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	Fundamentals of Engineering Exam	31
	Senior Exit Survey	Senior Exit Survey	~80
	Course Content Surveys	Course Content Surveys	~450
	Alumni Survey (OSU Assessment Office)	Alumni Survey (OSU Assessment Office)	34 (alumni)
	Instructor Survey	Instructor Survey	22 (faculty)
	Area of Specialization Reports	Area of Specialization Reports	NA
	IEEE and HKN Report	IEEE and HKN Report	NA
	Design II Written Reports (Consultants)	Design II Written Reports (Consultants)	~80
	Design II Oral Reports (Consultants)	Design II Oral Reports (Consultants)	~80
	Course Matrix	Course Matrix	NA
	Evaluation of Final Exams	Evaluation of Final Exams	~120
	Board of Visitors annual report	Board of Visitors annual report	NA

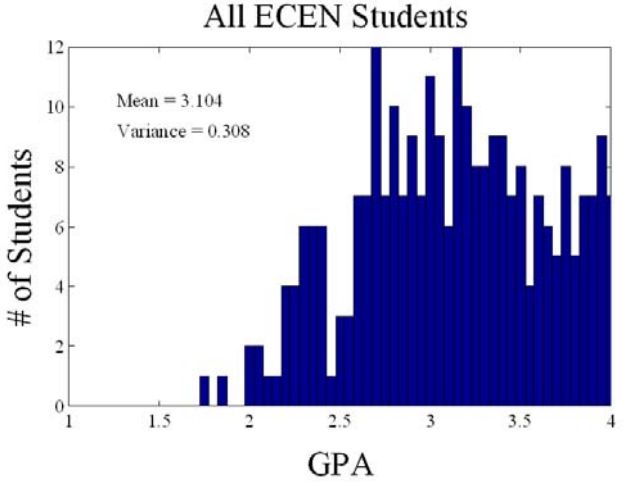
Analysis and Findings:

ECEN uses a variety of metrics both to 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, the only year this data is available.

Overall, ECEN students have an average GPA of 3.10, shown below. Those who took the FE exam in 2002 have a mean GPA of 3.08 with a variance of 0.167. We conclude that the students who took the FE exam in Spring 2002 are representative of ECEN students.



Summary of 2002 Exam Results (spring and fall semesters)

ECEN students who took the FE Exam in 2002 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: computer software engineering, computer hardware engineering, network analysis, and instrumentation

Scores deviating 2 or three standard deviations from national average from FE Exam

Semester	F97	S98	F98	S99	F99	S00	F01	S02	F02
# Taking	2	3	1	3	3	2	3	21	10
# Passing	2	3	1	2	3	2	3	16	7
% Pass	100.0%	100.0%	100.0%	66.7%	100.0%	100.0%	100.0%	76.2%	70.0%

	Deviation from National Score (2 or 3 st. dev.)								
AM Subject (1 Point Each)									
CHEMISTRY		+ +							
COMPUTERS									
DYNAMICS		+ + +						+ + +	
ELECTRICAL CIRCUITS									- - -
ENGINEERING ECON									
ETHICS								- - -	
FLUID MECHANICS	+ + +						+ + +	+ +	
MAT SCI/STR MATTER									
MATHEMATICS	+ +					- - -			
MECH OF MATERIALS		+ +			+ + +		+ + +		
STATICS									
THERMODYNAMICS									
PM Subject (2 Points Each)									
ANALOG ELEC CIRCUITS									
CONT SYS THEORY ANAL				- - -					
COMP HARDWR ENGINRNG		+ +			+ +	+ +			
COMP & NUM METHODS									
COMP SOFTWR ENGINRNG									- - -
COMM THEORY				+ + +					
DIGITAL SYSTEMS							+ + +		
ELECTRO THEORY & APP			+ +						
INSTRUMENTATION									
NETWORK ANALYSIS							- -		
POWER SYSTEMS									
SIGNAL PROCESSING									
SOLID ST ELEC & DEV			- -						

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.

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 area 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 there are few areas that raise concerns, most measurements remain fairly 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 has fallen from 1.0 to 0.7 in three semesters. 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.

