2006-987: PASSING THE FUNDAMENTALS OF ENGINEERING EXAMINATION AS A GRADUATION REQUIREMENT IN A GENERAL ENGINEERING PROGRAM: LESSONS LEARNED

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Passing the Fundamentals of Engineering Examination as a Graduation Requirement in a General Engineering Program: Lessons Learned

Abstract

The University of Tennessee (UT) at Martin offers a multi-disciplinary general engineering program with concentrations in civil, electrical, industrial, and mechanical engineering. The Bachelor of Science in Engineering (B.S.E) program was first accredited by ABET/EAC in 1999, and since program inception, a requirement for graduation is that students in each concentration must successfully pass the Fundamentals of Engineering (FE) Examination. In this paper, the authors discuss several aspects of interest related to problems, challenges, and future efforts associated with maintaining a 100% pass rate on this nationally administered examination. A brief overview of the program is presented, with emphasis on the multi-disciplinary nature of the program that supports and predicts successful passing of the examination independent of engineering concentration. The history behind requiring passing the examination is presented followed by an overview of the performance during the early years of the program and the program support mechanisms that were available to the students. As the number of students and graduates has increased, the first time pass rates have degraded. This paper examines a number of initiatives that have been implemented in the engineering program to increase these rates. The results of a detailed study of all students that have taken the examination are also presented. This study was performed to attempt to identify accurate quantitative predictors of both success and failure on the exam and to make improvements to the program to insure that all students successfully pass the exam. The UT Martin engineering program makes extensive use of FE examination results for its ABET continuous assessment and improvement process. This paper also includes a discussion of how the detailed quantitative results from the testing results may be used as an external metric for program outcome assessment and performance improvement.

History

The history of engineering and engineering technology on the University of Tennessee at Martin campus extends back to the 1930's when the school was a junior college. The University was known as The University of Tennessee Junior College, and the engineering program consisted of the first two years towards a baccalaureate degree in the student's chosen field of engineering. The University became a four-year college in 1951. Most degree programs were transformed into full four-year baccalaureate programs at that time. The engineering program remained a two-year transfer program with most students transferring to the University of Tennessee at Knoxville.

In the fall of 1967, a formal proposal was developed by the UT Martin Department of Engineering and submitted to the College of Engineering at Knoxville for an engineering degree with majors from one of six areas: graphics, electrical power, electronics, industrial, mechanical, and surveying. In the fall of 1969, the University of Tennessee system approval was granted for a four-year engineering technology degree. The six engineering majors were reduced to three technology majors: electrical, mechanical, and surveying. (The surveying major later became a

major in civil engineering technology.) The Tennessee Higher Education Commission granted approval to offer the degree Bachelor of Science in Engineering Technology the following spring. The program received ABET/TAC accreditation in 1976 and maintained the accreditation until it was discontinued in 1997.[1]

In early 1994, at the request of UT Martin constituents, a study team was appointed to assess the need by employers and the demand by students for engineering technology and engineering at UT Martin. A final recommendation was made in January 1995 to terminate the three engineering technology degree programs and to replace them with a single B.S.E degree. The program was to be built with no separable majors and was to be consistent with goals set forth in the ASEE report, *Engineering Education for a Changing World,* (Fall 1994).[2] The University of Tennessee system also imposed the requirement that the program be unique and different from any other engineering program in the state. In order to meet this requirement and with the full support of the UT Martin engineering faculty and central administration, passing the Engineer in Training (now the Fundamentals of Engineering) examination was set as a degree requirement. Inclusion of this requirement was vital to the approval of the program. At the time of the program development, no consideration was given to using the FE scores as a program improvement tool, although it was viewed as a means to validate the content and rigor of the program. Since the B.S.E program was developed as a general engineering program, including the passing of the general FE examination was consistent with the goal of graduating engineers who would have a broad understanding of the basic fundamentals of engineering.

The Bachelor of Science in Engineering degree was approved by the University of Tennessee system in June 1995 and received final approval by the Tennessee Higher Education Commission in July 1996. Students had been allowed to take a limited number of junior courses as the final program approval was sought. This resulted in the first graduates from the program in May 1997. The program received ABET/EAC accreditation in 1999. This accreditation was granted under pre-EC2000 guidelines.

