ABET
Self-Study Report

for the

Biosystems Engineering Program

at

University of Kentucky

Lexington, KY

July 2010

CONFIDENTIAL

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## TABLE OF CONTENTS

### BACKGROUND INFORMATION
- A. Contact Information ................................................................. 5
- B. Program History ........................................................................ 5
- C. Options ......................................................................................... 6
- D. Organizational Structure .............................................................. 6
- E. Program Delivery Modes ............................................................... 7
- F. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them ........................................... 7

### CRITERION 1. STUDENTS
- A. Student Admissions ................................................................. 8
- B. Evaluating Student Performance .............................................. 9
- C. Advising Students ................................................................. 11
- D. Transfer Students and Transfer Courses ............................... 11
- E. Graduation Requirements ................................................... 12
- F. Enrollment and Graduation Trends ........................................ 13

### CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES
- A. Mission Statements ................................................................. 15
- B. Program Educational Objectives ............................................ 16
- C. Consistency of the Program Educational Objectives with the Mission of the Institution ......................................................... 16
- D. Program Constituencies ........................................................... 16
- E. Process for Establishing Program Educational Objectives ........ 16
- F. Achievement of Program Educational Objectives ................ 19

### CRITERION 3. PROGRAM OUTCOMES
- A. Process for Establishing and Revising Program Outcomes .......... 22
- B. Program Outcomes ................................................................. 23
- C. Relationship of Program Outcomes to Program Educational Objectives ................................................................. 24
- D. Relationship of Courses in the Curriculum to the Program Outcomes ................................................................. 25
- E. Documentation ................................................................. 25
- F. Achievement of Program Outcomes ........................................ 25

### CRITERION 4. CONTINUOUS IMPROVEMENT
- A. Information Used for Program Improvement ......................... 27
- B. Actions to Improve the Program ............................................ 28
- C. Yearly Continuous Improvement Procedure .......................... 30

### CRITERION 5. CURRICULUM
- A. Program Curriculum ................................................................. 31
- B. Prerequisite Flow Chart .......................................................... 36
- C. Course Syllabi ............................................................................. 37

### CRITERION 6. FACULTY
- A. Leadership Responsibilities ..................................................... 38
- B. Authority and Responsibility of Faculty .................................. 38
- C. Faculty ......................................................................................... 38
- D. Faculty Competencies ............................................................. 43
- E. Faculty Size ................................................................................. 43
- F. Faculty Resumes ......................................................................... 44
- G. Faculty Development .............................................................. 44

### CRITERION 7. FACILITIES ........................................................................ 48
A. Departmental Space .................................................................48
B. Resources and Support ............................................................48
C. Major Instructional and Laboratory Equipment ....................49

CRITERION 8. SUPPORT .............................................................................................................................50
A. Program Budget Process and Sources of Financial Support ........50
B. Sources of Financial Support ....................................................50
C. Adequacy of Budget ................................................................50
D. Support of Faculty Professional Development .......................50
E. Support of Facilities and Equipment .......................................51
F. Adequacy of Support Personnel and Institutional Services .......51

CRITERION 9. PROGRAM CRITERIA .........................................................................................................52

APPENDIX A - COURSE SYLLABI ...............................................................................................................53
APPENDIX B - FACULTY RESUMES ...........................................................................................................77
APPENDIX C – LABORATORY EQUIPMENT ...............................................................................................113
APPENDIX D – INSTITUTIONAL SUMMARY ............................................................................................114
APPENDIX E - SUPPORTING DOCUMENTS .............................................................................................115

Alumni Survey Instrument ..........................................................115
BAE Advisory Council Bylaws .......................................................118
Advisory Council Meeting Minutes ..............................................121
ABET Subcommittee Meeting after Advisory Council Meeting ....124

APPENDIX F – DATA FOR ASSESSING PROGRAM OBJECTIVES ..............................................................125
APPENDIX G – DATA FOR ASSESSING OUTCOMES ................................................................................126

LIST OF TABLES

Table 1. (ABET Table 1-1) History of Admissions Standards for Freshmen Admissions for Past Five Years. .........................8
Table 2. (ABET Table 1-2) Transfer Students for Past Five Academic Years .........................................................12
Table 3. (ABET Table 1-3) Enrollment Trends for Past Five Academic Years .......................................................13
Table 4. (ABET Table 1-4) Current Employment of Program Graduates from December 2008 through May 2010.................................................................14
Table 5. Standards and Goals for Objectives, Shown with Justifications. ..............................................................18
Table 6. Achievement of Objectives (the data are contained in Appendix F). The percentages are all based on the 67 surveys returned .........................................................21
Table 7. Biosystems Engineering program Outcomes with Primary Metrics ..........................................................23
Table 8. Courses where Outcomes are Assessed ................................................................................................25
Table 9. Outcome Assessment Results for the 2008-2009 Yearly Assessment .....................................................26
Table 10. Actions to Improve Program Instigated by the UGCC .................................................................28
Table 11. Actions to Improve Program Instigated by the Instructors as a Result of Outcome Assessment .................................29
Table 12. (ABET Table 5-1) BAE Curriculum .................................................................32
Table 13. Percentage of Course Dedicated to each Outcome .................................................................................34
Table 14. (ABET Table 5-2) Course and Section Size Summary .................................................................37
Table 15. (ABET Table 6-1) Faculty Workload Summary .................................................................39
Table 16. (ABET Table 6-2) Faculty Analysis .........................................................................................41
Table 17 Professional Development of the BAE Faculty .................................................................45
Table 18. (ABET Table 8.1) Support Expenditures ...................................................................................51
Table 19. FE, PE, and Membership Data for Objective Assessment. ................................. 125
Table 20. Employment and Salary Data for Objective Assessment. ...................................... 125
Table 21. Normalized scores of BAE students on FE exam (Outcome 4 sections)................. 130
Table 22. Student activity in extra-curricular clubs and organizations. .............................. 144

LIST OF FIGURES

Figure 1. Organizational Administrative Structure of the Biosystems Engineering Program...... 6
Figure 2. Advising and Progress Evaluation of Students. ..................................................... 9
Figure 3. University of Kentucky BAE Graduates since 1999. Averages for 1998-2009 and 2004-2009 are also shown (*). ........................................................................................................ 13
Figure 4. Average Ratings from the Alumni Survey Divided by Graduation Year. ............... 19
Figure 5. BAE Students Taking and Passing FE Exam since 1998....................................... 20
Figure 6. Percentage of BAE graduates, since 1998, who are Professional Engineers (PE). The latest five years of data are omitted due to the amount of time it takes to get a PE. ............. 20
Figure 7. Average Starting (adjusted to 2009 dollars) and Current Salaries. ....................... 21
Figure 8. Continuous Improvement Process Model for the BAE Program. .......................... 27
Figure 9. Biosystems Engineering Prerequisite Mapping.................................................... 36
Figure 10. Normalized scores of BAE students in mathematics on FE exams, 2005-2009. ..... 127
Figure 11. Normalized scores of BAE students in computer usage on FE exams, 2004-2009. 128
Figure 12. Average grades of BAE students on oral and written reports in the capstone design course, 2004-2009................................................................. 134
Figure 13. Normalized scores of BAE students in ethics on FE exams, 2005-2009. ......... 142
BACKGROUND INFORMATION

A. Contact Information
The pre-visit contact person is:
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B. Program History
The Department of Biosystems and Agricultural Engineering (formerly the Department of Agricultural Engineering) at the University of Kentucky began its professional engineering curriculum with seven upper class transfer students and the first freshman class of three students in the fall of 1957. The department immediately sought to join the other engineering programs at the University of Kentucky in seeking accreditation of undergraduate engineering programs granting Bachelor of Science degrees by what was then the Engineers' Council for Professional Development (ECPD). Through May 2010, the program has granted over 400 B.S. degrees.

The American Society of Agricultural and Biological Engineers (ASABE), formerly the American Society of Agricultural Engineers, has collaborated with the ECPD and, more recently, with ABET Inc. in prescribing the body of knowledge which must be mastered by students receiving B.S. degrees in Agricultural, Biological, and Biosystems Engineering.

Bachelor of Science degrees in Agricultural Engineering were granted from 1957 to 1991, which culminated in senior-level design courses in the four traditional technical areas of Power and Machinery, Soil and Water, Structures and Environment, and Agricultural Processing. In 1991, a major curriculum revision added two semesters of general biology and microbiology to the undergraduate degree requirements. Some traditionally required engineering science courses, such as dynamics and electrical engineering, as well as the traditional departmental design courses were not required. Instead, students selected seven technical electives to develop individualized curricula with greater specialization and focus. The degree name changed to Bachelor of Science in Biosystems and Agricultural Engineering. Subsequent revisions of the curriculum replaced microbiology with a biological elective, added dynamics, and required all students to take three of the four senior-level departmental design courses.
Program changes since the 2004 ABET site visit include adding a new course BAE 503, Fundamentals of Biorenewable Resources, to offer students a technical elective covering the essential aspects of this emerging area of technology. Finally, in 2008, the faculty of both the BAE Department and the College of Engineering (COE) voted to change the name of the degree to Bachelor of Science in Biosystems Engineering. The first UK degrees in Biosystems Engineering were awarded in December 2009.

C. Options
The degrees offered by the University of Kentucky Department of Biosystems and Agricultural Engineering are:

a. Bachelor of Science in Biosystems Engineering (BSBN)
b. Master of Science in Biosystems and Agricultural Engineering (MSBAE)
c. Doctor of Philosophy (Ph.D.)

The areas of specialization offered are:

a. Bioenvironmental Engineering
b. Food and Bioprocess Engineering
c. Machinery Systems Automation Engineering
d. Controlled Environmental Systems
e. Pre-Biomedical Engineering
f. Pre-Veterinary Medicine

D. Organizational Structure

The Department of Biosystems and Agricultural Engineering is a part of the College of Agriculture (COA) and the College of Engineering (COE), as shown in Figure 1. Faculty funding, promotion, and tenure fall under the purview of the College of Agriculture while undergraduate education is administered by the College of Engineering.
E. Program Delivery Modes
The undergraduate program is a day program, occasionally extending into the late afternoon and early evening and delivered on the Lexington campus of the University of Kentucky. Courses consist of traditional lecture/laboratory experiences.

F. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them
The most recent ABET review of the program was in 2004. The department had implemented the continuous program improvement process with a limited history. The weaknesses and concerns regarding Criteria 2, 3 and 6 were noted in the 2004 review as resolved. The program was accredited through 2010; however, a Program Concern was noted regarding Criterion 4: Professional Component. The review noted a lack of consideration of non-technical topics such as safety, environmental, sociological and economic issues appearing in the capstone design course reports. While incorporation of some of these topics in specific projects can be challenging, a concerted effort has been made to implement these non-technical topics, whereby student design teams are required to consider these issues in their design development. Generally, safety and economic considerations are addressed, with social and environmental issues addressed as appropriate. The general quality of the design projects has been excellent as evidenced by student design teams placing second (twice) and third in the American Society of Agricultural and Biological Engineers AGCO Student Design Competition since the 2004 review.

The department has fully and formally implemented the Continuous Improvement Process with regard to program educational objectives and outcomes. Although the assessment techniques change as the process matures, with regard to the achievement of educational objectives and outcomes, we remain resolute in the desire to continuously improve our educational effectiveness.
CRITERION 1. STUDENTS

A. Student Admissions

Prospective students at the University of Kentucky must complete a prescribed curriculum of high school credits (see Appendix D) and complete the ACT standardized test. Selective admission criteria are then applied based upon the number of seats available. Table 1 presents the ACT and SAT scores of freshmen admitted to the College of Engineering and specifying BAE as their major since 2005. These data, along with similar results in Appendix D, show that the quality of our incoming freshmen is comparable to the quality of those in the other engineering disciplines.

Table 1. (ABET Table 1-1) History of Admissions Standards for Freshmen Admissions for Past Five Years.

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Composite ACT</th>
<th>Composite SAT*</th>
<th>Percentile Rank in High School</th>
<th>Number of New Students Enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MIN. AVG.</td>
<td>MIN. AVG.</td>
<td>MIN. AVG.</td>
<td></td>
</tr>
<tr>
<td>2005-2006</td>
<td>19 24.9</td>
<td>- 910</td>
<td>18% 79.9%</td>
<td>8</td>
</tr>
<tr>
<td>2006-2007</td>
<td>23 26.8</td>
<td>910 1196.7</td>
<td>9% 75.2%</td>
<td>4</td>
</tr>
<tr>
<td>2007-2008</td>
<td>17 25.6</td>
<td>1080</td>
<td>16% 78.6%</td>
<td>17</td>
</tr>
<tr>
<td>2008-2009</td>
<td>20 25.9</td>
<td>1040 1200</td>
<td>9% 79.2%</td>
<td>15</td>
</tr>
<tr>
<td>2009-2010</td>
<td>20 26.1</td>
<td>1060 1085</td>
<td>12% 81.7%</td>
<td>14</td>
</tr>
</tbody>
</table>

*There are a small number of students taking the SAT.

Recruiting

Our program benefits from student recruitment activities organized by both the College of Agriculture and the College of Engineering. The College of Engineering Office of Student Support Services annually visits several locations throughout Kentucky and bordering states to recruit qualified students. Interested students and their families are brought to campus for activities in which the various engineering programs present opportunities in their respective disciplines. The College of Engineering also hosts an Open House during the annual Engineers Week; potential students and their families visit exhibits and projects, demonstrated by BAE students and faculty.

The UK College of Agriculture Office of Student and Academic Services also maintains an active student recruitment effort through the Director of Student Relations. Similar off-campus events are scheduled each year at which potential students can learn about the BAE program. Potential students are invited to campus each year to meet with faculty and students from various programs in the College.

The Department has an active Student Recruitment Committee that hosts students during various activities on campus. This committee also hosts students and their families on numerous tours of the Department throughout the year. Committee personnel seek to identify opportunities to meet with prospective students who have been invited to campus for a variety of programs. We believe that these efforts have been essential in maintaining incoming freshmen classes of approximately 15-20 students per year.
B. Evaluating Student Performance

A student’s performance in each class is summarized through the semester grade for the class. The University of Kentucky uses a 4.0 grading scale. The performance of individual students is then monitored through several processes. The processes of monitoring a student’s progress and advising the student are shown in Figure 2, and discussed below.

![Figure 2. Advising and Progress Evaluation of Students.](image)

**During Student Advising Each Semester**

Each semester, students must meet with their academic advisors in order to be able to register for classes for the following semester. Prior to these meetings, advisors have on-line access to the academic records for each student, indicating what classes have been completed, the grade received in each class, and the required classes that remain to be taken. In addition, the Department keeps student curriculum sheets, which are updated by the Departmental Student Services Coordinator each semester. Typically, during the advising appointment, the advisor and student discuss the student’s past performance, the courses that are in progress, and the courses that must be taken in order to complete the degree. In 2009, the University of Kentucky implemented mandatory mid-semester grades for all undergraduates. The university course drop-date is after the mid-term grades come out and after the advising appointments. Therefore, the advisor and student can have an informed conversation about the student’s progress that semester. The advisor also counsels students in regards to their summer plans and/or professional school applications.

**During Application to Engineering Standing**

Students are in “Pre Biosystems Engineering” standing when they enter as freshmen and remain approximately through the end of the first semester of their sophomore year. To move from Pre Biosystems Engineering to Biosystems Engineering requires that the student achieve
Engineering Standing. In Biosystems Engineering, Engineering Standing requires (from the 2009-2010 UK Bulletin) the following:

Requirements for Engineering Standing for Biosystems Engineering: “Completion of a minimum of 35 semester hours acceptable towards the degree in biosystems engineering with a minimum cumulative grade-point average of 2.50. Completion of ENG 104, MA 113, MA 114, MA 213, CHE 105 and PHY 231 with a minimum cumulative GPA of 2.5 in these courses. University repeat options may be utilized as appropriate. Students who do not meet these GPA requirements may request consideration based upon departmental review if both of these GPA values are 2.25 or greater.”

Students request Engineering Standing through the BAE Department Student Services Coordinator. Situations requiring departmental review are brought to the Director of Undergraduate Studies. Engineering Standing is necessary for the student to progress in the degree, as it is a prerequisite for several upper-level courses. The requirement for Engineering Standing works as an early stop in the program for students who are unlikely to meet graduation requirements.