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, Fall 2002

Course	STUDENT COURSE SURVEY RESULTS					Faculty:Student Ratios	
	Coverage		Ability			Student Coverage	Student Ability
	Mean	Variance	Mean	Variance	A/C	Faculty Coverage	Faculty Ability
ECEN3031*	2.00	0.61	1.61	0.51	0.81	0.81	0.69
ECEN3233*	2.46	0.29	1.60	0.39	0.66	0.86	0.74
ECEN3513*	2.39	0.42	1.67	0.50	0.71	2.03	
ECEN3613*	2.38	0.33	1.75	0.55	0.75	0.99	0.96
ECEN3713*	2.65	0.28	1.87	0.29	0.71	0.92	
ECEN3723*	2.37	0.32	1.79	0.49	0.79	0.96	0.90
ECEN3813	2.49	0.38	1.79	0.45	0.73	1.32	1.00
ECEN4133	2.36	0.38	2.06	0.55	0.92	2.20	2.20
ECEN4413	2.61	0.30	1.67	0.26	0.64	0.91	0.65
ECEN4503*	2.38	0.38	1.69	0.48	0.75	1.21	1.17
ECEN4523	2.52	0.37	1.71	0.34	0.68	2.45	3.00
ECEN4613	2.43	0.23	1.81	0.45	0.86	1.09	1.24
ECEN4763	2.47	0.40	1.80	0.40	0.74	1.10	0.83
All ECEN: Mean	**2.42**	**0.36**	**1.75**	**0.44**	**0.75**	**1.30**	**1.22**
Variance	**0.024**	**0.009**	**0.015**	**0.009**	**0.006**	**0.310**	**0.535**
Req. ECEN Mean	**2.38**	**0.37**	**1.71**	**0.46**	**0.74**	**1.11**	**0.89**
Variance	**0.037**	**0.013**	**0.010**	**0.008**	**0.003**	**0.181**	**0.037**

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.

Alumni Survey

To evaluate whether students who successfully complete the ECEN degree requirements achieve the program objectives, ECEN uses responses from an alumni survey. ECEN has analyzed two separate alumni surveys performed by the Office of University Assessment. The undergraduate alumni survey consists of common questions specific to the College of Engineering, Architecture, and Technology, and discipline specific questions submitted by ECEN. We have given special weight to the open ended questions, looking for trends in the data or groups of responses. There were 14 responses from the class of 1996, and 20 responses from the class of 2000. The evaluation and raw data from the alumni survey results are attached as appendix 2.C.

We have analyzed the survey in two different ways. We first analyze the results to see what data supports or refutes students meeting the program objectives. Next, we analyze the data, especially the open-ended questions, to evaluate specific strengths and weaknesses in our program which may lead to program actions.

In this summary we have not included data on specific program objectives, it is available on request. The responses to open ended questions are more pertinent. In analyzing data from the alumni surveys we have looked for broad trends, specifically in the open-ended questions. Some unintentional interpretation of responses may be possible due to the brief nature (one sentence or less) of the data collected from the alumni office.

The strongest opinions of alumni on open-ended questions of strengths, weaknesses, and possible improvements of the ECEN program had to do with design courses. In rating weaknesses and areas to improve the ECEN curriculum the top response was to improve or increase design courses. In rating ECEN strengths, the second largest response was the benefit of design courses. In these categories 21% of respondents stated the design courses were the strongest part of the ECEN curriculum, 38% thought the weakest part of the curriculum was insufficient, non-relevant, or not up-to-date design courses. 42% of respondents thought the program could best be improved by focusing on labs or design experiences. While these are somewhat contradictory, analyzing the individual responses shows that alumni feel design courses are extremely important but are somewhat dissatisfied with the quality, content, or facilities of design courses.

18% of alumni surveyed thought the ECEN faculty or instruction was the strongest part of the program. 18% thought faculty or instruction was the major weakness. Positive comments were generally about the quality of the faculty while negative comments were about the lack of sufficient faculty or quality of TAs.

24% of alumni surveyed felt that a primary strength was the breadth of the ECEN program. Specific positive comments were on breadth of ECEN courses and the sound theoretical and mathematical background. 8% commented that improving math background would be the best way to improve the ECEN program. However, 18% of alumni criticized the breadth, though well over half of these criticisms were directed toward the CEAT engineering science core curriculum rather than ECEN courses.