The ABET Assessment Committee was formed by the UT Martin Engineering Department in the fall of 2001 with the charge of preparing for the next accreditation visit in 2004-2005. The complete overhaul of accreditation criteria that resulted in the EC2000 Guidelines necessitated the development of program objectives and outcomes. The department's adopted outcomes and objectives are monitored by analysis of the FE results, alumni surveys, employer surveys, and departmentally developed assessment tools.

The FE results are used extensively to monitor the ability of UT Martin engineering graduates to perform basic engineering and economic analysis. Secondary use involves using the results to monitor for a basic understanding of ethics. This paper concentrates on the use of the FE examination scores and problems associated with the use of those scores.

Curriculum

The total hours required for the B.S.E degree are 128. In 1999, concentration area electives were approved and published in the University catalog. The total number of elective hours required was set at 21 hours at that time. At the urging of faculty, students, and employers, the designation on a student's transcript of an area of concentration was also approved. The four

concentrations of civil, electrical, industrial, and mechanical were now established as the *de facto* majors within the degree. The number of concentration elective hours was increased in 2001 to 24 hours and again increased in 2004 to a total of 27.

In addition to the electives in a concentration area, each student is required to complete a yearlong senior research/design sequence of four semester hours. This sequence allows the student to work on an engineering design problem (project) requiring integration of previous knowledge and possibly the acquisition of new knowledge relevant to the concentration area.

The remaining 97 semester hours are comprised of 45 semester hours of engineering core courses and 51 semester hours of general education requirements.[3] Table 1 lists the topics covered on the general FE examination prior to the recent test modification that became effective in the fall of 2005, and the corresponding courses and number of credit hours in the program.

Table 1. General FE Exam Topics and Corresponding Program Required Courses

FE Topic	Program Courses	Total Credit Hours
Chemistry	General Chemistry (CHEM 121 & 121L)	4.0
Mathematics	Calculus Sequence, Differential Equations, and Probability & Statistics (MATH 251, 252, 320, ENGR 315 and ENGR 311)	18.0
Solid Mechanics	Physics of Kinematics & Kinetics (PHYS 220 & 220L), Statics (ENGR 121), Strength of Materials (ENGR 220), and Dynamics (ENGR 241)	13.0
Fluid Mechanics and Thermal Sciences	Thermodynamics (ENGR 340) and Fluid Dynamics (ENGR 341)	6.0
Electricity, Magnetism, and Computers	Physics of Electricity and Magnetism (PHYS 221 & 221L), Digital Logic (ENGR 231 & 231L) and Analog Circuits (ENGR 232 & 232L)	11.0
Materials and their Properties	Engineering Materials (ENGR 310 & 310L)	3.0
Engineering Economy	Engineering Economy (ENGR 380)	3.0

Note that all engineering specialties are required to complete all courses in this table. With the recent modifications to the FE exam, biology and heat transfer are now included in the test. Currently, students are not required to take a biology course, and only the mechanical engineering students are required to take a course in heat transfer. However, even with this modification to the FE exam, students completing the engineering core courses should be well prepared to pass the general form of the Fundamentals of Engineering Examination.

FE Examination Performance Trends

Engineering students matriculating at UT Martin were first allowed to take the FE examination in the fall of 1996. Because the program was new, there was a small number of students that were graduating, thus there was a small number taking and passing the exam. The students maintained a 100% pass rate for the first several semesters. Obviously, the University as a whole took great pride in this excellent accomplishment, and these early years of unblemished success

set a high standard. As the number of students in the program increased, some students were not successful on their first attempt at the examination. Figure 1 shows the number of students that took the FE exam and the pass rate of those students that were first time takers, for each semester beginning in the fall of 1996 through the most recent exam in the fall of 2005. In addition, the numbers of students and corresponding pass rates for those students who have sat for the FE exam for two or more times are shown in Table 2.

