (AWG) is responsible for course and program evaluation, represented by the blue boxes. The AWG communicates the results of program assessment evaluation along with recommended actions to the C&AC for discussion. A summary of the assessment metrics and a list of general recommended actions are given to the Curriculum Working Group (CWG). The CWG is represented by the yellow box in the diagram below. The CWG is responsible for planning course, curriculum, and program changes to improve the ECEN undergraduate program and to address recommendations from the assessment group. Proposed actions are evaluated and implemented by the Implementation Working Group (IWG). The IWG is represented by the green box in the diagram below. The IWG is responsible for ensuring course, curriculum, and program changes are implemented in a timely fashion into the ECEN program.



The assessment loop is closed annually. Each summer the ECEN C&AC and each Area of Specialization will generate a short report in a standardized format that is used as archival evidence. These reports contain results from assessment, document all areas of concern in the curriculum, and propose specific curricular changes. A faculty meeting, held annually, will be used as the forum to present these reports and discuss specific actions.

Assessment Driven Curricular Change: First, we summarize, in general, the conclusions of our assessment process. The following recommendations are drawn from the full assessment reports summarized above. All these recommendations have a high priority and indicate areas assessment has indicated immediate action needs to be taken to improve the ECEN program and help meet ABET objectives and outcomes. These recommendations are given in no particular order.

- ECEN needs to re-examine the number of hours in the sophomore year, primarily the engineering core curriculum. Data from the alumni survey indicates that graduates feel too much time is spent on these core courses. Data from the FE exam indicates our students do significantly better than the national average in general engineering compared to other electrical engineering students nationwide (with the exception of electrical circuits). These changes require a change of policy at the college level to be able to implement. We have been repeatedly blocked by college administration from making required changes.

- ECEN should examine structure and content of design courses and review the content of current design courses. Funding must be obtained to upgrade and support development of more design courses in the curriculum and bring laboratories up to standard. ECEN should re-examine the methods courses and the two senior design courses to see if they provide sufficient design experience. This is underway.
- ECEN should seek to offer a larger number of advanced courses at the undergraduate level. Alumni feel that offering more courses in advanced electrical engineering topics will benefit the program. This is the responsibility of faculty in each area of specialization. The implementation of areas of specialization last year is helping to give more flexibility to faculty.
- ECEN should guarantee that students meet objectives for softer outcomes such as ethics, social impact of engineering and environmental issues. Senior exit survey results indicate students do not feel prepared in environmental or social aspects of engineering. One hour courses have been proposed to achieve this. These have been blocked by CEAT administration.
- ECEN should re-examine course offerings in computer science due to declining student satisfaction with instructors and TA's. Additionally ECEN should examine whether we should offer or require more courses on computer hardware and software engineering for ECEN students. Scores on the FE exam indicate ECEN students are not competitive with other electrical engineering students nationwide. We have implemented a project based course in the sophomore year to address this (ECEN3233).

Changes Implemented or Planned in Specific Courses:

- ECEN has been negotiating with the Physics department to modify the contents of the Modern Physics course. After a number of meetings, the modern physics course content changed to emphasize rigorous solid-state physics. After the content modification, the student drop rate declined dramatically.
- ECEN making changes to improve the experience in our Experimental Methods Labs (ECEN 2011, ECEN 3021 and ECEN 3031). In the past, these laboratories have been independent of any course, and this has made it hard to coordinate the coverage of the analytical background needed for understanding of laboratory assignments. Significant student feedback has been received on this subject, and a committee was formed to study the issue. Based on the results of this study, starting in the fall of 2005, the lab and classroom portions of these courses will be integrated into four hour courses.
- ECEN has made several changes to improve our Systems I course (ECEN/MAE 3723). Starting in the Fall 2003 semester, each section of 3723 will consist of half electrical engineering students and half mechanical engineering students.
- ECEN has significantly redesigned the capstone design course, ECEN 4023. This will produce a more consistent design experience for all students, and will involve the entire faculty. This redesign will address deficiencies highlighted by written and oral communication assessments. The one-year trial outcome was positive.
- Requested removal of ENGR 1342 from CEAT; however, the request was ignored by college administration.
- Several new advanced courses have been added.

Programmatic Changes Implemented or Planned:

- The most significant change that we have introduced to strengthen the ability of students to explore topics in depth is the introduction of Areas of Specialization, which is a major program rearrangement. Each student now will be offered carefully selected curriculum plans that facilitate limited specialization in one of several topical areas.