Upon Academic Probation Review

The College of Engineering reviews students’ records each semester for academic probation or suspension issues. A student is placed on academic probation by the College of Engineering if he/she has a GPA of less than 2.0 for a given semester. A student who is on probation and fails to earn a 2.0 semester GPA in the following semester will be dropped from the College of Engineering and will not be readmitted until he/she has obtained a semester GPA of 2.0 or greater for one semester and the student’s cumulative GPA is 2.0 or greater.

In addition to the above three review processes, the college and university have implemented APEX (Academic Program Evaluation and eXploration), a computer-based system that compares a student’s academic work – at any point in the student’s career – with the requirements of the degree program. APEX prepares a comprehensive report detailing the student’s progress toward meeting those requirements. The reporting from APEX is available to both the student and the advisor, in order to monitor the progress of a student towards their degree. The Department of Biosystems Engineering became active on APEX prior to the start of the Spring 1999 semester. The report generated by APEX is used as a guide, but does not have final authority as some students have course equivalencies that the APEX system cannot recognize unless entered in the system separately. For example, many of our students take the Civil Engineering fluid dynamics course, followed by heat transfer taught in Mechanical Engineering, which has a pre-requisite of ME 330, the Mechanical Engineering fluid dynamics. The ME department accepts the Civil Engineering fluids course; however, APEX must be programmed to accept this course substitution.

Upon Application for Degree

During the registration and advising period prior to the last expected semester before graduation, the student must submit an Application for Degree. This initiates a review by the College of Engineering academic records staff to verify for that student that all requirements for graduation are expected to be met. The Criterion 5 section of this document contains more information on requirements for graduation in the Biosystems Engineering curriculum. Although the Application for Degree is due the semester prior to the student’s final semester, students are
asked to submit the application during the semester before, so that problems can be detected early enough that they might be rectified in the last semester.

A final review of the student’s progress is undertaken immediately after completion of the student’s final semester to ensure that all requirements have been completed before the degree is awarded.

C. Advising Students
Freshmen are enrolled in the College of Engineering and are advised by personnel in the Office of Student Support Services. The BAE Director of Undergraduate Studies (DUS) regularly confers with that office concerning students who have selected BAE as a major. The BAE curriculum includes freshman courses offered in BAE during both fall and spring semesters; our intention is to introduce our students to the BAE profession and to expose our students to the BAE faculty as well as to the types of support that are available in the department.

The BAE Director of Undergraduate Studies advises second year and transfer students until they either achieve Engineering Standing or select an area of curriculum specialization. Advising emphasizes satisfying requirements to achieve Engineering Standing in the BAE program. Sophomore courses offered in both the fall and spring semesters provide students with background in probability, statistics, and economics and provide continued exposure to the BAE facilities and faculty.

All BAE faculty have an area of specialization. When a student selects an area of curriculum specialization, a faculty member with the same specialization area will then advise the student. The areas of specialization within the BAE curriculum include: 1) bioenvironmental engineering, 2) food and bioprocess engineering, 3) machine systems automation engineering, and 4) controlled environmental systems. Students can also concentrate in pre-veterinary medicine or pre-biomedical engineering as preparation for pursuing advanced degrees in those fields. The BAE Director of Undergraduate Studies serves on the College of Engineering Undergraduate Studies Team and thereby serves as liaison between the BAE faculty and the College of Engineering regarding matters of undergraduate education. Usually during the fall semester of the student’s junior year, the student selects an area of specialization. At that time, the advising for that student is transferred from the DUS to a faculty member in the specialization area to assist the student in selecting appropriate technical electives and finding contacts for future job searches.

The Director of Undergraduate Studies or his/her designee advises all transfer students selecting the BAE program. The Associate Dean for Administration and Academic Affairs regularly schedules advising conferences for transfer students. The Director of Undergraduate Studies reviews student records and recommends courses during the transfer student’s initial semester of enrollment, until the student designates an area of specialization.

D. Transfer Students and Transfer Courses
Appendix D includes the policies regarding admittance of students transferring from other institutions to the University of Kentucky. Transfer students apply for admission through the University Registrar. Each transcript is reviewed and referred to the appropriate college. Students requesting admittance to the College of Engineering are referred to the Associate Dean for Administration and Academic Affairs.
Appendix D describes the methods employed by the University Registrar to validate credit hours transferred from courses taken at other institutions. Science, mathematics, writing, social studies and humanities courses taken at most community colleges in Kentucky are directly transferable. Most of the students transferring to the BAE program come from these institutions.

The University of Kentucky has established a list of equivalent courses with each college and university in Kentucky. The registrar analyzes transcripts of transfer students and assigns equivalent credit hours for courses completed. The Student Records Administrator refers all transcripts of transfer students desiring to major in the BAE program to the departmental Director of Undergraduate Studies, who also reviews the transcripts. The Director confers with each transferring student; they select courses for the next semester, discuss all transfer credit hours that were accepted and all that were denied. When the transferability of credit hours is in doubt, the Director of Undergraduate Studies can request that the applicant produce copies of syllabi of any courses in question for evaluation.

Table 2. (ABET Table 1-2) Transfer Students for Past Five Academic Years.

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Number of Transfer Students Enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-2006</td>
<td>0</td>
</tr>
<tr>
<td>2006-2007</td>
<td>2</td>
</tr>
<tr>
<td>2007-2008</td>
<td>1</td>
</tr>
<tr>
<td>2008-2009</td>
<td>1</td>
</tr>
<tr>
<td>2009-2010</td>
<td>1</td>
</tr>
</tbody>
</table>

E. Graduation Requirements
The Student Records Administrator in the College of Engineering determines whether each BAE major meets the undergraduate degree requirements of the College of Engineering. The BAE Director of Undergraduate Studies maintains a file for each BAE student to monitor courses taken and academic standing. The BAE Department maintains an Excel spreadsheet for each student, recording the completion of courses. This spreadsheet is the primary means by which the BAE Department monitors student attainment of Engineering Standing (see Appendix D). When BAE students achieve Engineering Standing, the Director of Undergraduate Studies advises the Student Records Administrator, who then confers that status. Engineering Standing status indicates that the student has shown potential to successfully complete the advanced courses offered by the College of Engineering.

The Student Records Administrator monitors all students in the College of Engineering relative to academic standing. The Associate Dean for Administration and Academic Affairs executes such actions as placing students on academic probation, dismissing students from the college, and readmitting students to the college in accordance with published academic requirements.

The Student Records Administrator certifies, by conducting degree audits, that each student in the College of Engineering meets all requirements for graduation. The Director of Undergraduate Studies and the Student Records Administrator resolve any questions concerning BAE students.

On average 14 students have graduated each year from the BAE program during the evaluation period (see Appendix D). The average number of students enrolled during that time was 67 students, or 13 students per class. The average graduation rate was approximately 80% of the
average number of freshmen enrolled (15 students/year) and was approximately 76% of the average enrollment per class. Thus, students transferring into the BAE program from other institutions, as well as other programs in the College of Engineering, tend to offset the attrition of students registering as freshmen.

F. Enrollment and Graduation Trends
The Department of Biosystems and Agricultural Engineering recruits and educates a diverse and capable student population. Approximately 64 students are currently registered in our undergraduate program, with female and minority components of 43% and 7.8%, respectively. The majority of our students are graduates of Kentucky high schools; however, we maintain a substantial component of out-of-state and international students. A majority of entering freshmen declare an interest in our pre-biomedical engineering program implemented in 1998-1999 as part of our major curriculum modification.

After moving into new facilities in 1990, the number of undergraduate students in our program more than doubled by the end of the decade and has remained relatively constant since 2000. Table 3 shows the enrollment trends for the past five academic years and Figure 3 shows total number of graduates each year, since 1998-1999. Class sizes have remained relatively small, from 24 in freshman courses to 5-15 in senior-level courses. With active student professional organizations and activities, our students and faculty maintain a camaraderie that would be difficult in larger programs. Students are encouraged to join the American Society of Agricultural and Biological Engineers (ASABE), Institute of Biological Engineering (IBE), or the American Society of Heating, Refrigerating and Air-Conditioning (ASHRAE) as part of their membership in the University of Kentucky BAE Student Branch.

Table 3. (ABET Table 1-3) Enrollment Trends for Past Five Academic Years.

<table>
<thead>
<tr>
<th></th>
<th>05-06</th>
<th>06-07</th>
<th>07-08</th>
<th>08-09</th>
<th>09-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-time Students</td>
<td>38</td>
<td>43</td>
<td>41</td>
<td>47</td>
<td>55</td>
</tr>
<tr>
<td>Part-time Students, Student FTE¹</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Graduates</td>
<td>12</td>
<td>8</td>
<td>26</td>
<td>17</td>
<td>9</td>
</tr>
</tbody>
</table>

¹ FTE = Full-Time Equivalent

Figure 3. University of Kentucky BAE Graduates since 1999. Averages for 1998-2009 and 2004-2009 are also shown (*).
<table>
<thead>
<tr>
<th>Numerical Identifier</th>
<th>Year Matriculated</th>
<th>Year Graduated</th>
<th>Current Employment Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fall 2000</td>
<td>Dec '08</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>2</td>
<td>Fall 2004</td>
<td>Dec '08</td>
<td>Test Engineer</td>
</tr>
<tr>
<td>3</td>
<td>Fall 2004</td>
<td>Dec '08</td>
<td>Validation Engineer</td>
</tr>
<tr>
<td>4</td>
<td>Fall 2004, T</td>
<td>Dec '08</td>
<td>Grad School, Ohio State Univ.</td>
</tr>
<tr>
<td>5</td>
<td>Fall 2004</td>
<td>Dec '08</td>
<td>Environmental Engineer</td>
</tr>
<tr>
<td>6</td>
<td>Fall 2004</td>
<td>Dec '08</td>
<td>Maintenance Engineer</td>
</tr>
<tr>
<td>7</td>
<td>Fall 2001</td>
<td>Dec '08</td>
<td>n/a</td>
</tr>
<tr>
<td>8</td>
<td>Fall 2004</td>
<td>Dec '08</td>
<td>MBA School, Purdue</td>
</tr>
<tr>
<td>9</td>
<td>Sum 2006, T</td>
<td>May '09</td>
<td>n/a</td>
</tr>
<tr>
<td>10</td>
<td>Fall 2003, T</td>
<td>May '09</td>
<td>Grad School, UK</td>
</tr>
<tr>
<td>11</td>
<td>Fall 2006, T</td>
<td>May '09</td>
<td>Pharmaceutical Engineer</td>
</tr>
<tr>
<td>12</td>
<td>Spr 2005, T</td>
<td>May '09</td>
<td>Small business owner</td>
</tr>
<tr>
<td>13</td>
<td>Fall 2001</td>
<td>May '09</td>
<td>n/a</td>
</tr>
<tr>
<td>14</td>
<td>Fall 2005</td>
<td>May '09</td>
<td>Engineer, UK-BAE</td>
</tr>
<tr>
<td>15</td>
<td>Fall 2005, T</td>
<td>May '09</td>
<td>n/a</td>
</tr>
<tr>
<td>16</td>
<td>Fall 2005, T</td>
<td>May '09</td>
<td>Grad School, UK-ME</td>
</tr>
<tr>
<td>17</td>
<td>Fall 2005</td>
<td>Dec '09</td>
<td>Grad School, UK-BAE</td>
</tr>
<tr>
<td>18</td>
<td>Fall 2007, T</td>
<td>May '10</td>
<td>n/a</td>
</tr>
<tr>
<td>19</td>
<td>Spr 2008, T</td>
<td>May '10</td>
<td>n/a</td>
</tr>
<tr>
<td>20</td>
<td>Fall 2006</td>
<td>May '10</td>
<td>Grad School, UK-BAE</td>
</tr>
<tr>
<td>21</td>
<td>Fall 2006</td>
<td>May '10</td>
<td>Grad School, UK-BAE</td>
</tr>
<tr>
<td>22</td>
<td>Fall 2006</td>
<td>May '10</td>
<td>Grad School, UK-BAE</td>
</tr>
<tr>
<td>23</td>
<td>Fall 2008</td>
<td>May '10</td>
<td>n/a</td>
</tr>
<tr>
<td>24</td>
<td>Fall 2006</td>
<td>May '10</td>
<td>Vet School, Texas A&amp;M</td>
</tr>
<tr>
<td>25</td>
<td>Spr, 2007</td>
<td>May '10</td>
<td>Test Engineer</td>
</tr>
<tr>
<td>26</td>
<td>Spr 2006</td>
<td>May '10</td>
<td>Grad School, UK-BAE</td>
</tr>
</tbody>
</table>

*Transfer students indicated with a T.
CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statements
Department of Biosystems and Agricultural Engineering Mission Statement

"The mission of the Department of Biosystems and Agricultural Engineering is to serve and benefit the people of Kentucky and beyond through learning, discovery, and engagement in engineering for food, energy, agricultural and biological systems."
-http://www.bae.uky.edu/AboutBAE/

College of Agriculture Mission Statement

The mission of the College of Agriculture is:
• to promote sustainable farming and food systems, from production through consumption;
• to enhance the health and well-being of people and the environment in which they live; and
• to expand economic opportunity by sharing the knowledge and tools for wise, innovative uses of natural resources and development of human potential.
As full partners in the University of Kentucky and in every Kentucky county we:
• facilitate lifelong learning, informed by scholarship and research,
• expand knowledge through creative research and discovery, and
• serve Kentuckians by sharing and applying knowledge.
The College shall sustain the land-grant heritage of achievement in this challenging new century.

College of Engineering Mission Statement

To provide education, research, and service in a scholarly environment in a way that:
• prepares our students for successful professional career;
• addresses the changing needs of our other constituents; and
• responds to the technological challenges facing the Commonwealth and the nation.
-http://www.engr.uky.edu/general/mis_vis_val.html

University of Kentucky Mission Statement

The University of Kentucky is a public, research-extensive, land grant university dedicated to improving people's lives through excellence in teaching, research, health care, cultural enrichment, and economic development.
The University of Kentucky:
• Facilitates learning, informed by scholarship and research.
• Expands knowledge through research, scholarship and creative activity.
• Serves a global community by disseminating, sharing and applying knowledge.
The University, as the flagship institution, plays a critical leadership role for the Commonwealth by contributing to the economic development and quality of life within Kentucky's borders and beyond. The University nurtures a diverse community characterized by fairness and equal opportunity.

http://www.uky.edu/webuk/subpages/mission.html

B. Program Educational Objectives
The program educational objectives are to:

1. Educate students so that when they become engineers they can successfully design components and/or processes for advancement of agricultural, biological, or environmental systems.
2. Prepare students to be engineers with successful careers in industry, government, consulting firms, or academia. Successful careers begin with employment in their chosen field, continue with steady advancement, and include professional development.

These objectives are published on the web at http://www.bae.uky.edu/Instruction/ABET/objectives_outcomes.htm

C. Consistency of the Program Educational Objectives with the Mission of the Institution

As a land grant university, the University of Kentucky’s mission to improve people’s lives extends to all of the citizens of Kentucky. The economy of the Commonwealth of Kentucky is driven in large part by the agricultural industries in the state, and large portions of Kentucky’s citizens are impacted daily by environmental and/or agricultural systems. Our educational objectives are consistent with the Mission of the Institution because the engineers that we educate to design components and processes for agricultural, biological and environmental systems (i.e. Biosystems Engineers) are the future of Kentucky’s economic development and the global economy. It is essential that Kentucky educate Biosystems Engineers to move these industries forward in a safe and an environmentally sustainable way.

Objective 2 relates to the ability of our students to transition successfully from the University into society, which is necessary if the University is to fulfill its mission of playing a critical leadership role. Some of the future leaders will emerge from the Biosystems Engineering graduates, and professional advancement and development are essential to retain relevancy to the Commonwealth and the global community.

D. Program Constituencies
For purposes of ongoing evaluation of Program Educational Objectives (PEO), we have selected recent graduates for feedback and our BAE Advisory Council for strategic planning and initiatives. The BAE Advisory Council includes members representing our constituencies including employers of our students and alumni of our program. Our constituents include students, employers of our graduates, and graduate programs.