18% of alumni surveyed thought a primary weakness was lack of courses reflecting current areas of importance in electrical engineering or lack of sufficient advanced courses. Many of these mentioned a specific topic, probably related to the respondent's job. When asked the best way to improve the ECEN program, 15% suggested more advanced topics or adding specific topics. No respondents mentioned advanced topics as a primary strength of the program although on a five point scale graduates rated their preparation in advanced topics at a 3.6 (near mean).

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.

Faculty listed a total of 25 topics in which students lacked sufficient preparation in Fall, 2002; approximately 50% of the topics listed cited difficulties in mathematics at various levels. Of the other responses, the next largest (12%) was problem solving ability and a lack of understanding of basic physics and chemistry (8%). Of the fifteen responses indicating areas students had good preparation, two listed basic calculus and one a more advanced math topic. The other responses varied widely.

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 are 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. As of the date of this report we have received evaluation of one semester, evaluating 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.

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, nine teams are an average score of 2.47 with organization averaging 3.13, credibility of 2.97, visual aid of 3.44, eye contact of 2.56, and elocution of 2.41. The evaluators' recommendations 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 only 3.2% (unnormalized) or 0.9% (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% of the curriculum devoted to objective #1. Similarly ECEN objective #2 is extremely well covered; this objective amounts to approximately 17%/27% of the ECEN curriculum. Of the remaining 15%/20%, about 3%/6.5% is devoted to ECEN objective #3, 1%/3.3% to ECEN objective #4, and 11%/11% to all topics which make up ECEN objective #5. This analysis shows that ECEN needs to address the final three objectives directly, especially objective #4. ECEN program objectives are available on request.

Evaluation of Final Exams

Starting in Spring 2003, a team of faculty from each area of specialization analyze specific exam problems from each course at the end of each semester using a rubric. Example problems are analyzed as a group to set a consistent rating scale, then each faculty member evaluates specific examination problems in his/her area. The faculty team then compares evaluations and decides on an overall integer score. Problems are evaluated from five students in each course – one each from high and low grade ranges, and three from near the class mean. Three courses are being evaluated currently. ECEN3713, the basic electrical networks course, ECEN3613, the introductory electromagnetic fields course, and ECEN4503, an advanced course in random signals and noise. We feel these courses are a good representation of students at the beginning of the ECEN program, near the mid-point, and at the end of the program.