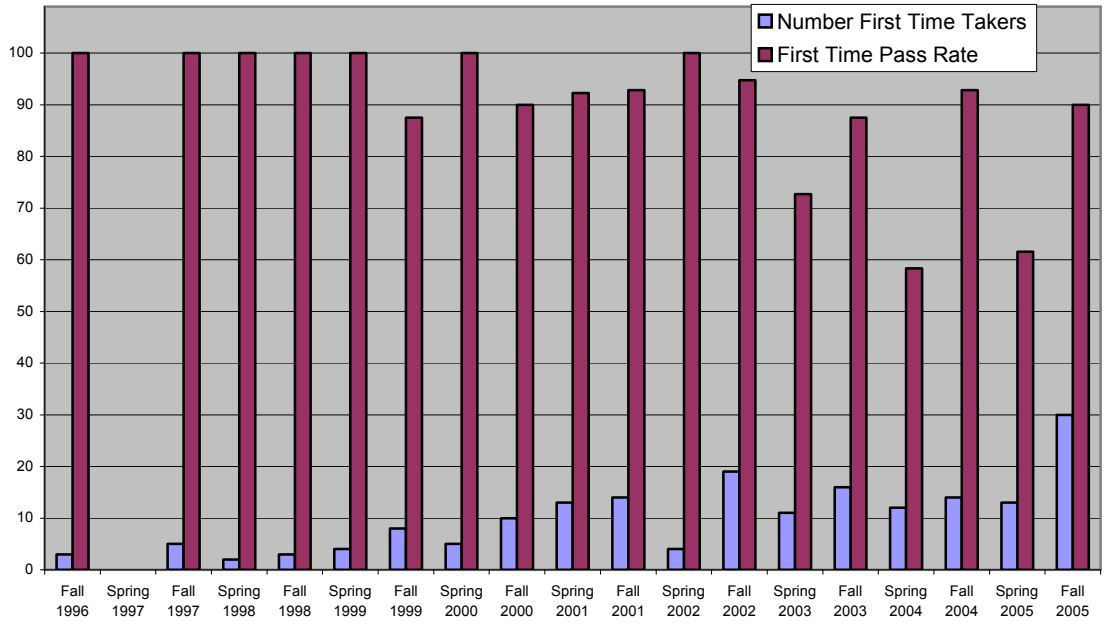

Figure 1. First Time FE Pass Rate and Number of Test Takers

Table 2. Numbers of Repeat FE Exam Takers and Pass Rates

Test Date	Total 2nd time takers	2nd time pass rate	Total 3rd time takers	3rd time pass rate	4th or 5th time takers	4th or 5th time pass rate
Spring 2000	1	100.00				
Fall 2000						
Spring 2001						
Fall 2001	2	50.00				
Spring 2002			1	100.00		
Fall 2002	1	100.00				
Spring 2003	1	0.00				
Fall 2003	3	66.67	1	100.00		
Spring 2004	2	100.00	1	0.00		
Fall 2004	5	40.00			1	0
Spring 2005	1	0.00	3	66.67	1	0
Fall 2005	4	20.00	1	0.00	1	0

A number of observations can be made from examining Figure 1 and Table 2:

- First time pass rate has decreased as the number of students has increased.
- For a given semester, the pass rate does not necessarily decrease as the student number increases.
- For the past three years the, the pass rate in the spring is significantly lower than the fall pass rate.
- As the first time pass rate has decreased, there are a small group of students who have not passed the exam by the time they have completed all their courses.

When the low pass rate of spring 2003 was observed, the chair of the department immediately began a study to identify the causes of the poor performance. The purpose of this study was to propose recommendations and implement changes to the program that would ensure that each student who meets the other requirements of the program would be capable of passing the FE examination. This detailed study and the resulting recommendations are discussed in a subsequent section.

During this same period of time, the detailed National Council of Examiners for Engineering and Surveying (NCEES) report that is provided from each semester's examination results had been incorporated into a newly developed ABET EC2000 assessment and improvement process. The Engineering Department faculty was not only concerned with the overall pass rate but was also tracking the performance of each test group in each of the specific subject areas of the test and using these results to measure whether program objectives were being met. Student success on the FE examination had become very important to the department and the University.