E. Process for Establishing Program Educational Objectives
Program Educational Objectives were established in 1997, and revised in 2003 and 2010. The revisions in 2003 were made after a faculty retreat that focused on continuous quality improvement. These revisions were implemented to more clearly articulate the capabilities and
accomplishments desired of engineers who are our graduates. These revisions were intended to facilitate measurement of the program’s success in meeting the Objectives in an ongoing process of program improvement. In the last review period, the faculty reviewed our program educational objectives and changed some wording to fully reflect that we mean graduates three to five years out of school, and not our graduating engineers. The wording of the Program Objectives was vetted with and approved by the BAE Advisory Council in June of 2010 meeting (Appendix F).

**Metrics for Assessing Accomplishment of Program Educational Objectives**

The metrics for assessing our program’s accomplishments towards achieving the PEO were initially developed by the Undergraduate Curriculum Committee (UGCC). Our criteria in determining the metrics were: 1) relevance to the objectives and 2) sustainable availability of data for ongoing tracking and analysis. The metrics were presented to the full faculty in 2003 and approved. In April 2010, the UGCC revised the metrics based on feedback from a mock ABET review. The revised metrics and standards/goals were thoroughly reviewed by and approved as shown by the BAE Advisory Council (Appendix F). The revised metrics are:

**Objective 1 - Metrics:**

a) Graduate performance on the Fundamentals of Engineering examination as a predictor of competence in the first 3-5 years post-graduation;

b) Performance on the Professional Engineering (PE) examination as a measure of attainment of the ability to successfully design components and/or processes for advancement of agricultural, biological, or environmental systems.

**Objective 2 - Metrics:**

a) Acquisition of engineering employment (or employment in desired area) as a measure of employer confidence in our “product”.

b) Salaries and promotions received since graduation to measure attainment of “steady advancement”.

c) Key roles and leadership positions attained by graduates, which speak to both steady advancement and professional development.

d) Memberships in professional organizations, indicating access to professional development.

For each metric, standards and goals were determined. Standards represent the minimum acceptable, such that results below standard will require action (described in greater detail in Criterion 4). Goals represent the desired level for each metric.
Table 5. Standards and Goals for Objectives, Shown with Justifications.

<table>
<thead>
<tr>
<th>Obj.</th>
<th>Tool</th>
<th>Standard</th>
<th>Goal</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Performance on FE</td>
<td>Equal to the average national score over the review period.</td>
<td>10% higher than the average national score over the review period.</td>
<td>Our students should be able to perform as well as or above the national average.</td>
</tr>
<tr>
<td></td>
<td>PERFORMANCE ON THE PE</td>
<td>70% of the BAE graduates responding who take the PE pass</td>
<td>95% of the BAE graduates responding who take the PE pass</td>
<td>At least half of the engineering alumni from our program should be prepared for the PE.</td>
</tr>
<tr>
<td>2</td>
<td>Acquisition of engineering employment in the desired area</td>
<td>70% of BAE graduates responding employed in satisfactory employment within 6 months of graduation</td>
<td>95% of BAE graduates responding employed in satisfactory employment within 6 months of graduation</td>
<td>Measures employer confidence in our “product” and the value of our program to students.</td>
</tr>
<tr>
<td>2</td>
<td>Salary and promotions since graduations for those employed</td>
<td>50% of BAE graduates responding had salary increases in the past 5 years</td>
<td>95% of BAE graduates responding had salary increases in the past 5 years</td>
<td>Measures attainment of steady advancement.</td>
</tr>
<tr>
<td>2</td>
<td>Key roles and leadership positions attained</td>
<td>10% of our graduates responding have supervisory roles</td>
<td>25% of our graduates responding have supervisory roles</td>
<td>Quantifies both steady advancement and professional development.</td>
</tr>
<tr>
<td>2</td>
<td>Memberships in professional organizations</td>
<td>50% of our graduates responding are members of at least one professional society</td>
<td>75% of our graduates responding are members of at least one professional society</td>
<td>Indicates access to professional development.</td>
</tr>
</tbody>
</table>
F. Achievement of Program Educational Objectives

An Alumni Survey was used to collect some of the data for assessment of the Program Educational Objectives. A copy of the Alumni Survey is included in Appendix E. The survey was emailed to alumni who had graduated in the last 10 years, not including the most recent year. For the most recent survey, alumni from 1998-1999 through 2007-2008 were sent a login and password for the Alumni Survey website. Email requests were sent to all of the alumni for whom we were able to obtain valid email addresses (106 of the 134 graduates for the specified years). Of the 106 requests, 67 alumni completed the survey. All of the assessments used for Objective 2 were based on these 67 responses. The results are shown in Figure 4Figure 7. For all five metrics our results were above standard, shown in Table 6, such that no further action was required. Our BAE Advisory Council also provided valuable feedback on the achievement of our educational objectives (included in Appendix E).

The Alumni Survey queried BAE alumni on their own perception of their preparedness for life and work, in terms of technical engineering knowledge, communication, and general non-technical knowledge (social factors, manufacturability, ethics, etc.). Figure 4 presents the average ratings for the 3 survey questions, with a rating of 0 meaning less than prepared and a 5 meaning well prepared. The goal for this metric is an average of 4 and the standard is an average of 3. The BAE program is meeting standard or goal for all years and for the average. There does seem to be a slight increase in the ratings over time, which is hopefully an indication that we are improving our program.

![Figure 4. Average Ratings from the Alumni Survey Divided by Graduation Year.](image-url)
Figure 5. BAE Students Taking and Passing FE Exam since 1998.

Figure 6. Percentage of BAE graduates, since 1998, who are Professional Engineers (PE). The latest five years of data are omitted due to the amount of time it takes to get a PE.
Figure 7. Average Starting (adjusted to 2009 dollars) and Current Salaries.

Table 6. Achievement of Objectives (the data are contained in Appendix F). The percentages are all based on the 67 surveys returned.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Tool</th>
<th>Why?</th>
<th>Result</th>
<th>Action?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Performance on FE</td>
<td>Measuring preparedness</td>
<td>48/54 passed (89%, where 54 took the PE)</td>
<td>No</td>
</tr>
<tr>
<td>1</td>
<td>Performance on the PE</td>
<td>Measures engineering competence</td>
<td>Of the 12 that took the exam, 11 passed (92%)</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Acquisition of engineering employment in the desired area</td>
<td>Measures employer confidence in our “product”</td>
<td>65/67 within 6 months of graduation (97%)</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Salary and promotions since graduations for those employed</td>
<td>Measures attainment of steady advancement</td>
<td>Average increase in pay from starting position (adjusted) was 29% (only 49 responded) with 78% having increases</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Key roles and leadership positions attained</td>
<td>Quantifies both steady advancement and professional development</td>
<td>43% of the individuals have supervisor roles (only 47 responded)</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Memberships in professional organizations</td>
<td>Indicates access to professional development</td>
<td>58/67 members of at least one (86%)</td>
<td>No</td>
</tr>
</tbody>
</table>
CRITERION 3. PROGRAM OUTCOMES

A. Process for Establishing and Revising Program Outcomes
Program Educational Outcomes were initially developed during a faculty retreat in 2003. The outcomes were developed in conjunction with a redefinition of Program Educational Objectives, also in 2003. The Program Outcomes were selected to align with the missions of the BAE Department, College of Engineering, College of Agriculture, and the University of Kentucky. In addition, special attention was paid to ensure that our outcomes were closely aligned with the outcomes required by ABET (a-k). Each outcome is also directly related back to one of the two Objectives. Every year, at the UGCC meeting at the end of spring semester, the program outcomes are revisited to determine whether the department, the colleges, the university, the supporting industries, agencies, or government have changed such that the outcomes need to be revised. We then bring these suggestions before the Advisory Council meeting in June to obtain their input, before the faculty make a final decision on implementing changes to our program at the August faculty meeting.
### B. Program Outcomes

Table 7. Biosystems Engineering program Outcomes with Primary Metrics.

<table>
<thead>
<tr>
<th>Outcome - Objective 1</th>
<th>ABET Outcome</th>
<th>Primary Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Students should be able to:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Apply knowledge of mathematics, science and engineering to solve problems.</td>
<td>a) BAE 427/447: Homework assignments applying mathematics, science, and engineering to a biosystems problem, scored separately.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) FE: score on the math section.</td>
</tr>
<tr>
<td>2. Use techniques, skills and modern engineering tools necessary for engineering practice.</td>
<td>k) BAE 402/403: Homework assignments applying techniques, skills and modern engineering tools, scored separately.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) FE: score on the computer section.</td>
</tr>
<tr>
<td>3. Design and conduct experiments, as well as to analyze and interpret data.</td>
<td>b) BAE 202</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) BAE 305</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c) BAE 402/403</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Homework assignment(s) focused on the design of experiments and interpretation of data.</td>
</tr>
<tr>
<td>4. Identify, formulate, and solve engineering problems.</td>
<td>e) BAE 427/447: Homework assignments which evaluate the ability of our students to identify, formulate, and solve engineering problems, scored separately.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) FE: composite score*</td>
</tr>
<tr>
<td>5. Design a system, component, or process to meet desired needs.</td>
<td>c) BAE 4X7: Homework assignment(s) focused on designing a system, component, or process germane to the discipline. Especially problems typical of the PE exam should be considered.</td>
<td></td>
</tr>
<tr>
<td>6. Solve BAE problems that are vague or poorly constrained.</td>
<td>c) BAE 402/403: Quarterly report grades, because senior design focuses on vague or poorly constrained problems.</td>
<td></td>
</tr>
<tr>
<td>7. Utilize research and technical literature to interpret key issues or concepts.</td>
<td>i) BAE 4X7: Homework assignments that require students to consult published design standards and/or use technical literature (journal articles) to arrive at a final solution, scored separately.</td>
<td></td>
</tr>
</tbody>
</table>

* Composite score based on the engineering science sections, including engineering mechanics, strength of materials, material properties, fluid mechanics, thermodynamics, application of engineering mechanics, engineering of materials, fluids, and heat transfer.
Table 7. Biosystems Engineering program Outcomes with Primary Metrics (continued).

<table>
<thead>
<tr>
<th>Outcome - Objective 2</th>
<th>ABET Outcome</th>
<th>Primary Metrics</th>
</tr>
</thead>
</table>
| 8. Effectively communicate interpersonally, formally, and technically whether oral or written. | g | a) BAE 400  
b) BAE 402/403  
c) Student Competitions |
| 9. Recognize the need for, and have an ability to engage in life-long learning. | i | a) BAE 400: A survey focused on future plans and career planning. |
| 10. Work within a team approach to complete projects with many facets. | d | a) BAE 402/403: Performance in design teams, assessed by professional/faculty advisors and peers. |
| 11. Work in a multi-disciplinary environment. | d | a) BAE 400: Homework assignments focused on researching and describing non-engineering roles such as accountants, environmentalists, community leaders, and safety specialists, scored separately. |
| 12. Understand professional and ethical responsibility. | f | a) BAE 402/403: Homework assignment, scored separately.  
b) FE: score on the ethics section |
| 13. Appreciate contemporary issues arising from industrially-relevant design questions. | j | a) BAE 403: Students are asked to write a paragraph after viewing each of the senior design presentations and describe a contemporary issue which the project addresses. |
| 14. Understand the impact of engineering solutions in a global and social context. | h | a) BAE 417/437: Homework assignment focused on the evaluation of the students' perspective of global and social issues around engineering solutions. |
| 15. Recognize the importance of and be engaged in the process of becoming a Registered Professional Engineer. | f | a) BAE 102  
b) BAE 400  
Homework assignment focused on the significance of becoming a Registered Professional Engineer. |
| 16. Appreciate the advantages of being active in student clubs and professional organizations. | f | a) Exit interviews: All students are surveyed at the completion of their undergraduate program to track their participation in any clubs and professional organizations.  
b) BAE 102: Students are required to attend BAE Student Branch meetings during, and the instructor reports the actual attendance.  
c) BAE 403: Students are required to join ASABE on a national level during BAE 403, and the instructor reports the actual number of students that join. |

Published on-line at http://www.bae.uky.edu/Instruction/ABET/outcomes.htm

C. Relationship of Program Outcomes to Program Educational Objectives
Outcomes 1-7 support attainment of Objective 1 and Outcomes 8-16 support attainment of Objective 2. Outcomes supporting Objective 1 are assessed by student mastery of basic technical skills necessary for engineering practice; these outcomes are easier to quantify numerically. Outcomes supporting Objective 2 measure attributes that are believed to be correlated with lifelong career success, and are more subjective in relation to the assessment techniques.
D. Relationship of Courses in the Curriculum to the Program Outcomes
Table 8 shows the linkages between individual courses in the BAE curriculum and the Program Outcomes. The twelve required BAE courses are listed, and the outcomes evaluated in each course are tracked. Faculty responsible for each course are responsible for administering the assessment(s) and summarizing the data.

Table 8. Courses where Outcomes are Assessed.

<table>
<thead>
<tr>
<th>Classes</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>BAE 102</td>
<td></td>
</tr>
<tr>
<td>BAE 103</td>
<td></td>
</tr>
<tr>
<td>BAE 201</td>
<td></td>
</tr>
<tr>
<td>BAE 202</td>
<td></td>
</tr>
<tr>
<td>BAE 305</td>
<td></td>
</tr>
<tr>
<td>BAE 400</td>
<td></td>
</tr>
<tr>
<td>BAE 402</td>
<td>X</td>
</tr>
<tr>
<td>BAE 403</td>
<td>X</td>
</tr>
<tr>
<td>BAE 417</td>
<td>X</td>
</tr>
<tr>
<td>BAE 427</td>
<td>X</td>
</tr>
<tr>
<td>BAE 437</td>
<td></td>
</tr>
<tr>
<td>BAE 447</td>
<td>X</td>
</tr>
</tbody>
</table>

E. Documentation
Our 16 outcomes are listed the next section (F) along with the assessment process (tool), results of our 2008-2009 yearly evaluation, and summaries of actions resulting from previous yearly evaluations. The 2008-2009 yearly evaluation will serve as an example of the evaluation done every year. Details about the evaluations prior to 2008-2009 can be found in the Department’s ABET documentation. Materials available for the ABET review team at the Fall 2010 visit will include homework assignments, class exercises and examination questions, survey results, and other materials needed to support the outcomes assessment described in the following pages.

F. Achievement of Program Outcomes
Assessments are compared to goals and standards that have been established for homework assignments scored separately, as indicated in Table 7. Unless noted otherwise, the standard metric is 70% of the assessment tool “correct”, and the metric goal is 80%, which is the equivalent to the minimum score needed to obtain a “B” grade. For the FE examination assessment, a normalized score ($FE_N = BAE \text{ score}/\text{national average}$) greater than 1.0 is used as the standard and a normalized score greater than 1.1 is set for the goal.
### Table 9. Outcome Assessment Results for the 2008-2009 Yearly Assessment.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Tool</th>
<th>Result from 2008-2009</th>
<th>UGCC Action Required?</th>
</tr>
</thead>
</table>
| 1.      | a) BAE 427/447  
           b) FE math score  
           c) BAE 402/403  
           d) FE engineering sciences  
           e) Student Comp. | a) BAE 427 - 88%  
           BAE 447 - 87%  
           b) FE_{N}(math) = 1.0  
           c) n/a*  
           d) BAE 427 - 88%  
           BAE 447 - 87%  
           e) n/a** | No  
           No  
           No  
           No  
           No |
| 2.      | a) BAE 427/447  
           b) FE computers | a) n/a *  
           b) FE_{N}(computers) = 1.0 | No |
| 3.      | a) BAE 202  
           b) BAE 402/403  
           c) BAE 402/403 | a) 92%  
           b) 95.6%  
           c) 90% | No |
| 4.      | a) BAE 427/447  
           b) FE engineering sciences | a) BAE 427 - 88%  
           BAE 447 - 87%  
           b) For 2008-2009, FE_{N} = 1.0  
           For 2005-2009, FE_{N} = 0.9 | Yes, see Table 10. |
| 5.      | a) BAE 4X7 | a) BAE 417 - 61%  
           BAE 427 - 87.6%  
           BAE 437 - 84%  
           BAE 447 - 90%  
           b) BAE 417 - 94.7%  
           BAE 427 - 82%  
           BAE 437 - 97%  
           BAE 447 - 70% | Yes, see Table 10 |
| 6.      | a) BAE 402/403 | a) 80% | No |
| 7.      | a) BAE 4X7 | a) BAE 417 - 94.7%  
           BAE 427 - 82%  
           BAE 437 - 97%  
           BAE 447 - 70% | No |
| 8.      | a) BAE 400  
           b) BAE 402/403  
           c) Student Comp. | a) 86.7%  
           b) oral 94%; written 83%  
           c) n/a** | No |
| 9.      | a) BAE 400 | a) 94.4% | No |
| 10.     | a) BAE 402/403 | a) >90% | No |
| 11.     | a) BAE 400 | a) 88.9% | No |
| 12.     | a) BAE 400  
           b) FE ethics score | a) 90.6%  
           b) FE_{N}(ethics) = 1.0 | No |
| 13.     | a) BAE 403 | a) 85% *** | No |
| 14.     | a) BAE 417  
           b) BAE 437 | a) 75%  
           b) 96% | No |
| 15.     | a) BAE 102  
           b) BAE 400 | a) 90%  
           b) 91.7% | No |
| 16.     | a) Exit interviews  
           b) BAE 102  
           c) BAE 403 | a) average 64% are members  
           b) n/a*  
           c) n/a* | Yes, see Table 10. |

* New metric, no data for this year. ** There were no applicable competitions for this year. *** New metric, data from 2009-2010.