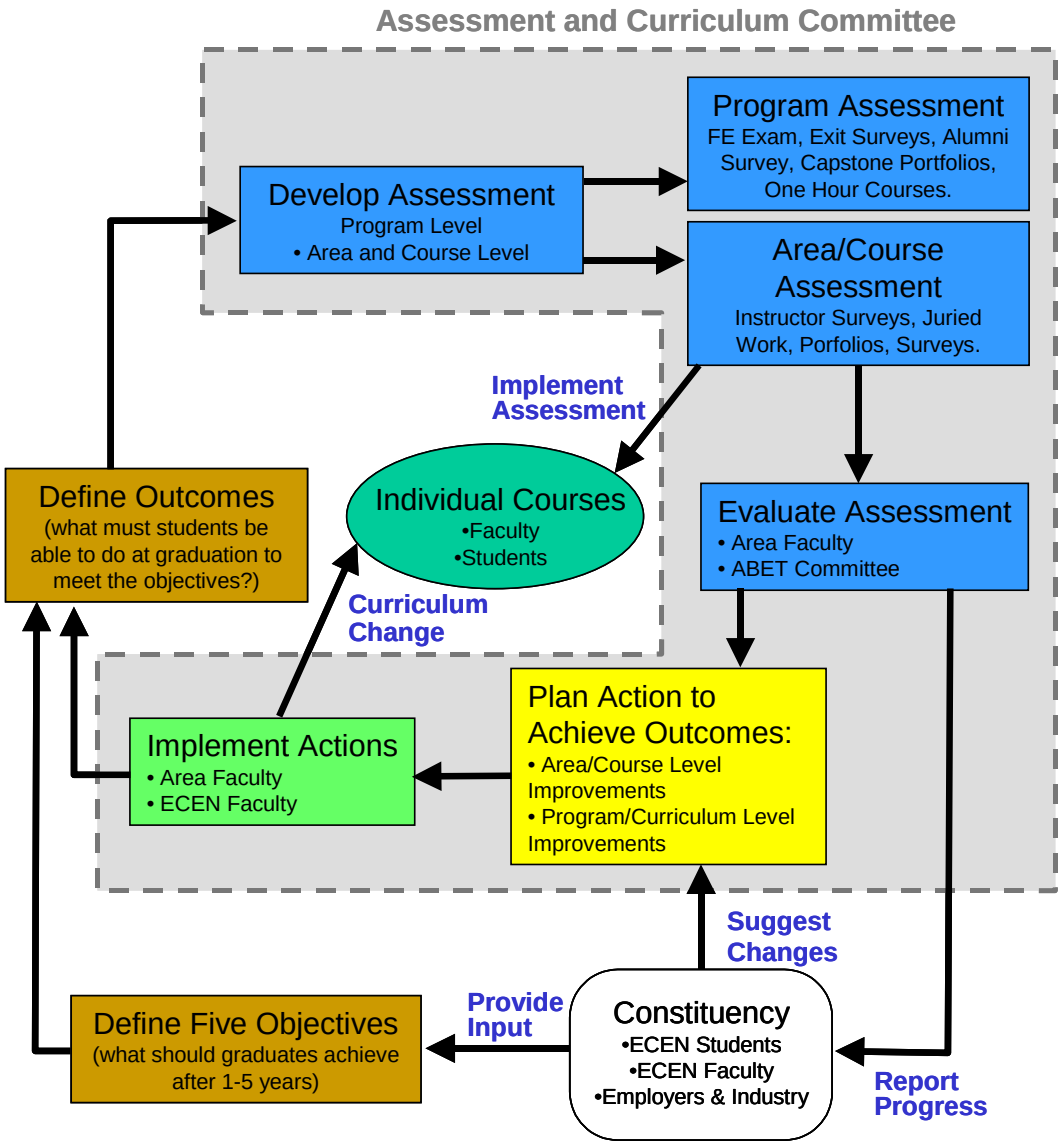
Results from each of these courses is available on request, but not included in this evaluation since trends are not yet visible in the data. Future assessment will establish a baseline to use to determine if curriculum changes increase or decrease student skills in solving examination problems. We also set as a criterion that the scores will increase between the sophomore and senior year, indicating increase in student problem solving abilities.

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 get 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.

- Data on course coverage, the FE exam, and ad hoc input from faculty indicate the program needs to directly address ethics. One hour courses are being planned to achieve this.
- 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.

- 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 will help by giving more flexibility to faculty.
- ECEN should guarantee 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 are being implemented to achieve this.
- 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. This has not yet been addressed.

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 will change to emphasize rigorous solid-state physics and will be less of a survey of modern physics.
- 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 2003, ECEN 3021 will be taught by the same instructor as ECEN 3713, and ECEN 3031 will be taught by the same instructor as ECEN 3313.
- 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.

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.
- ECEN has begun the potentially lengthy process of implementing one-hour courses to ensure life-long learning, social and environmental aspects of engineering, and ethics are covered directly by the curriculum and is not ad-hoc. To free up time in the curriculum for these courses, ECEN has requested that ECEN students no longer take ENGR1342, Engineering Design with CAD, part of the CEAT engineering science core curriculum. The two hours saved in the curriculum were to be used for the implementation of two new one-hour courses in the sophomore and junior years with the curriculum described in appendix 3.3.A. After ECEN proposed this idea to CEAT administration, the Dean requested ECEN take the lead on establishing a new format for ENGR1342 which will incorporate into a two hour course the items planned for the two one-hour courses. While not in line with the original plan this potentially addresses concerns about faculty workload compensation. Additionally, during the Fall semester of 2003, we will be bringing in industrial speakers to our Senior Design I course (ECEN 4013). These speakers will address the importance of professionalism and ethics in the workplace.