The Use of FE Test Results in ABET EC2000 Outcomes and Their Assessment

Following the development of the continuous assessment and improvement process, 26 outcomes were developed that mapped to the ABET required outcomes a through k. Initially, the FE results were used to assess the following outcome as adopted by the faculty and constituents of the UT Martin Engineering Department:

> *Outcome C: At the time of graduation, graduates will have an ability to formulate and perform basic engineering analyses.*

Following an ABET visit in February of 2005, the faculty modified the outcome as follows:

> *Outcome B: At the time of graduation, graduates will have an ability to formulate and perform basic engineering analyses and economic assessment.*

Since all UT Martin engineering students are required to pass the FE prior to graduation, this test provides a basis to evaluate the student's ability to formulate and perform basic engineering analysis. The subject areas of interest were determined to be: chemistry, computers, dynamics, electrical circuits, engineering economics, ethics, fluid mechanics, material science, mathematics, mechanics of materials, statics, and thermodynamics.

The specific exams used in this assessment metric are the A.M. exam, and the General Engineering P.M. exam, of the FE administered by the NCEES. In each subject area listed above, a ratio of the average UTM "percent correct" exam score divided by the national average

"percent correct" exam score is computed for the group of students that took the exam. The numbers used to compute this ratio are found under the "Special Code Average Percent Correct" and the "Nat'l Average Percent Correct" columns of Report 6, Subject Matter Report by Major/All Majors Combined, published by NCEES.

When the "normalized" scores are plotted, they show significant amounts of fluctuation. In order to make trends easier to identify in the data, a moving average based on four examinations is calculated and plotted.

The metric for Outcome B is the moving average of the "normalized" scores for the four most recent examinations taken by the UT Martin students, evaluated for each of the 12 subject areas. The metric goal for Outcome B is that the moving average ratio for each of the listed subject areas will be greater than or equal to one. That is, the performance will be at least as good as the national average.

Figure 2 is an example of a normalized ratios graph. Table 3 summarizes the tabulated data used in the graph.

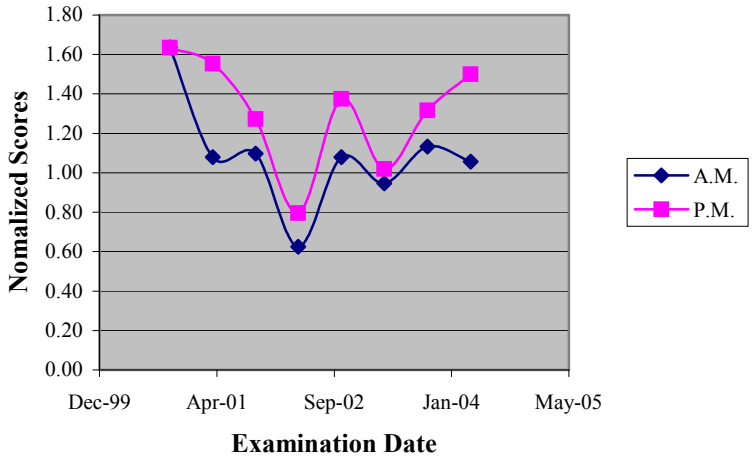

Figure 2. UTM scores for Engineering Economy normalized by the national average.

Table 3. UTM raw scores and normalized by national average scores for Engineering Economy

A.M.	**OCT-00**	**APR-01**	**OCT-01**	**APR-02**	**OCT-02**	**APR-03**	**OCT-03**	**APR-04**
UTM	90	68	68	40	68	53	68	56
Nat'l Avg	55	63	62	64	63	56	60	53
Normalized	1.64	1.08	1.10	0.63	1.08	0.95	1.13	1.06
P.M.								
UTM	67	59	42	39	77	52	54	60
Nat'l Avg	41	38	33	49	56	51	41	40
Normalized	1.63	1.55	1.27	0.80	1.38	1.02	1.32	1.50

Figure 3 is an example of a moving average graph. Table 4 summarizes the tabulated data used in the graph.