There were three outcomes that required further action: 4, 5, and 16. Details about the specific actions taken by the UGCC and the results of these actions are in Table 10, in the Criterion 4 discussion. In addition, there are examples of other improvements made in individual classes instigated by the instructors (as opposed to the UGCC) in Table 11.
CRITERION 4. CONTINUOUS IMPROVEMENT

A. Information Used for Program Improvement
Figure 8 provides an overview of the process used for continuous improvement of our program. Two feedback loops join linking the assessments of the Program Educational Objectives with the assessments of the Outcomes. The interlocking circles meet at the Evaluation, Recommendation, and Decisions step. The faculty, in consultation with the Advisory Council, reviews the assessment results and determines the area of improvement which should be our highest priority for the coming academic year.

Figure 8. Continuous Improvement Process Model for the BAE Program.
## B. Actions to Improve the Program

Over the review period several actions have been made to improve the program. These are discussed in Tables 10 and 11. Table 10 focuses on the actions taken as a direct result of the assessment and review by the UGCC that have been approved by the faculty and the Advisory Council. Table 11 focuses on the actions done by individual instructors as a direct result of performing the required assessment.

### Table 10. Actions to Improve Program Instigated by the UGCC.

<table>
<thead>
<tr>
<th>Area</th>
<th>Tool</th>
<th>Result</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome</td>
<td>Yearly assessments</td>
<td>The assessment tools needed to be revised, as well as the standards and goals.</td>
<td>Revised the outcome assessment metrics, goals, and standards.</td>
<td>Revisions approved by the faculty in April 2007, August 2008, August 2009, and December 2009.</td>
</tr>
<tr>
<td>FE engineering sciences</td>
<td>Similar to national average for 2008-2009, below national average for 2004-2009.</td>
<td>Reinforce thermodynamics and applications of engineering mechanics in BAE 447 and BAE 417, respectively. These topics were the two lowest scoring sections on the FE in the engineering sciences.</td>
<td>In progress.</td>
<td></td>
</tr>
<tr>
<td>BAE 417</td>
<td>Students scored 61% on the assessment.</td>
<td>Fall 2009, the students were given more time to complete the assignment.</td>
<td>In Fall 2009, the average score was 82%. No further action required.</td>
<td></td>
</tr>
<tr>
<td>Exit interviews</td>
<td>On average 64% of students are members of student organizations (standard of 70%).</td>
<td>Fall 2009, further emphasized the importance of being a member of a professional organization by requiring BAE 102 students to attend 5 BAE Student Branch meetings during the Fall semester and by requiring BAE 403 students to join ASABE nationally. The standard was revised to 50%.</td>
<td>Students from BAE 102 were more likely to continue in the BAE student branch in the spring following BAE 102. Need to gather more data about students completing BAE 403. The average for professional society membership over the review period is 60%. No further action required.</td>
<td></td>
</tr>
<tr>
<td>Program Criteria</td>
<td>ABET criteria: dual vs. single-named program</td>
<td>Faculty voted to change to Biosystems Engineering for our program</td>
<td>Approved by COE in Spring 2008, approved by university in Fall 2009.</td>
<td>Effective Fall 2009. No further action required.</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------------</td>
<td>------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
</tbody>
</table>

Table 11. Actions to Improve Program Instigated by the Instructors as a Result of Outcome Assessment.

<table>
<thead>
<tr>
<th>Area</th>
<th>Tool</th>
<th>Result</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome 2</td>
<td>BAE 102 Excel assessment</td>
<td>47% of the students proficient at initial assessment; 75% of the students proficient at end of semester.</td>
<td>In Fall 2009, introduced more structured study of Excel by working on the computers during class</td>
<td>Proficiency went from 75% to 93% at the end of the semester</td>
</tr>
<tr>
<td>Outcome 4</td>
<td>Senior exit interviews</td>
<td>Students routinely said ME 340 was not helpful b/c of emphasis on mechanical systems.</td>
<td>In Fall 2008, changed curriculum to allow BAE 502 or ME 340; BAE 502 is Modeling of Biological Systems</td>
<td>Updated in the Bulletin Fall 2010</td>
</tr>
<tr>
<td>Outcome 8</td>
<td>BAE 400</td>
<td>Students’ slides for presentations were poorly constructed.</td>
<td>In Fall 2008, added lecture specifically on proper construction of technical slides.</td>
<td>Slide preparations have improved.</td>
</tr>
<tr>
<td>Outcome 8</td>
<td>BAE 402/403</td>
<td>Technical writing in design reports was below standard.</td>
<td>In Fall 2008, Multiple rewrites implemented, with instructor checking against prior review comments to make sure appropriate changes were made</td>
<td>Writing has improved, Figure 12.</td>
</tr>
<tr>
<td>Outcome 8</td>
<td>BAE 402/403</td>
<td>Additional milestones</td>
<td>In Fall 2009, additional milestone assignments, such as economics, statistics, decision matrices, sustainability, social and political factors, environmental.</td>
<td>The students were able to consider design facets beyond their own individual project.</td>
</tr>
</tbody>
</table>
C. Yearly Continuous Improvement Procedure
The following describes the procedure for yearly Program Objective and Outcome assessments. This procedure will be followed every year, unless it is the year prior to an ABET review, for those years efforts will all be geared towards preparing for the ABET review.

Assessment Responsibilities
The Director of Undergraduate Studies (DUS) and the Chair of the Undergrad Curriculum Committee, with support from the Administrative Assistant to the DUS (referred to subsequently as the DUS*), have responsibility for collecting, analyzing, archiving and presenting all data used to assess achievement of Program Objectives and Outcomes. The DUS* will provide to the BAE Undergraduate Curriculum Committee a summary of metrics (assessed against data from current students) meeting and failing goals/standards, in June of each academic year. Additionally, the DUS* will provide a summary of metrics (assessed against data from the alumni survey) in June of the year preceding the 6-year ABET review. The committee will review the DUS* summary of metrics each year in July, and draft recommendations for possible revision of the program objectives and/or methods of assessment (including goals and standards) for presentation to the full faculty. The committee may, at its discretion, consider metrics not achieving goals. The committee must consider and act on metrics not meeting standards. In the event that a metric standard is not met, possible actions include:
   a. Recommend a change in our procedures.
   b. Adopt a new metric, goal and standard.
   c. Revise the standard.

Revision of Objectives or Metrics
Metrics may be revised by a majority vote of full-time, tenure-track faculty of the Biosystems and Agricultural Engineering Department (BAE Faculty) at any meeting where a quorum of faculty is present.

Standards and/or goals may be revised by a majority vote of full-time, tenure-track faculty of the Biosystems and Agricultural Engineering Department (BAE Faculty) at any meeting where a quorum of the faculty is present.

Constituent Review
The final recommendations for objective revisions will be presented to the BAE Advisory Council consultation purposes. Comments and guidance from the BAE Advisory Council will be considered in the next review cycle.

Action and Documentation
In July, the BAE faculty will review the draft recommendations for revised program objectives and/or methods of assessment, and will vote on any recommended revisions in early August. Changes will be documented in the ABET documentation, in the next ABET Self-Study, and on the web as appropriate. The purpose of the ABET documentation will be to show the process over the course of the six year review period and to document the department’s “closing the loop” each cycle, which naturally feeds into the next cycle and continues the process.
CRITERION 5. CURRICULUM

A. Program Curriculum

Students are prepared for a professional career and further study in the discipline by obtaining a firm grounding in math and the sciences, and a thorough set of engineering science courses. This allows our students to be successful on the FE exam, and to have the background needed to understand new science as it develops over the course of their careers. The engineering science courses are followed with a series of design courses that train the student in a breadth of biological engineering topics so that they can be successful in advancing biological systems, including agricultural and environmental systems. The final year of the program focuses on professionalism, combining the design skills they have learned with the realities of the world in which we live. In this way, our curriculum is consistent with our Program Educational Objectives, addressing both the technical and professional education of our students. Our curriculum is consistent with the Program Educational Outcomes because we have thoughtfully incorporated the outcomes into our courses so that we are teaching the necessary material for students to achieve the outcomes, and also because we are assessing the outcomes at appropriate junctures in the curriculum (for example see Table 9).

The Biosystems Engineering curriculum meets the requirements set forth in ABET CRITERIA FOR ACCREDITING ENGINEERING PROGRAMS, 2009-2010, Criterion 5.

Table 12 presents a listing of the basic curriculum of the BAE Bachelor of Science program, by semester. Required courses in calculus, chemistry, physics and biology total 44 semester credit hours and therefore exceed the 32 credit hours required under Criterion 5. Similarly, the program curriculum requires a total of 51 semester credit hours of engineering science and design courses (this would be a minimum, since technical electives typical also contain engineering topics and are not included in this number), also exceeding the 48 credit hours required by Criterion 5. The balance of program curriculum requirements are writing and oral communication (8 credit hours), university social studies, humanities and cross-cultural requirements (15 credit hours) and one free supportive elective (3 credit hours).
### Table 12. (ABET Table 5-1) BAE Curriculum

#### Biosystems Engineering

<table>
<thead>
<tr>
<th>Year, Semester</th>
<th>Course (Department, Number, Title)</th>
<th>Category (Credit Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Math &amp; Basic Sciences</td>
<td>Engineering Topics*</td>
</tr>
<tr>
<td>Yr 1, Fall</td>
<td>BAE 102 Intro to Biosystems Eng.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>CHE 105 Gen College Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ENG 104 Writing I</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>MA 113 Calculus I</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>CE 106 Computer Graphics</td>
<td>3</td>
</tr>
<tr>
<td>Yr 1, Spr</td>
<td>BAE 103 Energy in Biological Systems</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>CHE 107 Gen College Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>BIO 150 Principles of Biology I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MA 114 Calculus II</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>PHY 231 Gen University Physics</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>PHY 241 Gen University Physics Lab</td>
<td>1</td>
</tr>
<tr>
<td>Yr 2, Fall</td>
<td>BAE 201 Econ. Anal. for Biosystems</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>BIO 152 Principles of Biology II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EM 221 Statics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MA 213 Calculus III</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>PHY 232 Gen University Physics</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>PHY 242 Gen University Physics Lab</td>
<td>1</td>
</tr>
<tr>
<td>Yr 2, Spr</td>
<td>BAE 202 Prob and Stats for Biosystems</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>CS 221 First Course in CS for Engrs.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>ENG/University Studies</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EM 302 Mechanics of Deform. Solids</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MA 214 Calculus IV</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ME 220 Engineering Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ME 330 Fluid Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EE 305 Electrical Circuits</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EM 313 Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>Yr 3, Fall</td>
<td>Biological Science Elective</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Core Elective</td>
<td>3</td>
</tr>
</tbody>
</table>

* ✓ indicates the course has a significant design component

(continued on next page)
Table 12. (ABET Table 5-1) BAE Curriculum(continued)

<table>
<thead>
<tr>
<th>Year, Semester</th>
<th>Course (Department, Number, Title)</th>
<th>Category (Credit Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Math &amp; Basic Science</td>
</tr>
<tr>
<td>Yr 3, Spr</td>
<td>COM 199 Presentational Com. Skills</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>ME 325 Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>BAE 305 DC Circuits and Microelect.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Core Elective</td>
<td>3✓</td>
</tr>
<tr>
<td></td>
<td>Technical Elective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>University Studies</td>
<td>3</td>
</tr>
<tr>
<td>Yr 4, Fall</td>
<td>BAE 400 Senior Seminar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>BAE 402 BAE Design I</td>
<td>2✓</td>
</tr>
<tr>
<td></td>
<td>Core Elective</td>
<td>3✓</td>
</tr>
<tr>
<td></td>
<td>Supportive Elective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>University Studies</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>BAE 502 Modeling of Biological Syst</td>
<td>3</td>
</tr>
<tr>
<td>Yr 4, Spr</td>
<td>BAE 403 BAE Design II</td>
<td>2✓</td>
</tr>
<tr>
<td></td>
<td>Technical Elective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technical Elective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>University Studies</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>University Studies</td>
<td>3</td>
</tr>
</tbody>
</table>

TOTALS-ABET BASIC-LEVEL REQUIREMENTS 44 54 20 3

OVERALL TOTAL FOR DEGREE 130

PERCENT OF TOTAL 34% 49% 15% 2%

<table>
<thead>
<tr>
<th>Totals must satisfy one set</th>
<th>Minimum semester credit hours</th>
<th>Minimum percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>32 hrs</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>48 hrs</td>
<td>37.5%</td>
</tr>
</tbody>
</table>

* ✓ indicates the course has a significant design component

Note that instructional material and student work verifying course compliance with ABET criteria for the categories indicated above will be available during the campus visit.

The BAE program requires students to complete a two-course capstone design sequence, for a total of 4 credit hours (2 credit hours each semester). One of three credit hours of oral communication required by the university is satisfied by this sequence. Students receive instruction in preparing and delivering technical oral presentations and are required to present four formal presentations of their design work (proposal, preliminary design, progress and final design). Students are assigned to 3- or 4-person teams and select problems submitted by professional advisors. The student teams research the problems and propose design solutions, specifying measurable design requirements. Design solutions are developed and presented for evaluation. After responding to recommendations of the professional advisors and the instructor, design prototypes are fabricated or constructed. The student teams design and conduct experiments whereby the prototypes are tested to assess the attainment of design requirements. Student teams prepare a final design report, as well as design drawings and specifications.
The capstone design sequence consists of 1 hour per week of lecture and 2 hours per week of team collaboration. Instruction is presented in team roles and teamwork, technical oral presentations, technical writing, design modeling, design analysis, estimating design costs, selection of design materials, design reliability, statistical hypothesis testing, engineering ethics, environmental protection, design safety, multidisciplinary design teams, and other topics. Students evaluate themselves and their peers’ relative contributions to the design effort. The professional advisors meet with the design teams throughout the two-semester period to offer suggestions and advice. Finally, the advisors are asked to complete a survey whereby they evaluate their student team with regard to various educational outcomes as reported in Criterion 4.

Table 13 quantifies the time devoted to each outcome in each course, as computed by the instructor. The percentage are allowed to overlap, such that the total percentage for a course will be over 100%. The general distribution of attention and time given to each outcome is observable. Outcomes 1-7 map back to Educational Objective 1, and Outcomes 8-16 map back to Educational Objective 2. Roughly, two-thirds of our core classes are devoted to aspects that are more technical in nature and the remaining one-third are devoted to more professional aspects of biosystems engineering. The percent time allocated to each outcome has been reviewed by faculty and by the BAE Advisory Council, and has been deemed appropriate for our objectives.

Table 13. Percentage of Course Dedicated to each Outcome.
Percentages are allowed to overlap, such that the total percentage for a course will be over 100%.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>102</th>
<th>103</th>
<th>201</th>
<th>202</th>
<th>305</th>
<th>400</th>
<th>402</th>
<th>403</th>
<th>417</th>
<th>427</th>
<th>437</th>
<th>447</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (math/science)</td>
<td>20</td>
<td>40</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>130</td>
</tr>
<tr>
<td>2 (computers/tools)</td>
<td>20</td>
<td>25</td>
<td>20</td>
<td>33</td>
<td>5</td>
<td>15</td>
<td>15</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td></td>
<td>173</td>
</tr>
<tr>
<td>3 (stats)</td>
<td>75</td>
<td>40</td>
<td>10</td>
<td>20</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>155</td>
</tr>
<tr>
<td>4 (engineering prob.)</td>
<td>50</td>
<td>90</td>
<td>40</td>
<td>50</td>
<td>30</td>
<td>60</td>
<td>55</td>
<td>55</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td>490</td>
</tr>
<tr>
<td>5 (design)</td>
<td></td>
<td></td>
<td>10</td>
<td>70</td>
<td>70</td>
<td>25</td>
<td>30</td>
<td>30</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td>260</td>
</tr>
<tr>
<td>6 (vague)</td>
<td>15</td>
<td>10</td>
<td>5</td>
<td>20</td>
<td>10</td>
<td>5</td>
<td>15</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>7 (literature)</td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>10</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>65</td>
</tr>
<tr>
<td>8 (communication)</td>
<td></td>
<td></td>
<td>20</td>
<td>5</td>
<td>70</td>
<td>20</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td></td>
<td></td>
<td>160</td>
</tr>
<tr>
<td>9 (life-long)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
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<td>20</td>
</tr>
<tr>
<td>10 (team)</td>
<td>15</td>
<td></td>
<td>25</td>
<td>20</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>11 (multi-discip.)</td>
<td></td>
<td></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20</td>
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<tr>
<td>12 (ethics)</td>
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<td>5</td>
<td>10</td>
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<td></td>
<td></td>
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<td></td>
<td>5</td>
<td>40</td>
</tr>
<tr>
<td>13 (contemporary)</td>
<td></td>
<td></td>
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<td>5</td>
<td></td>
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<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>14 (global)</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>15 (PE)</td>
<td>5</td>
<td></td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>16 (membership)</td>
<td></td>
<td></td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Total</td>
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<td>208</td>
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<td>165</td>
<td>150</td>
<td>155</td>
<td>135</td>
<td>140</td>
<td></td>
</tr>
</tbody>
</table>
The biosystems engineering program does not require any cooperative education experiences. BAE does encourage students to participate in cooperative education. Cooperative education is not typically used to fulfill curriculum requirements, but could be used to fulfill the supportive elective.

The documentation available on-site for the reviewer includes: 1) binders for all required classes taught in BAE (electives available upon request), and 2) the BAE ABET documentation folders. The class binder will contain the syllabus, ABET assessment instruments and results, and examples of student work. The BAE ABET documentation folders contain information about the yearly assessments, minutes and agendas for the UGCC, and other documentation that is required for completing the self-study every six years.
B. Prerequisite Flow Chart
The prerequisite flow chart is shown in Figure 9.

Figure 9. Biosystems Engineering Prerequisite Mapping
C. Course Syllabi
Course syllabi are provided in Appendix A. Table 14 summarized both required and elective courses with details about the number of sections, number of students, and time devoted to lecture and lab.

Table 14. (ABET Table 5-2) Course and Section Size Summary

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title</th>
<th>No. of Sections</th>
<th>Avg. No. Students</th>
<th>Lecture %</th>
<th>Lab %</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAE 102</td>
<td>Introduction to Biosystems Engineering</td>
<td>1</td>
<td>20</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>BAE 103</td>
<td>Energy in Biological Systems</td>
<td>1</td>
<td>21</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>BAE 201</td>
<td>Economic Analysis of Biosystems</td>
<td>1</td>
<td>22</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>BAE 202</td>
<td>Probability and Statistics for Biosystems</td>
<td>1</td>
<td>18</td>
<td>66</td>
<td>33</td>
</tr>
<tr>
<td>BAE 305</td>
<td>DC Circuits and Microelectronics</td>
<td>1</td>
<td>14</td>
<td>66</td>
<td>33</td>
</tr>
<tr>
<td>BAE 400</td>
<td>Senior Seminar</td>
<td>1</td>
<td>11</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>BAE 402/403</td>
<td>Biosystems and Agric. Eng. Design I/II</td>
<td>1</td>
<td>12/12</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>BAE 417</td>
<td>Design of Machine Systems</td>
<td>1</td>
<td>6</td>
<td>66</td>
<td>33</td>
</tr>
<tr>
<td>BAE 427</td>
<td>Structures and Environment Engineering</td>
<td>1</td>
<td>5</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>BAE 437</td>
<td>Land and Water Resources Engineering</td>
<td>1</td>
<td>7</td>
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<td>BAE 447</td>
<td>Bioprocess Engineering Fundamentals</td>
<td>1</td>
<td>13</td>
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<tr>
<td>BAE 502</td>
<td>Modeling of Biological Systems</td>
<td>1</td>
<td>15</td>
<td>66</td>
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<tr>
<td>BAE 513</td>
<td>Soil Dynamics in Tillage and Traction</td>
<td>1</td>
<td>6</td>
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<td>BAE 515</td>
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<td>Fluvial Hydraulics</td>
<td>1</td>
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<td>BAE 537</td>
<td>Irrigation and Drainage Engineering</td>
<td>1</td>
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<td>BAE 549</td>
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<td>BAE 580</td>
<td>Heating, Ventilating and Air Conditioning</td>
<td>1</td>
<td>3</td>
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<td>BAE 438G</td>
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</table>
CRITERION 6. FACULTY

A. Leadership Responsibilities
The Biosystems Engineering degree program resides in the Department of Biosystems and Agricultural Engineering (BAE) and is administered by the Chair of BAE. However, important decisions about the program require consultation with the faculty of the Department.

The Chair of BAE delegates significant daily responsibilities for the program to the BAE Director of Undergraduate Studies (DUS) and the Student Affairs Administrator. The DUS meets with potential students, advises incoming transfer students, monitors the progress of students, and works with faculty on the curriculum. The Undergraduate Curriculum and Course Committee is appointed annually by the Chair and is charged with continual review of the curriculum and for making recommendations for changes to the faculty. All major changes to the curriculum are reviewed and approved by the faculty.

B. Authority and Responsibility of Faculty
The Department has an Administrative Coordinator, whose duties are to coordinate the fiscal and personnel matters of the department and direct activities of three administrative assistants and an accounts clerk. The administrative coordinator has signature authority and is responsible for payroll, monitoring purchases and providing accounting for extramural grants and Departmental state and federal accounts. The primary duty of one administrative assistant is to assist in the administration and documentation associated with the Department’s Graduate and Undergraduate degree programs. The Department also has technical and professional support personnel who assist the faculty in the execution of laboratory exercises and the fabrication of research apparatus and senior design project prototypes. Dr. Sue Nokes is the Director of Undergraduate Studies and serves as the leader of the Continuous Quality Improvement efforts and ex officio member of the Undergraduate Curriculum and Course committee (Dr. Czarena Crofcheck, Chair; members: Drs. Edwards, Payne, Stombaugh, Wells, and Nokes (ex-officio)). This committee is responsible for an annual Outcomes Assessment review and brings forward, to the full faculty, suggestions for improvement of curriculum and various current issues related to the program.

C. Faculty
The BAE faculty consists of nineteen individuals working at the Lexington Campus, including Assistant Dean (COA) Dr. Stephen Workman, and two Associate Extension Professors at the Princeton facility. The faculty are listed in Table 15 with corresponding classes taught. All BAE faculty have Ph.D. degrees, granted from eleven different universities. Table 16 lists faculty with education and activity details as of September 2009.
<table>
<thead>
<tr>
<th>Faculty Member</th>
<th>FT</th>
<th>Classes Taught (Course No./Credit Hour)</th>
<th>Total Activity Distribution</th>
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<tr>
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<td>Teaching</td>
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<td>Agouridis, Carmen</td>
<td>FT</td>
<td></td>
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</tr>
<tr>
<td>Colliver, Donald</td>
<td>FT</td>
<td></td>
<td>30%</td>
</tr>
<tr>
<td>Crofcheck, Czarena</td>
<td>FT</td>
<td>BAE 402/2</td>
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<tr>
<td>Edwards, Dwayne</td>
<td>FT</td>
<td>BAE 536/3</td>
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</tr>
<tr>
<td>Fehr, Robert</td>
<td>FT</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>McNeill, Samuel</td>
<td>FT</td>
<td></td>
<td>20%</td>
</tr>
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<td>Montross, Michael</td>
<td>FT</td>
<td>BAE 201/2</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>BAE 447/3</td>
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<tr>
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<td>BAE 102/1</td>
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</tr>
<tr>
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<td>BAE 599/3</td>
<td></td>
</tr>
<tr>
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<td>FT</td>
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<td>15%</td>
</tr>
<tr>
<td>Payne, Fred</td>
<td>FT</td>
<td>BAE 400/1</td>
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</tr>
<tr>
<td></td>
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<td>BAE 549/3</td>
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<tr>
<td>Shearer, Scott</td>
<td>FT</td>
<td></td>
<td>55%</td>
</tr>
<tr>
<td>Stombaugh, Timothy</td>
<td>FT</td>
<td></td>
<td>38%</td>
</tr>
<tr>
<td>Taraba, Joseph</td>
<td>FT</td>
<td>BAE 435G/3</td>
<td>10%</td>
</tr>
<tr>
<td>Warner, Richard</td>
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<td></td>
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</tr>
<tr>
<td>Wells, Larry</td>
<td>FT</td>
<td>BAE 417/3</td>
<td>60%</td>
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<tr>
<td></td>
<td></td>
<td>BAE 517/3</td>
<td></td>
</tr>
<tr>
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<td>FT</td>
<td></td>
<td>30%</td>
</tr>
<tr>
<td>Workman, Stephen</td>
<td>FT</td>
<td></td>
<td>10%</td>
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</table>

*Other includes time devoted to administration and/or extension.
<table>
<thead>
<tr>
<th>Faculty Member</th>
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<th>Classes Taught (Course No./Credit Hour) Spring Semester 2010</th>
<th>Total Activity Distribution</th>
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<td>BAE 532/3</td>
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<tr>
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<td>BAE 580/3</td>
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<td>BAE 202/3</td>
<td>78%</td>
</tr>
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<td></td>
<td></td>
<td>BAE 403/2</td>
<td></td>
</tr>
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<td>Edwards, Dwayne</td>
<td>FT</td>
<td>BAE 437/3</td>
<td>30%</td>
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<td>FT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>McNeill, Samuel</td>
<td>FT</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Montross, Michael</td>
<td>FT</td>
<td>BAE 427/3</td>
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<tr>
<td>Nokes, Sue</td>
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<td>BAE 502/1</td>
<td>67%</td>
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<tr>
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<td></td>
<td>BAE 599/3</td>
<td></td>
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<td>FT</td>
<td></td>
<td>15%</td>
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<tr>
<td>Payne, Fred</td>
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<td></td>
<td>70%</td>
</tr>
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<tr>
<td>Shearer, Scott</td>
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<tr>
<td>Stombaugh, Timothy</td>
<td>FT</td>
<td>BAE 305/3</td>
<td>38%</td>
</tr>
<tr>
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<td>FT</td>
<td></td>
<td>30%</td>
</tr>
<tr>
<td>Warner, Richard</td>
<td>FT</td>
<td></td>
<td>30%</td>
</tr>
<tr>
<td>Wells, Larry</td>
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<td>BAE 103/2</td>
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</tr>
<tr>
<td>Workman, Stephen</td>
<td>FT</td>
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</tr>
</tbody>
</table>

*Other includes time devoted to administration and/or extension.
Table 16. (ABET Table 6-2) Faculty Analysis

**Biosystems Engineering**

<table>
<thead>
<tr>
<th>Name*</th>
<th>Rank</th>
<th>Type of Appointment</th>
<th>FT or PT</th>
<th>Highest Degree and Field</th>
<th>Institution from which Highest Degree Earned &amp; Year</th>
<th>Years of Experience</th>
<th>Govt./Industry</th>
<th>Total Faculty</th>
<th>This Institution</th>
<th>State in which registered</th>
<th>Level of Activity (high, med, low, none)</th>
<th>Consulting/Summer Work</th>
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<td>1</td>
<td>Agouridis, Carmen</td>
<td>Asst</td>
<td>TT</td>
<td>FT</td>
<td>PhD BAE</td>
<td>University of Kentucky, 2004</td>
<td>0</td>
<td>4</td>
<td>6</td>
<td>KY</td>
<td>low</td>
<td>high</td>
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<tr>
<td>2</td>
<td>Colliver, Donald</td>
<td>Prof</td>
<td>T</td>
<td>FT</td>
<td>PhD AE</td>
<td>Purdue University, 1979</td>
<td>1</td>
<td>31</td>
<td>31</td>
<td>KY</td>
<td>high</td>
<td>med</td>
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<td>3</td>
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<td>University of Kentucky, 2001</td>
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<td>T</td>
<td>FT</td>
<td>PhD AE</td>
<td>Oklahoma State University, 1988</td>
<td>-</td>
<td>22</td>
<td>16</td>
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<td>T</td>
<td>FT</td>
<td>PhD AE</td>
<td>Iowa State University, 1976</td>
<td>-</td>
<td>34</td>
<td>34</td>
<td>KY</td>
<td>low</td>
<td>med</td>
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<td>T</td>
<td>FT</td>
<td>PhD AE</td>
<td>University of Tennessee, 1996</td>
<td>-</td>
<td>14</td>
<td>32</td>
<td>KY</td>
<td>med</td>
<td>med</td>
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<tr>
<td>7</td>
<td>Montross, Michael</td>
<td>Assoc</td>
<td>T</td>
<td>FT</td>
<td>PhD BAE</td>
<td>Purdue University, 1999</td>
<td>1</td>
<td>11</td>
<td>11</td>
<td>KY</td>
<td>med</td>
<td>high</td>
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<tr>
<td>8</td>
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<td>T</td>
<td>FT</td>
<td>PhD BAE</td>
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<td>2</td>
<td>14</td>
<td>14</td>
<td>OH</td>
<td>med</td>
<td>high</td>
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<td>Assoc</td>
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<td>FT</td>
<td>PhD BE</td>
<td>University of Nebraska, 1982</td>
<td>-</td>
<td>28</td>
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<td>10</td>
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<td>Prof</td>
<td>T</td>
<td>FT</td>
<td>PhD AE</td>
<td>University of Kentucky, 1980</td>
<td>5</td>
<td>30</td>
<td>25</td>
<td>-</td>
<td>med</td>
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<td>T</td>
<td>FT</td>
<td>PhD AE</td>
<td>Purdue University, 1989</td>
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<td>Prof</td>
<td>T</td>
<td>FT</td>
<td>PhD AE</td>
<td>Ohio State University, 1986</td>
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<td>24</td>
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<td>med</td>
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<td>T</td>
<td>FT</td>
<td>PhD AE</td>
<td>University of Illinois, 1998</td>
<td>-</td>
<td>10</td>
<td>10</td>
<td>KY</td>
<td>med</td>
<td>high</td>
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<td>14</td>
<td>Taraba, Joseph</td>
<td>Prof</td>
<td>T</td>
<td>FT</td>
<td>PhD</td>
<td>Ohio State University, 1978</td>
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<td>34</td>
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<td>med</td>
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<td>Institution</td>
<td>Year</td>
<td>Age</td>
<td>Rank</td>
<td>Race</td>
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<td>Prof</td>
<td>T</td>
<td>FT</td>
<td>PhD</td>
<td>ChemE</td>
<td>Clemson University, 1981</td>
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<td>29</td>
<td>31</td>
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<td>high</td>
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<td>16</td>
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<td>T</td>
<td>FT</td>
<td>PhD</td>
<td>Envir Sys Eng</td>
<td>North Carolina State University, 1975</td>
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<td>35</td>
<td>35</td>
<td>KY</td>
<td>med</td>
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<tr>
<td>17</td>
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<td>Assoc</td>
<td>TT</td>
<td>FT</td>
<td>PhD</td>
<td>BAE</td>
<td>Virginia Polytechnic Institute &amp; State University, 1989</td>
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<td>10</td>
<td>VA</td>
<td>low</td>
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<td>18</td>
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<td>T</td>
<td>FT</td>
<td>PhD</td>
<td>BAE</td>
<td>North Carolina State University, 1990</td>
<td>6</td>
<td>14</td>
<td>14</td>
<td>KY</td>
<td>med</td>
</tr>
</tbody>
</table>

* In addition, Emeritus Professors include: George Duncan, Joe Ross, John Walker, Blaine Parker, Gerry White, Linus Walton
D. Faculty Competencies
Of the nineteen regular or Extension faculty on campus (September 2009), excluding the Chair and Assistant Dean, one holds the rank of Research Assistant Professor, six are Associate Professors and ten are Professors. Six members of the faculty have received the top teaching award in both the College of Agriculture and College of Engineering and three have received the University Provost teaching award for non-tenured faculty and a USDA Southeast Region Teaching Award. Four members of the faculty have received the Young Teacher award from the American Society of Agricultural and Biological Engineers. The strong tradition of excellence in teaching by BAE faculty is recognized by both Colleges of Engineering and Agriculture administration, the student body, and alumni of the program. A formal faculty mentoring and review process has been implemented for all untenured faculty members. All faculty members are encouraged to attend teaching development workshops regularly offered on campus.