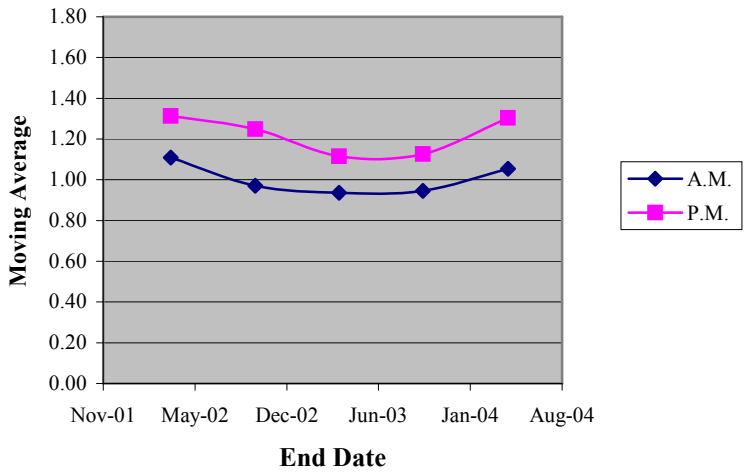

Figure 3. Moving Average of UTM scores for Engineering Economy normalized by the national average.

Table 4. Normalized UTM scores and moving averages for Engineering Economy

A.M	**OCT-00**	**APR-01**	**OCT-01**	**APR-02**	**OCT-02**	**APR-03**	**OCT-03**	**APR-04**
Normalized	1.64	1.08	1.10	0.63	1.08	0.95	1.13	1.06
Moving Avg				1.11	0.97	0.94	0.95	1.05
P.M.								
Normalized	1.63	1.55	1.27	0.80	1.38	1.02	1.32	1.50
Moving Avg				1.31	1.25	1.12	1.13	1.30

During each evaluation period (every third year), the ABET Assessment Committee collects and computes the metric information and identifies those areas in which the outcome goal has not been achieved. It also identifies subject areas in which adverse trends are observed. This information along with any previous actions taken by the faculty to affect the metric is reported to the faculty in the next Assessment Report.

Detailed Analysis of Student Preparedness to Sit for the FE Exam

Since the program inception, engineering faculty members have conducted FE review sessions each semester. These review sessions typically take place two evenings per week from the beginning of the semester until just prior to the examination. Each session lasts two hours, and a faculty member who is proficient in the subject area volunteers to cover one or more sessions. Faculty members from both mathematics and chemistry have also been active in these sessions. Students are encouraged, though not required, to attend the sessions. Although no clear evidence exists that the review sessions are helpful, the general consensus among both students and faculty is that the sessions have positively impacted the students' performance on the exam.

Prior to 2003, a full, eight-hour sample test was given to each student at the end of the review course, immediately before the actual exam. In 2003, when the pass rate declined noticeably, the department chair decided to give the sample test at the beginning of the semester, and the results of this test were used to structure the content of the review sessions for the semester. Thus, additional emphasis could be placed on areas in which the students performed poorly. The decision was made to use an on-line sample test that the department pays for beginning with the fall semester of 2004. An analysis of the scores on the sample test to the actual scores on the FE exam has shown that the two are largely uncorrelated.

The study that began in late 2003 took a close look at the sequence in which individual students took courses. Under the assumption that students fail the FE examination because they do not know the material, the study revealed that in many cases students put off particular engineering courses that they feel are not relevant to their engineering concentration. For example, civil students would often delay taking electronics and circuits, and electrical students would delay taking strength of materials and dynamics. In other cases, students would often delay taking courses that they had difficulty with or perceived as too challenging. For example, courses such as the third calculus (multi-variable) course and the second physics course were delayed. In an effort to address this problem, beginning in the fall of 2004, a student was only allowed to sit for the FE examination if he/she had completed all the courses covered on the examination, which are listed in Table 1.