Fourteen faculty hold the P.E. license. Licensure is considered important by the faculty and a Kentucky statute requires licensure to teach engineering design at the undergraduate level.

E. Faculty Size
Of the eighteen BAE faculty, nine BAE faculty have formal teaching assignments, while eight have a formal Extension appointment. Four Extension faculty have a teaching assignment as well, typically teach one course per year, primarily either upper division undergraduate or graduate courses. The average faculty teaching assignment was 24.3% in 2009-2010 for the sixteen Lexington-based faculty, which equates to approximately two courses per year (see Table 15). The remaining two faculty are based in Princeton. Faculty teaching workload is fairly evenly distributed among teaching faculty; however the teaching efforts listed in Table 15 also include effort for student advising, administration, and teaching graduate courses. Instructors teaching new courses, and courses with significant laboratory time, are weighted more heavily in the teaching distribution of effort, as recognition of the importance of these activities. This is especially important given the lack of teaching assistant lines.

The undergraduate program has a fairly stable population of 60-70 students. The program is attractive to students for a number of reasons, including: the only Biological and similarly named accredited program in Kentucky, a broad-based curriculum focused on fundamentals of engineering, a unique pre-biomedical and pre-veterinary program, and active recruitment that articulates the positive benefits of smaller class sizes and greater faculty:student interactions.

A key element in our retention strategy has been to revise our curriculum (Table 12) to ensure that most students are involved in a BAE course every semester of their first two critical years. Table 15 lists those courses taught in 2009-2010. This curriculum has been implemented since the 1998 accreditation visit and was done as a means of addressing the relatively remote location of the department compared to the venue for most engineering courses. Thus, incoming freshman enroll in BAE 102 in the fall semester, BAE 103 in spring semester, and BAE 201 and BAE 202 in the sophomore year. Students are encouraged to form cohorts. The requirement for students to enroll in a
class in the C.E. Barnhart Building each semester of the first two years provides opportunity for faculty to build relationships with these cohorts, encourage participation in student branch and other activities, and become acquainted with the students. We judge this approach to be critical to retention and to an enhanced undergraduate engineering experience.

Students in the BAE Student Branch organization are encouraged to join one of three professional societies, namely ASABE, ASHRAE, or IBE. Regular biweekly meetings of the student branch are held during the academic year, with officers elected to represent the Engineering Student Council and the Agriculture Student Council. Faculty involvement with student branch activities includes facilitation of meetings and topics, assistance with fund-raising, and organization of annual regional trips (typically the Southeast Student Rally and North Central Rally). In 2005, the North Central Rally was held at UK and, in 2006 the Southeast Rally was held at UK. Each year a different faculty member is the primary advisor; for continuity, the faculty advisor from the prior year and the expected advisor for the next year are also involved.

Students have also been actively involved in the annual ASABE ¼-scale tractor design competition. This competition draws membership from the full array of BAE undergraduates (fifteen students traveled to Peoria, IL in 2009), not only those with a machinery systems focus. The team members are involved in all aspects of the project, including securing the majority of direct expenses. Several faculty (Drs. Shearer, Wells, Montross, and Stombaugh) and additional engineers on staff assist the students.

F. Faculty Resumes
Faculty resumes are included in Appendix B.

G. Faculty Development
Professional development of faculty members can include involvement in professional conferences and workshops (research, teaching, or administrative), professional societies, and participation in professional development activities associated with the university, Colleges of Agricultural and Engineering, or the Department.

Involvement in professional conferences and workshops (research, teaching, or administrative).

The faculty members in BAE are active in research and/or extension. Through research/extension, these faculty members regularly interact with colleagues nationally and internationally, and keep current in their fields. Table 17 includes example professional conferences or other professional development travel for each faculty member.
<table>
<thead>
<tr>
<th>BAE Faculty</th>
<th>Professional Societies</th>
<th>Conferences or other Professional Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agouridis</td>
<td>ASABE; Am. Soc. of Mining &amp; Reclamation; Appalachian Regional Reforestation Initiative; Am. Soc. of Civil Engineers; Alpha Epsilon</td>
<td>2010 – EPA Regional Meeting, Atlanta, GA. 2009 – Geomorphic Reclamation Conference at Southern Illinois University; Joint Meeting of GCAGS and NRCS. 2008 – SME Annual Meeting; SEDCAD 4 Workshop. 2005 – Master of Public Policy. Martin School of Public Policy and Administration, University of Kentucky, (55% complete).</td>
</tr>
<tr>
<td>Crofcheck</td>
<td>ASABE; Institute of Biological Engineering (IBE), Alpha Epsilon, Gamma Sigma Delta</td>
<td>2010 – ASABE Annual Conference, Pittsburgh, PA; Institute of Biological Engineers Meeting, Boston, MA. 2009 – ASABE Annual Conference, Reno, NV. Attended various teaching improvement workshops sponsored by the UK College of Agriculture, Lexington, KY.</td>
</tr>
<tr>
<td>Nokes</td>
<td>ASABE, American</td>
<td>2010 – ASABE Annual Conference, Pittsburgh, PA.</td>
</tr>
<tr>
<td>Name</td>
<td>Organization</td>
<td>Year(s)</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Payne</td>
<td>ASABE, Institute of Food Technologists (IFT), The International Society for Optical Engineering (SPIE)</td>
<td>2010 – ASABE Annual Conference, Pittsburgh, PA; ASABE Foundation Board of Trustees Meeting, St. Joseph, MI; Industry Summit Meeting by Walker Transport, Madison, WI. 2009 – ASABE Annual Conference, Reno, NV.</td>
</tr>
<tr>
<td>Purschwitz</td>
<td>ASABE, National Institute for Farm Safety (NIFS), Tau Beta Pi, Gamma Sigma Delta</td>
<td>2010 – NCERA-197 Multi-State Project Meeting, USDA-NIFA, Washington, D.C.; KY ASABE Student Branch Mid-West Region Rally, Champaign, IL; NIOSH Conf., Cooperstown, NY. 2009 – NIOSH Conference, Cincinnati, OH; Western KY Research and Educational Center Field Day; ASABE Annual Conference, Reno, NV.</td>
</tr>
<tr>
<td>Stombaugh</td>
<td>ASABE, Gamma Sigma Delta, Alpha Epsilon</td>
<td>2010 – ASABE Annual Conference, Pittsburgh, PA; International Conference on Precision Agric., Denver, CO. 2009 – ASABE Annual Conference, Reno, NV; Seventh European Conference on Precision Agriculture, Wageningen, Netherlands; Agricultural Equipment Technology Conference, Louisville, KY.</td>
</tr>
<tr>
<td>Taraba</td>
<td>ASABE, Gamma Sigma Delta, Sigma Xi, Amer. Institute of Chemical Engineers, Am.</td>
<td>2010 – S-1025 Joint Annual Meeting – Controlling Air Pollutant Emissions from Animal Agriculture Facilities, Sacramento, CA; Environmental Compliance Training Greenhouse Gas Workshop, Frankfort, KY; Cattlemen Association Meetings,</td>
</tr>
</tbody>
</table>
Financial support for these activities comes from grants and contracts, departmental funds, and sometimes College of Agriculture funds. Because of the successful research activity of most department faculty, most professional travel is supported by research grants associated with the individual faculty members. The Department dedicates funds for professional development, and in FY2009, this totaled $13,027. Decisions regarding use of departmental resources are made by the Chair. Departmental support is available for conferences or workshops for faculty without other sources of support, or for conferences specifically benefitting the department (examples: ABET, ECEDHA, etc. or conferences on key topics on instructional strategies in areas of departmental need).

In addition to the above sources of support, the College of Engineering and the Office of the Vice President for Research have limited funds for faculty for travel to professional development conferences.

**Involvement in professional societies**

Faculty of the BAE Department are active in professional societies, as shown in Table 17.

**Participation in professional development activities associated with the university or department.**

The University offers professional development activities through the Teaching and Academic Support Center (TASC). TASC provides a wide variety of educational support services, including: seminars, workshops and individual consultation to improve instructional skills; audio-visual and classroom support services; web-based resource materials; and instructional technology support. In addition, faculty in BAE are eligible to take advantage of teaching improvement workshops sponsored by the College of Agriculture.
CRITERION 7. FACILITIES

A. Departmental Space

The Department of Biosystems and Agricultural Engineering has been housed in the Charles E. Barnhart Building since 1990. This is located in the College of Agriculture complex south of central campus. The department has available 4,576 m² (49,252 ft²) space in offices, classrooms and laboratories. It is approximately a twenty minute walk to the Engineering College buildings. The Barnhart Building four-story office tower is shared with the Department of Agricultural Economics (top two floors). Each floor has a gross area of 604 m² (6,500 ft²) and contains central rooms and 21 perimeter offices. The University maintains one classroom on the second floor; the Department maintains a computer laboratory on the first floor, and an Engineering Design Laboratory (Room 236) on the second floor that is used heavily for instruction.

Attached to the Barnhart office tower is the department’s laboratory facilities, featuring 3,373 m² (36,306 ft²) of laboratories. This space includes a long (>100m) central hallway with laboratories for electronics, mechanical fabrication, wet chemistry, material properties analysis and fermentation technologies on one side and large high-bay laboratories for controlled environment systems, grain handling, machinery systems, food engineering, biomechanics and bioprocess engineering on the other. Two large arms off this central corridor provide additional labs housing controlled temperature-humidity units, fabrication areas for student and research projects, and a series of bays for soil and machinery interaction testing, surface and sub-surface hydrology, and waste management. One laboratory (153) is dedicated to electronics and instrumentation instruction.

These facilities provide adequate quality space for undergraduate and graduate instruction needs. Current infrastructure challenges related to several years of budget shortfall include the need for a new roof, and implementation of wireless internet connectivity.

The Department also maintains the Agricultural Machinery Research Laboratory and HVAC Training Facility, a 17,000 ft² steel structure located near the football stadium. Four full-time staff are employed and housed in this facility, providing key engineering, fabrication and machining support for the wide variety of teaching projects, particularly the capstone design course. Typically, four to twelve undergraduate students are employed on various projects in this facility. Since the last review, the space between these two buildings was enclosed increasing the square footage of the facility by 2600 ft².

B. Resources and Support

1. The student computer lab includes eighteen personal computers, networked printers, and restricted access for BAE students, staff and faculty. The computers in this lab have been updated twice since 2004, the most recent being in 2008. There are several specialized programs installed on these computers for our students’ use, including Microsoft Office, Visio, Ansys, ArcInfo, EndNote 2x, Microsoft Expression Web 2, Microsoft Visual Basic 2008 Enterprise, SAS, SigmaPlot, AutoCAD, and ProE.

The engineering design room includes internet access, computer-based projection and audio-visual equipment. A computer identical to the ones in the student computer laboratory is installed in that room as well to be used for teaching.
Shared network space is available for use by classes to share files and programs. Faculty also have web authoring access for use with their class as desired.

2. The BAE computer committee continually oversees the computing resources in the department. This committee has established a policy of replacing the computers in the student laboratory every 2-3 years as funds permit. The replaced computers are first committed to the electronics teaching laboratory to be used for data acquisition and microcontroller development. Computers not needed in that facility are then moved to other teaching/research labs as needed.

Other specialized laboratory facilities are maintained by the respective faculty members. Various pieces of state-of-the-art equipment that are purchased for research projects are also utilized for teaching. This equipment is updated as new research projects are initiated.

3. The department has one full time staff member committed fully to oversight and maintenance of the computing and network resources. This person is accountable to the computer committee. There is also a full time staff member committed to support of electronics and instrumentation. Though this person supports research activities as well, a significant portion of their time is committed to the support of instruction in instrumentation, and in that capacity, they also support the computing resources for teaching.

4. The department supports three full time staff managers to oversee the mechanical fabrication, wet chemistry, and general laboratory areas, respectively. In addition, several other full-time staff, some supported by the department, and some supported on soft money, assist in the maintenance and use of laboratory facilities.

C. Major Instructional and Laboratory Equipment
In Appendix C, include a list of major instructional and laboratory equipment.
CRITERION 8. SUPPORT

A. Program Budget Process and Sources of Financial Support
Faculty are on twelve-month appointments in the College of Agriculture. Students are formally enrolled in the College of Engineering, and have close ties with College of Agriculture services, faculty and staff. Students compete for scholarships in both Colleges.

B. Sources of Financial Support
Annual budgets for the BAE Department include approximately $3.5M of state funding (including personnel benefits) distributed among teaching, research and cooperative extension accounts. Most faculty and staff lines are funded from two or more accounts. For FY 11, the department is facing a $35K recurring cut that is being handled through elimination of a vacant staff position. A hiring freeze is currently in effect.

The annual budget is developed in conjunction with the Dean of the College of Agriculture. The teaching budget for FY 10 was $513,493 and has remained relatively stable since the previous accreditation visit. The departmental accounting system does not readily lend itself to determining actual expenditures for teaching-related activities (e.g. copier use, telephones, etc.). The financial expenditures listed in Table I-5 include all funds in the state teaching account and a pro-rated portion from state research and extension accounts. A $122,500 USDA Higher Education Challenge grant was awarded in 2006 as a subcontract from Iowa State University. This is a collaborative project with Iowa State University and University of Idaho to develop biobased courses for internet delivery. The Principal Investigator is Dr. Sue Nokes and Co-Investigators are Drs. Czarena Crofcheck and Larry Wells. A $239,965 extramural grant was awarded in 2009 from the U.S. Department of Education for an undergraduate exchange program with Brazilian institutions. Dr. Timothy Stombaugh is the Principal Investigator and Dr. Stephen Workman is Co-Investigator. Funds for the ¼-scale design team include donations of about $19,200 in 2010.

C. Adequacy of Budget
Institutional support is adequate for maintenance of our undergraduate program. State budget shortfalls have created some administrative challenges in the last two fiscal years, but the teaching program has been relatively unscathed in the process.

D. Support of Faculty Professional Development
Faculty professional development is regularly supported and encouraged. An annual professional meeting (ASABE, IBE, ASHRAE) is attended by most faculty. Recent budget shortfalls have required that faculty secure funding from alternate sources; however, partial expense reimbursement is still a goal. Approximately $1300 per eligible faculty and $880 per eligible graduate student will be spent for the ASABE and ASHRAE meetings in 2010. Faculty also attend many regional, national and international meetings and find support from a variety of sources including their grants, the sponsoring agency, and the Associate Dean for Research in the College of Agriculture’s program for refund of some grant indirect costs.
E. Support of Facilities and Equipment
The department does not have an explicit plan in place for regular replacement of obsolete equipment, partially because it is not possible to carry forward budgeted state funds past a fiscal year. Hence, the decision to maintain a departmental computer laboratory without specific recurrent upgrade support requires some flexibility and creativity on the part of the faculty, but an in-house computer laboratory is seen as a strong benefit for our student programs. We have been able to maintain high quality systems since creation of the laboratory in 1990. Having a full-time system administrator on-hand has meant that the department has been less affected by recent computer viruses and related problems than most other units on campus. The UK College of Agriculture support for this position has been critical.

F. Adequacy of Support Personnel and Institutional Services
Other staff lines are budgeted across research, extension and teaching accounts. Several professional staff are pursuing graduate degrees part-time. The staff contributes greatly to the ambiance of collegiality and support for our undergraduate students. Part-time employment for students provides opportunity for interaction between staff and students, and faculty view staff support for students as critically important. A great deal of flexibility is afforded by most supervisors for staff to assist in student projects, social functions and related events.

Table 18. (ABET Table 8.1) Support Expenditures.

<table>
<thead>
<tr>
<th>Expenditure Category</th>
<th>2008 (prior to previous year)</th>
<th>2009 (previous year)</th>
<th>2010 (current year)</th>
<th>2011 (year of visit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations (not including staff)</td>
<td>71,906</td>
<td>52,287</td>
<td>41,438</td>
<td>45,205</td>
</tr>
<tr>
<td>Travel</td>
<td>12,040</td>
<td>12,183</td>
<td>4,744</td>
<td>5,175</td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institutional Funds</td>
<td>1,855</td>
<td>11,061</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Grants and Gifts</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Graduate Teaching Assistants</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Part-time Assistance (other than teaching)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Biosystems & Agricultural Engineering
CRITERION 9. PROGRAM CRITERIA

The program criteria for “Biological and similarly named engineering programs” states:

“Programs must demonstrate that graduates have proficiency in mathematics through differential equations, a thorough grounding in chemistry and biology, and a working knowledge of advanced biological sciences consistent with the program educational objectives. Competence must be demonstrated in the application of engineering to biological systems.”

Our program requires mathematics through differential equations. The students demonstrate their mathematics proficiency in our upper division design classes. The thorough grounding in chemistry and biology occurs during the year of chemistry, and the year and a half of biology our students are required to take. The working knowledge of advanced biological sciences, consistent with the program educational objectives, is demonstrated in our core design courses. Students are required to have completed their biology before attempting these courses, and the different courses require different biological knowledge bases depending on the systems the course is teaching the students to design. For example, BAE 447 requires the knowledge of biological material properties, BAE 427 requires knowledge of mammal physiology, and BAE 437 requires knowledge of soil physics and microbiology within biosystems engineering. The students demonstrate competence in the application of engineering to biological systems through the capstone design experience.
APPENDIX A - COURSE SYLLABI

BAE 102: Introduction to Biosystems Engineering
Biosystems and Agricultural Engineering
University of Kentucky
Fall 2009

Course (Catalog) Description: An introduction to the engineering of food and fiber production and processing systems. Professionalism and the engineering approach will be emphasized. 1 credit hour. Prerequisites: None. *This course is required.*

Class Schedule: Lecture: MW 3:00-4:50 pm; CE Barnhart Building, Room 227


Learning Outcomes: At the end of this class, a successful student will:

- Seek assistance from other students, staff, and faculty and be familiar with the facilities in the department of Biosystems and Agricultural Engineering.
- List and describe the technical options available to BAE majors, and give examples of how technical course selection differs by option.
- Use the engineering computing facilities and software packages (i.e., search electronic databases; analyze engineering data; prepare and transmit engineering reports and documents electronically).
- Accurately describe potential careers of a biosystems engineer.
- Work cooperatively on a team.
- Write a resume and cover letter, and strategically plan activities to develop desired resume.
- Understand the FE and PE exam format and content.
- Know, understand, and correctly apply the engineering approach to problem solving.

Topics:

<table>
<thead>
<tr>
<th>Professionalism Topic</th>
<th>Textbook Topic</th>
<th>Reading (to be read before class)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chair’s welcome/treasure hunt</td>
<td>Syllabus/topic outline</td>
<td></td>
</tr>
<tr>
<td>Clubs</td>
<td>Problem solving and the engineering approach</td>
<td>Chapter 1 &amp; 2</td>
</tr>
<tr>
<td>Resumes</td>
<td>Gathering info</td>
<td>Chapter 3</td>
</tr>
<tr>
<td>Transitions</td>
<td>Defining the problem</td>
<td>Chapter 4</td>
</tr>
<tr>
<td>Teamwork</td>
<td>Creativity</td>
<td>Chapter 5</td>
</tr>
</tbody>
</table>
Contribution of course to meeting the program criteria: The course is intended to be taken by a first-semester freshman, or a first-semester transfer student. In addition to the information on university life, problem solving, engineering in general and biosystems engineering in particular, technical material is presented on using the advanced features of Microsoft Word and Microsoft Excel. Homework assignments and small assigned projects reinforce these skills. In this way, this course provides the students with an opportunity to get up to speed with word processing and spreadsheet applications. Students will revisit problem solving in BAE 103 and extensively use Excel in BAE 201.

Relationship of Course to Program Outcomes:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Outcome Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Graduates should demonstrate an ability to use techniques, skills and modern engineering tools necessary for engineering practice.</td>
</tr>
<tr>
<td>10</td>
<td>Graduates should be able to work within a team approach to complete projects that include multiple facets.</td>
</tr>
<tr>
<td>12</td>
<td>Graduates should have an understanding of professional and ethical responsibility.</td>
</tr>
<tr>
<td>15</td>
<td>Graduates should know the importance of and be engaged in the process of becoming a Registered Professional Engineer.</td>
</tr>
<tr>
<td>16</td>
<td>Graduates should have been active in student clubs and professional organizations.</td>
</tr>
</tbody>
</table>

Prepared by: Sue Nokes, May, 2010
Course (Catalog) Description: This course introduces the concepts of energy transport in biological systems, including the study of thermodynamics, heat transfer, psychrometrics and fluid flow. 2 credit hours. Prerequisites: BAE 102, MA 113 (concurrent). This course is required.

Class Schedule: Lecture: 2—50 minute sessions per week

Textbooks (suggested):

Course Learning Outcomes:
- To apply the engineering problem solving approach to perform energy balances on biological systems.
- To apply the fundamental laws of thermodynamics to solving problems relating to energy transfer and transformations within biological systems.
- To use the psychrometric chart to solve problems relating to air-water vapor mixtures.
- To apply the Gibb’s Energy concept to estimate the chemical potential to build proteins and power muscle contraction.
- To use direct and indirect bomb calorimetry to estimate the energy content of biological materials.
- To estimate the power and energy requirements for controlling plant and animal environments.

Topics Covered:
- Unit and dimensional analysis
- Problem solving
- Defining systems (biological, chemical, thermal, mechanical, electrical)
- Laws of thermodynamics
- Work, energy, power
- Conservation of energy (internal combustion engine)
- Conversion of energy (photosynthesis)
- Conversion efficiency (Carnot cycle)
- State change (heat capacity, heat of fusion, heat of vaporization)
- Fluid flow in biosystems (mass balance, Bernoulli’s equation, pressure loss)
- Psychrometrics (heating, cooling, humidification, dehumidification, drying, latent and sensible heat balance)
• Elementary heat transfer in biosystems (conduction, convection, insulation)
• Heating (energy sources and conversion)
• Refrigeration (air conditioning, heat pumps)
• Thermodynamics of microorganisms
• Gibb’s energy
• Calorimetry

Contribution of course to meeting the program criteria: The class contributes two credit hours to the engineering science components of the program.

Relationship to Program Outcomes:

BAE 103

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Outcome Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Graduates must demonstrate their ability to apply knowledge of mathematics, science and engineering to solve problems.</td>
</tr>
<tr>
<td>2</td>
<td>Graduates should demonstrate an ability to use techniques, skills and modern engineering tools necessary for engineering practice.</td>
</tr>
<tr>
<td>4</td>
<td>Graduates must demonstrate an ability to identify, formulate, and solve engineering problems.</td>
</tr>
<tr>
<td>6</td>
<td>Graduates should gain experience in solving BAE problems that are vague or poorly constrained.</td>
</tr>
</tbody>
</table>

Prepared by: Larry G. Wells, Ph.D., P.E., Professor, April 2010
Course (Catalog) Description: The financial and managerial aspects of biosystems in evaluating design alternatives. Typical topics included are: concepts of present and future value, techniques of managerial economics, and biosystem design analysis in the evaluation of alternatives. Retirement/replacement policies and risk analysis. 2 credit hours. Prerequisite: MA 113. This course is required.

Class Schedule: Lecture: MW 8:00 to 8:50 AM


Learning Outcomes:
- To develop an appreciation of the importance of economics and decision analysis processes in evaluating alternative engineering systems.
- To introduce many of the processes and procedures used in effective economic analysis.
- To gain skills in conducting economic analyses of typical engineering problems, including alternatives and risk assessments.

Topics: Nominal and effective interest rates, present worth analysis, annual equivalent analysis, rate of return, depreciation and taxes

Contribution of course to meeting the program criteria: The course is a required sophomore level course. Initial coverage of engineering economics is a course component. BAE 201 course objectives are to learn the principles of engineering economic analysis and apply these principles to the design, financial and managerial aspects of biosystems.
Relationship of Course to Program Outcomes: This course covers topics that are focused on outcomes 1, 2, and 4. In addition, some coverage of outcomes 11, 12, 13, 15, and 16 is accomplished.

BAE 201

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Outcome Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Graduates must demonstrate their ability to apply knowledge of mathematics, science and engineering to solve problems.</td>
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<td>10</td>
<td>Graduates should be able to work within a team approach to complete projects that include multiple facets.</td>
</tr>
<tr>
<td>12</td>
<td>Graduates should have an understanding of professional and ethical responsibility.</td>
</tr>
<tr>
<td>13</td>
<td>Graduates should have a knowledge of contemporary issues.</td>
</tr>
<tr>
<td>15</td>
<td>Graduates should know the importance of and be engaged in the process of becoming a Registered Professional Engineer.</td>
</tr>
<tr>
<td>16</td>
<td>Graduates should have been active in student clubs and professional organizations.</td>
</tr>
</tbody>
</table>

Prepared by: Michael Montross, May 2010
Course (Catalog) Description: Introduction to biosystems engineering: engineering problem solving; computer applications and structured programming; probability; and statistics. Emphasis on application of these skills to biosystems applications. 3 credit hours. Prerequisites: MA 113 and sophomore standing. This course is required.

Class Schedule: Lecture: MW 1:00-1:50 in CE Barnhart Building, Room 236; Laboratory: F 1:00-2:50 in CE Barnhart Building, Room 136


Learning Outcomes: At the end of this class, a successful student will have:
- an understanding of probability and statistics,
- the ability to apply fundamental knowledge to solve engineering problems,
- an appreciation for the breadth and scope of biosystems engineering, and
- the ability to use a computer to understand, describe, and solve problems.

Topics: descriptive statistics, histograms, probability, combinations, permutations, discrete probability distributions, binomial, Hypergeometric, uniform, normal, log-normal, sampling distribution, hypothesis testing, linear regression, and experimental design

Contribution of course to meeting the program criteria: The course is intended to be taken by a sophomore. In addition to the technical material presented, several written reports are assigned. In this way, this course also provides the students with an opportunity to hone their writing skills. The students will revisit experimental design and hypothesis testing in senior design.

Relationship of Course to Program Outcomes: This course includes content that directly relates to Outcomes 1, 2, 3, 6, and 8. Outcome 3 is specifically assessed in this course, which is that graduates should be able to design and conduct experiments, as well as to analyze and interpret data.
## BAE 202

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Outcome Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Graduates must demonstrate their ability to apply knowledge of mathematics, science and engineering to solve problems.</td>
</tr>
<tr>
<td>2</td>
<td>Graduates should demonstrate an ability to use techniques, skills and modern engineering tools necessary for engineering practice.</td>
</tr>
<tr>
<td>3</td>
<td>Graduates should be able design and conduct experiments, as well as to analyze and interpret data.</td>
</tr>
<tr>
<td>6</td>
<td>Graduates should gain experience in solving BAE problems that are vague or poorly constrained.</td>
</tr>
<tr>
<td>8</td>
<td>Graduates should demonstrate effective interpersonal, formal, and technical communications skills whether oral or written.</td>
</tr>
</tbody>
</table>

**Prepared by:** Czarena Crofcheck, February 22, 2010
Course (Catalog) Description: An introduction to the use of digital electronics and integrated circuits in solving biosystems engineering problems. Digital circuits, microprocessor concepts, computer interfacing, transducers, signal conditioning and control applications are discussed. 3 credit hours. Prerequisites: EE 305 or EE 306. This course is required.

Class Schedule: Lecture: two hours per week; Laboratory: two hours per week.

Text:
- Lecture Outlines: Provided by instructor

Learning Outcomes: Students successfully completing this course should be able to:
- Analyze and design basic analog signal conditioning circuitry.
- Construct and troubleshoot basic analog and digital circuits.
- Identify sources of electromagnetic interference and methods for elimination.
- Statistically scrutinize data obtained from instrumentation systems.
- Understand techniques and limitations of converting analog to digital signals.
- Use common computer interfacing protocols.
- Understand and use basic sensor technologies.

Topics:

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture Topic</th>
<th>Reading</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/13</td>
<td>Introduction</td>
<td>1</td>
<td>1. Lab Orientation</td>
</tr>
<tr>
<td>1/18</td>
<td>MLK</td>
<td>2</td>
<td>2. Circuit Measurement</td>
</tr>
<tr>
<td></td>
<td>Electrical Components</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>1/25</td>
<td>Circuit Analysis/Measurement</td>
<td>5</td>
<td>3. Op Amps</td>
</tr>
<tr>
<td></td>
<td>Op Amps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/1</td>
<td>Op Amps</td>
<td></td>
<td>4. Signal Conditioning</td>
</tr>
<tr>
<td></td>
<td>Signal Conditioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/8</td>
<td>Power Supplies</td>
<td>10.1-10.3</td>
<td>5. Power Supplies</td>
</tr>
<tr>
<td></td>
<td>Transistors, Relays, Switches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/15</td>
<td>Electromagnetic Interference</td>
<td>4</td>
<td>6. Analog Controller</td>
</tr>
<tr>
<td></td>
<td>Filters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/22</td>
<td>Filters</td>
<td></td>
<td>(Cont.)</td>
</tr>
<tr>
<td>Date</td>
<td>Topic</td>
<td>Syllabus References</td>
<td>Notes</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------</td>
<td>---------------------</td>
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</tr>
<tr>
<td>3/1</td>
<td>Numbering Sys./Digital Logic</td>
<td>6.1, 6.2, 6.8</td>
<td></td>
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<tr>
<td></td>
<td>A/D Conversion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>A/D Conversion</td>
<td></td>
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<tr>
<td></td>
<td>A/D Conversion</td>
<td></td>
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<tr>
<td>3/15</td>
<td><strong>SPRING BREAK</strong></td>
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<tr>
<td>3/22</td>
<td>Microcontrollers</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Data Communications</td>
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<tr>
<td>3/29</td>
<td>Statistic data interpretation</td>
<td>Handout</td>
<td>10</td>
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<td></td>
<td>Statistics</td>
<td></td>
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<tr>
<td>4/5</td>
<td>Confidence Intervals</td>
<td></td>
<td>11</td>
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<tr>
<td></td>
<td>Instrument Error/Selection</td>
<td></td>
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<tr>
<td>4/12</td>
<td>Sensors</td>
<td>9</td>
<td>(Cont.)</td>
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<tr>
<td></td>
<td>Sensors</td>
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<tr>
<td>4/19</td>
<td>Sensors</td>
<td></td>
<td>12</td>
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<tr>
<td></td>
<td>Sensors</td>
<td></td>
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</tr>
<tr>
<td>4/26</td>
<td>Actuators and Control</td>
<td>10, 11</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Clean-up/Review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5/5</td>
<td>Final exam 10:30 a.m.</td>
<td></td>
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</tr>
</tbody>
</table>

**Contribution of course to meeting the program criteria:** This course is intended to give students practical experience in the design and use of analog and digital instrumentation systems to solve agricultural and biosystems problems. Guidelines used in the selection of commercial sensors and measurement systems as well as commonly overlooked limitations of instruments are discussed.

**Relationship of Course to Program Outcomes:**

BAE 305

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Outcome Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Graduates should be able design and conduct experiments, as well as to analyze and interpret data.</td>
</tr>
<tr>
<td>9</td>
<td>Graduates should demonstrate recognition of the need for and an ability to engage in life-long learning.</td>
</tr>
<tr>
<td>10</td>
<td>Graduates should be able to work within a team approach to complete projects that include multiple facets.</td>
</tr>
</tbody>
</table>

**Prepared by:** Timothy S. Stombaugh, May 2010
Course (Catalog) Description: A course for senior students in biosystems and agricultural engineering with emphasis on oral communications skills. Students will do literature searches on topics related to the biosystems and agricultural engineering profession and present oral and written reports. 1 credit hour. Prerequisites: COM 199 and senior standing in Biosystems and Agricultural Engineering. This is a required course.