Also, the observation was made that in numerous cases students would enroll in and take a particular engineering course without having completed the prerequisites with the required minimum grade of C. A computer-based system has been subsequently implemented that clearly flags all students in engineering, science, and mathematics courses on the first day of class that do not have the required prerequisites. These students must obtain a waiver signed by the course instructor, the student's advisor, and the department chair in order to remain enrolled in the class.

Most recently, the engineering faculty has revisited all prerequisites in the program and has made changes to several courses. The faculty has adopted the philosophy that the purpose of prerequisites is to ensure that the student has the necessary skills and knowledge to be successful in a course. Previously, some faculty and administrators had viewed prerequisites as a method to control student flow through the program. The current departmental faculty agreed that program flow was best controlled through effective advising. To support this philosophy, a new comprehensive advising system was implemented in the fall of 2004.

After these changes had been implemented, some students who appeared to meet these constraints still failed the exam. At the end of the fall semester of 2004, a more detailed study was undertaken. In an effort to more closely examine each student's preparedness for the FE examination, student performance in each of the FE-related courses was examined. Specifically, the study was interested in not only what grades a student earned, but also how many times he/she took a course before successfully earning a grade of C or better. Data was accumulated on all students that have taken the FE examination since the inception of the B.S.E program. For each student, the following information was obtained from his/her records: GPA, number of attempts and the grade earned for each attempt for each of the seventeen core, FE-related courses

presented in Table 1, how many times he/she took the FE exam, and what was the exam score each time.

The first question was whether a student's overall GPA is a predictor of success on the FE exam. The results of this analysis are shown in Table 5. As one might expect, a student with a higher GPA is more likely to pass the exam on the first attempt, and as the GPA goes down, so does the chance of passing on multiple attempts. In addition, the average GPAs of students who fail the exam are generally below the average GPAs of those students who pass. However, many students with much lower GPAs have passed, and students with higher GPAs have failed.

Table 5. GPAs of Students who Pass or Fail the FE Examination

	Overall GPA	**Standard Deviation**
GPA first time pass	3.18	0.46
GPA second time pass	2.72	0.40
GPA third time pass	2.61	0.17
GPA first time fail	2.64	0.36
GPA second time fail	2.58	0.15
GPA third time fail	2.56	0.16
GPA fourth time fail	2.56	0.23

Although these results are instructive, they do not help in constructing a filter that will remove the students who will likely fail the examination when they reach their senior year. Hopefully, such a filter would not remove a weaker student who through hard work and diligence would be able to pass the exam.

When the detailed grade sheets for each student who has taken the FE exam were compiled, some interesting patterns emerged. A typical section from that analysis is shown in Table 6. (Multiple letters, *e.g.* FFC, indicate multiple attempts in the course.) This table shows the grades earned in nine of the 17 FE-related courses that are required in the program. These are grade histories of some students who failed the exam one or more times. Of course, it is not unusual for a student in engineering to repeat a course. However, at UT Martin, the GPA that is reported on the transcript is based on the most recent grade earned in a course. Thus, the GPAs for the second and sixth row students in Table 6 would reflect actual courses taken since these students did not repeat any course. The GPAs for all the other students in Table 6 will be artificially higher than a true GPA reflecting all the attempts made. Since this GPA computation is unalterable due to computer constraints in the program that archives the grades, this presents a unique problem in terms of predicting success in passing the FE exam for the program.

Table 6. Grades Earned in Representative Courses by Students Who Have Failed the FE Exam

Student	Physics I	Physics II	Calculus I	Calculus II	Calculus III	Statics	Strength of Materials	Circuits	Dynamics
1	DC	C	FA	A	C	B	C	C	B
2	C	B	B	C	C	A	A	C	B
3	B	C	FC	C	DB	B	C	DC	C
4	C	FC	BC	DC	C	C	C	B	C
5	DC	C	C	FC	FC	DC	DC	C	B
6	C	C	C	C	C	B	A	C	B
7	B	C	CC	FFC	FDD	C	C	C	B
8	C	C	C	FC	C	C	C	C	C
9	C	C	FDC	C	D	DDA	C	DC	C
10	C	DC	C	DC	C	C	C	C	DDB

It was further observed that in many cases students who subsequently either failed the FE or showed signs of weakness as they progressed through the program had repeated a subset of the core math, science, and engineering courses more often. This subset of core courses includes Physics I and II, Calculus I, II, and III, Statics, Strength of Materials, and Dynamics. These eight courses may be viewed as gateways into the four specialties of civil, electrical, industrial, and mechanical engineering. In an effort to gain more insight into the "real" performance of the students, the real GPAs for these eight courses were computed for each student using all attempts. In addition, each student who had repeated any of these eight courses more than twice was also flagged. The results of this analysis are summarized in Table 7.

Table 7. FE Performance based on the real GPA in core courses and number of repeats

Student group	Number of Students	Percent with Core Eight-course GPA > 2.0	Percent that Took Any of the Core Eight-courses No More than Twice
Passed on 1st attempt	143	84.6%	87.4%
Passed on 1st or 2nd attempt	155	83.9%	86.5%
Passed on 1st, 2nd, or 3rd attempt	159	83.0%	86.8%
Failed on 1st attempt	26	57.7%	76.9%
Failed on 2nd attempt	10	30%	70%
Failed on 3rd attempt	3	0%	33%
Failed on 4th attempt	2	0%	0%

The data in Table 7 indicates that a real GPA less than 2.0 in the eight identified core courses does a good job of predicting failure. Analysis of the data further determined that only one of all the students that have earned at least a 2.0 real GPA in these eight courses has failed to pass the

FE with either one or two attempts. That equates to a 99.2% (132 out of 133 students) probability of passing in at most two attempts if the student has a real GPA of at least 2.0! This fact is even stronger evidence of a link between the success in the eight core courses and successfully passing the FE exam.

If all students had been required to earn at least a 2.0 real GPA on these eight courses to continue in the degree program, then from Table 7 it would appear that the 17% (100% - 83.0%) of the 159 students who passed the exam on their first, second, or third attempts would have been terminated from the program. This would have resulted in 27 fewer graduates if this rule had been in effect. Because implementation of such a rule is being considered, a more careful examination of these 27 students is warranted.

The UT Martin program is small, with high student/faculty interaction, and thus the faculty has been able to clearly recall these 27 students. The students have been grouped into the five categories shown in Table 8. These five groupings identify students that:

- Were poorly prepared when they entered the program.
- Barely passed their classes, relying on their friends for homework and projects.
- Tended to be academically unmotivated; and though they have the ability, they perform at a low level, setting their goal at a C in a course but instead often earning an F or D on their first attempt.
- Committed too much time to part-time jobs, resulting in quitting a course after the drop date or simply failing the course.
- Had professionally evaluated and verified test-taking/learning disability.

In addition, there are currently six students who have failed the FE exam at least twice. Of these students, all but one has a real GPA in the eight-course group below 2.0. These students are also included in Table 8. Based on these groupings, the conclusion might be drawn that if this rule had been in effect, all but a few of the 27 graduates could have successfully completed the program if they had changed their academic attitudes. The five students who were poorly prepared from high school would have needed extra help before they began the core set of courses. It is entirely possible that the marginal students that were either unmotivated or poorly prepared might have been able to achieve a 2.0 GPA if they were aware of the consequences.

Table 8. Poor Students that have passed the FE, or not passed and failed two or more times

Student Description	**Passed With a GPA < 2.0 (27 Students)**	**Not Yet Passed with Multiple Attempts (6 Students)**
Poorly prepared from high school	5	
Verifiable learning disability	0	1
Rely on friends to complete work	2	2
Academically unmotivated	17	2
Too many commitments	3	1

Recent Changes to Improve First Time Pass Rate

Some of the actions taken to improve the performance on the FE have been discussed. While the yearlong study that resulted in the observations made in the previous section was being performed, increasing pressure from the University administration was being applied to improve the first-time pass rate. This metric is used by the state higher education system for formula funding, and the low pass rates on the spring semester exam were of particular concern. The low pass rate in the spring has been hypothesized to be due in large part to the time commitment required of the students to successfully complete their yearlong senior design projects. Because of staffing constraints, these projects only begin in the fall semester. A good deal of the work required to complete the projects occurs at the end of the spring semester which is when many of these students take the FE exam. The students who take the FE in the spring semester usually plan to graduate the following fall semester, whereas students who take the FE in the fall tend to graduate the following spring. Thus, those students who graduate in the fall must both pass the FE in the spring and complete their senior projects.

Based on these observations, effective in the spring of 2006, students who wish to sit for the FE must earn at least a 50% raw score on a sample FE exam given at the end of the previous semester. Students are also encouraged to take the FE review course the semester before they plan to take the FE exam. The intent is that students who wish to take the exam in a given semester should prepare for the exam the previous semester. If they fail the sample test, they have the break between semesters for additional study, and then they can retake the sample test before the FE registration deadline. If they do not pass the sample test, then they must wait until the semester of graduation. The students are not pleased with this modification, although they fully appreciate the importance of passing the test on their first attempt.

Recommendations

Under the assumption that the FE remains a program requirement, there are three student groups that must be considered: those who have already completed all courses but have not passed the exam (six students), those currently enrolled in the program (250 students), and those who have not yet entered our program.

Students who have completed all courses

The policy currently in effect is if a student has a verifiable test-taking/learning disability, the student can request a waiver of the requirement to pass the FE. All of the following criteria must be met: 1) the disability is verified and documented by a professional psychologist, 2) the student has failed the state administered FE examination at least three times, and 3) the student is competent in all of the FE subject areas, demonstrated by passing third-party administered subject area tests that accommodate the test-taking/learning disability. The departmental Degrees Committee and the faculty of the Engineering Department must approve the waiver. Clear and convincing evidence of the disability must be presented before the faculty of the department will agree to consider such a waiver. This waiver has been requested by and granted for only one student. The remaining five students that have not passed the exam have been encouraged to take the FE review course and spend their free time studying for the exam. At this time there are no discussions concerning waiver of the requirement for any of the five students. Without the waiver, these students will not receive their engineering degree from UT Martin

until they have passed the FE exam. The option to transfer to another school and take the last thirty hours of an engineering degree program and earn their degree is also available to them.

Students currently enrolled in the program

Transcript analysis of the current engineering student population is being carried out to identify those students that are at risk based on the real GPA of the eight-course core group previously discussed. Students with less than a 2.0 GPA in these courses will be strongly encouraged to retake specific courses to raise this average. Table 9 shows a comparison of the real GPA in these courses between all students who have passed the exam and those six who have not. This table clearly illustrates the importance of math, physics, and the first engineering courses that require the student to apply math and physics skills to solve engineering problems.

Table 9. Comparison of Real GPA in Core Courses

	Average Real GPA for Eight Identified Core Courses that Predict Success On the FE Examination							
Course	Physics I	Physics II	Calculus I	Calculus II	Calculus III	Statics	Strength of Materials	Dynamics
Students that have passed	2.58	2.47	2.71	2.53	2.41	3.07	2.85	2.88
Students that have failed	2.08	1.92	1.83	1.36	1.44	2.08	2.25	2.44

Future Students

Students entering the engineering program will be required to earn a real GPA of at least 2.0 in the eight core courses identified in Table 9 before being permitted to enroll in upper division engineering courses with the exception of ENGR 315 Analysis I, Differential Equations and ENGR 380, Engineering Economy. Effective faculty advising/mentoring will be necessary to ensure that all students understand the importance of their success in these courses. This is possible because the engineering faculty performs all advising/mentoring.

Conclusion

The UT Martin Engineering Department will continue to track and study trends in performance of the FE examination as mandated by its assessment and improvement process. The engineering faculty is steadfastly committed to the requirement that each student pass the FE exam in order to graduate. They are also committed to taking any necessary and appropriate steps to ensure the success of the students on the exam. The requirement that a student earn a real GPA of at least 2.0 in the subset of core courses will be fully implemented by the 2006 fall semester. The faculty believes in this requirement and is fully committed to the success of its students.

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