Class Schedule: M 3:00 pm – 4:30 pm, CE Barnhart Building, Room 236

Reference: Bostom, Speaking in Public. (Text required for COM 199.)

Learning Outcomes:
Course Objectives: This course is designed to enhance and further develop the oral communication skills of students with particular emphasis on technical presentations. It is intended to build on the prerequisite, COM 199 - Presentational Communication Skills, and requires literature searches for presentation development. In addition, professional topics relating to engineering, ethics, professional registration, professional societies, goal setting, etiquette and personal commitment will be discussed and interspersed with topics on oral communication.

Topics:
- Oral communication (9 classes + 1 Toastmasters meeting)
- Engineering profession, life-long learning opportunities (1 class)
- Professional engineering registration and benefits (1 class)
- Professional resumes and class introduction (1 class)
- Personal development (etiquette, dress, interviewing, goals) (1 class)

Contribution of course to meeting the program criteria: The ability to communicate effectively is a necessary skill for engineering students in our society. This course provides the students with an incubator to grow and develop their oral communication skills in a friendly and hospitable environment. The friendly attitudes generated in class are conducive to rapid growth in communication skills. Professional maturity and personal confidence generated are a great boost for the starting engineer.
Relationship of Course to Program Outcomes

Relationship of course to program outcomes: The ability to communicate effectively is a necessary skill for engineering students in our society. This course provides the students with an incubator to grow and develop their oral communication skills in a friendly and hospitable environment. The friendly attitudes generated in class are conducive to rapid growth in communication skills. Professional maturity and personal confidence generated are a great boost for the starting engineer. Each student prepares and delivers five 5-minute speeches. The first is regarding their personal life, the second is a PowerPoint presentation on a major historical engineering or scientific accomplishment, the third is a speech to a non-technical audience, the fourth is structured around a “Contemporary Issue" in which the student is asked to present the viewpoint of a discipline other than engineering, and the fifth is a formal presentation in which students showcase their oral technical presentation skills to a panel of three external evaluators.

<table>
<thead>
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<td>Graduates should have an understanding of professional and ethical responsibility.</td>
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<td>Graduates should know the importance of and be engaged in the process of becoming a Registered Professional Engineer.</td>
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</table>

Prepared by: Fred A. Payne, May 2010
Course (Catalog) Description: A design course for seniors in BAE requiring students to solve open-ended problems. Students will use previously learned engineering principles to produce actual designs which will be built and analyzed in BAE 403. 2 credit hours. Prerequisites: Engineering standing in BAE or consent of instructor. This course is required.

Class Schedule: Lecture T 3-3:50 pm, Laboratory: W 3-4:50 pm


Learning Outcomes: Upon successful completion of BAE 402, each student will be able to:

- Understand the various roles that constitute a design team and how team members interact for maximum productivity.
- Define an open-ended design problem and apply previously learned engineering principles in the formulation and development of a solution.
- Utilize and demonstrate effective oral and written communication in presenting a design proposal and a preliminary design report.
- Apply appropriate ethical principles, as well as ensure an appropriate and viable solution to an open-ended design problem.
- Apply sound manufacturing, economic and safety considerations in the development of a design solution.
- Utilize CAD software, spreadsheets, presentation software, etc. in the development and presentation of a design solution.


Contribution of course to meeting the program criteria: BAE 402/403 includes team experiences, problem formulation, multiple presentations to a technical audience that includes engineers from appropriate industries, and prototype fabrication/construction, testing and analysis.
**Relationship of Course to Program Outcomes:** This course includes content that directly relates to Outcomes 1, 2, 3, 6, 8, and 16. Outcome 3, 6, 8, and 16 are specifically assessed in this course.

BAE 402

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</table>

**Prepared by:** Czarena Crofcheck, February 22, 2010
Course (Catalog) Description:  Student design teams evaluate and enhance design solutions, fabricate prototypes, execute performance tests, analyze results, and develop final design specifications. Oral and written reports are required. 2 credit hours.

Prerequisites:  BAE 402. This course is required.

Class Schedule:  Lecture: M 3-3:50 pm, Laboratory: T 3-4:50 pm


Learning Outcomes:  Upon successful completion of BAE 403, each student will be able to:

- Understand the various roles that constitute a design team and how team members interact for maximum productivity.
- Define an open-ended design problem and apply previously learned engineering principles in the formulation and development of a solution.
- Utilize and demonstrate effective oral and written communication in presenting a design proposal and a preliminary design report.
- Apply appropriate ethical principles, as well as ensure an appropriate and viable solution to an open-ended design problem.
- Apply sound manufacturing, economic and safety considerations in the development of a design solution.
- Utilize CAD software, spreadsheets, presentation software, etc. in the development and presentation of a design solution.


Contribution of course to meeting the program criteria:  BAE 402/403 includes team experiences, problem formulation, multiple presentations to a technical audience that includes engineers from appropriate industries, and prototype fabrication/construction, testing and analysis.
**Relationship of Course to Program Outcomes:** This course includes content that directly relates to Outcomes 1, 2, 3, 6, 8, and 16. Outcome 3, 6, 8, and 16 are specifically assessed in this course.

**BAE 403**

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**Prepared by:** Czarena Crofcheck, February 22, 2010
Course (Catalog) Description: A study of the operational characteristics and design features associated with the production and processing equipment for food and fiber products and an introduction to conceptualization, analysis and design of these systems. 3 credit hours. Prerequisites: EM 313 (or concurrent), ME 330, engineering standing or consent of instructor. *This course is required.*

Class Schedule: Lecture: 2—90 minute sessions per week; Laboratory: 2 hours biweekly, six laboratories scheduled


Course Learning Outcomes:
- To understand important machine design concepts, including free body diagrams, stress-strain relationships, combined stress analysis, failure theories, and kinematic analysis, so that students can apply these principles to the design of agricultural machinery.
- To be able to examine the functional requirements of selected agricultural machines and understand the role of the engineer in the design of this equipment.
- To be able to examine and analyze specific components of agricultural machinery.
- To gain experience and confidence in applying machine design concepts.
- To develop problem solving skills by using software (i.e. Excel, ProE, Matlab, etc.) to create, synthesize and optimize machine components and assemblies.
- To complete a comprehensive design problem whereby a mechanism is conceived and designed to perform specified functions under realistic constraints and prepare a report, which describes conceptualization, synthesis, analysis and evaluation of the resulting solution.

Topics:
- Machine design
- Material properties
- Alloys and casting materials
- Stress components and Mohr’s circle
- Stress-strain relationships
- Stress concentration
- Spring rates and deflections
- Buckling and impact loading
- Failure from static loading
- Failure from variable loading
- Fatigue
• Shafts and shaft components
• Gear drives
• Belt drives
• Roller chain drives
• Bearings
• Mechanical springs
• Clutches and brakes
• Power transmission
• Hydraulic components and circuits

**Contribution of course to meeting the program criteria:** The class contributes three credit hours to the engineering design components of the program.

**Relationship to Program Outcomes:**

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**Prepared by:** Larry G. Wells, Ph.D., P.E., Professor, May 2010
Course Description: This course teaches load estimate for light timber and concrete structures and introduces the design of heating, cooling, and ventilation systems in these structures. 3 credit hours. Prerequisites: EM 302, prereq or concur: ME 325, or consent of instructor. This course is required.

Class Schedule: Lecture: MWF 10:00-10:50 am, CE Barnhart Building, Room 236

Required Text: Environment Control for Animals and Plants. 1990 Albright. ASAE Publications, MI.

Learning Outcomes: At the completion of the course, the student should be able to apply:

• Structural design in agriculture, with emphasis on load estimation, light timber and concrete, granular materials storage, and fasteners.
• Psychrometrics, physical environment for animals and plants, design of thermal environment systems, with emphasis on plant and animal interaction with the building thermal environment.
• Heating, ventilating, cooling and interior air distribution.

Topics:
• Psychometric chart
• Steady state energy and mass balances
• Ventilation rates
• Concrete floors and footings
• Post design
• Load analysis
• Fasteners

Contribution of course to meeting the program criteria: The course is one of the four design technical electives taken in the junior or senior year.
Relationship of Course to Program Outcomes: This course covers topics that are focused on outcomes 1, 2, 4, 5, and 8. The course also helps address outcomes 6, 7, 9, 13, 14, and 15.

BAE 427

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Prepared by: Michael Montross, May 2010
Course (Catalog) Description: The hydrologic cycle is studied and design procedures are developed for flood control structures, water table management, wetlands, irrigation, and erosion control systems. 3 credit hours. Prerequisites: CE 341 or ME 330. This course is required.

Class Schedule: Lecture: MWF 9:00-9:50 am, CE Barnhart Building, Room 227


Learning Outcomes: Upon successful completion of BAE 437, a student will have:
- Developed an understanding of the hydrologic cycle with an ability to use Internet resources and mathematical techniques to estimate key hydrologic parameters and variables.
- Developed the ability to analyze and design hydrologic structures or structural components to control excess water.
- Developed an understanding of the methods to alleviate excess and deficit soil water conditions.

Topics:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Chapter</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction and Water Quality</td>
<td>1 and 2</td>
<td>Chapter 1, Chapter 2</td>
</tr>
<tr>
<td>2</td>
<td>Precipitation</td>
<td>3</td>
<td>Chapter 3, Example problems</td>
</tr>
<tr>
<td>3</td>
<td>Evapotranspiration</td>
<td>4</td>
<td>Chapter 4</td>
</tr>
<tr>
<td>4</td>
<td>Runoff</td>
<td>5</td>
<td>Chapter 5</td>
</tr>
<tr>
<td>5</td>
<td>Open Channel Hydraulics</td>
<td>6</td>
<td>Chapter 6</td>
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<tr>
<td>6</td>
<td>Soil Erosion</td>
<td>7</td>
<td>Chapter 7</td>
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<tr>
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<td>Vegetated Waterways</td>
<td>8</td>
<td>Chapter 8</td>
</tr>
<tr>
<td>8</td>
<td>Water and Sediment Control Structures</td>
<td>9</td>
<td>Chapter 9</td>
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<tr>
<td>9</td>
<td>Channel Stabilization and Restoration</td>
<td>10</td>
<td>Chapter 10</td>
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<tr>
<td>Week 10</td>
<td><strong>Spring Break (March 15-19)</strong></td>
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<tr>
<td>Week 11</td>
<td>Water Supply</td>
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<td>Week 12</td>
<td>Wetlands</td>
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<td>Week 13</td>
<td>Drainage Principles and Surface Drainage</td>
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<td>Week 14</td>
<td>Water Table Management</td>
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<tr>
<td>Week 15</td>
<td>Irrigation Principles &amp; Sprinkler Irrigation</td>
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<tr>
<td>Week 16</td>
<td>Microirrigation</td>
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<td></td>
<td>Monday, May 3 at 8:00</td>
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</tbody>
</table>

**Contribution of course to meeting the program criteria:** This course is one of the four design technical electives taken the junior or senior year.

**Relationship of Course to Program Outcomes:**

BAE 437

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**Prepared by:** Dwayne Edwards, May 2010
Course (Catalog) Description: Design principles and equipment selection for the most common processing operations are studied for the manufacturing and preservation of biological materials. Topics will include the design of fluid flow systems, transient heat transfer, heat exchangers, psychometrics, and refrigeration. 3 credit hours. Prerequisite: ME 325 and engineering standing. *This course is required.*

Class Schedule: Lecture: MWF 2:00-2:50 PM


Learning Outcomes: At the completion of the course, the student should be able to:

- Analyze and design fluid flow systems (pumps, fans, pipes, ducts) for Newtonian and non-Newtonian fluids.
- Design and analyze transient heat transfer processes for processing biological materials. Size and analyze heat exchangers.
- Find and correctly use physical property data for biological materials.
- Use psychometric relationships to analyze and design drying systems.

Topics:
- Pipe fluid flow
- Friction losses in piping networks
- Pump/fan laws
- Heat transfer
- Drying processes

Contribution of course to meeting the program criteria: The course is one of the four design technical electives taken in the junior or senior year.
Relationship of Course to Program Outcomes: This course covers topics that are focused on outcomes 5 and 7. In addition, some coverage of outcomes 1, 2, 4, 6, 8, 9, 10, and 14 is accomplished.

BAE 447

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Prepared by: Michael Montross, May 2010
APPENDIX B - FACULTY RESUMÉS

CARMEN T. AGOURIDIS, Ph.D., P.E.
90% Research, 10% Teaching

Professional Preparation

<table>
<thead>
<tr>
<th>University of Tennessee</th>
<th>Agricultural Engineering</th>
<th>B.S., 1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Tennessee</td>
<td>Agricultural and Biosystems Engineering</td>
<td>M.S., 2000</td>
</tr>
<tr>
<td>University of Kentucky</td>
<td>Biosystems and Agricultural Engineering</td>
<td>Ph.D., 2004</td>
</tr>
<tr>
<td>University of Kentucky</td>
<td>Public Policy and Administration</td>
<td>M.P.P., 2005-present</td>
</tr>
</tbody>
</table>

Professional Licensure

Professional Engineer (P.E.), since 2007, Kentucky License No. 25431
Professional Engineer (P.E.), since 2009, West Virginia License No. 018003

Appointments and Experience

- Assistant Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, Lexington, KY, January 2010-present.
- Assistant Research Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, March 2006-December 2009.
- Engineer Associate IV/Research for Water Resources, Biosystems and Agricultural Engineering Department, University of Kentucky, August 2004-March 2006.

Principal Publications (last five years)


**Honors and Awards**

- United States Department of Interior’s 2007 Cooperative Conservation Award to ARRI Core and Academic Teams (member of the Academic Team).
- American Society of Mining and Reclamation 2nd place poster award (graduate student) at the 2006 7th ICARD Annual Meeting, Hydrologic and Water Quality Characteristics of Loose-Dumped Mine Spoil.
- University of Kentucky Commonwealth Collaborative (two selected projects): Reforestation of Surface Mined Lands and Cane Run Watershed Assessment and Restoration.

**Professional Societies**

- American Society of Mining and Reclamation
- Appalachian Regional Reforestation Initiative
- American Society of Civil Engineers
- Alpha Epsilon Kentucky Omega Chapter
- American Society of Biological and Agricultural Engineers

**Service**

- Environment and Natural Resources Initiative, steering committee.
- Kentucky Department for Natural Resources, wetlands working group.
- University of Kentucky, Biosystems and Agricultural Engineering Department, chair of the alumni and development committee.
- 2009 Mid-Atlantic Stream Restoration Conference, member of conference steering committee.
- Developed tour posters for Appalachian Regional Reforestation Initiative Conference, Starfire Mined Land Reclamation Research Project, Prestonsburg, Kentucky, August 4-6, 2009.
- Natural Resource Initiative Planning Committee member, University of Kentucky, College of Agriculture, 2007-present.
- 2007 Mid-Atlantic Stream Restoration Conference, Cumberland, MD, November 6-8, Member of Conference Steering Committee.
DONALD G. COLLIVER, Ph.D., P.E.
75% Research, 25% Teaching

Professional Preparation

<table>
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<th>University of Kentucky</th>
<th>Agricultural Engineering</th>
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<td>Purdue University</td>
<td>Agricultural Engineering</td>
<td>Ph.D., 1979</td>
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Professional Licensure
Professional Engineer (P.E.), since 1981, Kentucky License #12228

Appointments and Experience
- Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, Lexington, Kentucky, June 2008 to present.
- Associate Professor; Biosystems and Agricultural Engineering Department, University of Kentucky, Lexington, Kentucky, June 1985 to June 2008.
- Assistant Professor; Department of Agricultural Engineering, University of Kentucky, Lexington, Kentucky, June 1979 to June 1985.

Principal Publications (last five years)

Consultations
Honors and Awards

• Title Sponsor Representative to the US DOE 2007 Solar Decathlon - an international competition for students from 20 universities to design and construction houses on the National Capitol Mall (see www.solardecathlon.org). Each university raises approximately $600K to support their program. The UK team placed ninth out of the twenty teams.

• Received three national awards for the Advanced Energy Design Guide for Small Office Buildings
  — US Green Building Council 2005 Leadership Award for Research
  — Alliance to Save Energy 2005 Stars of Energy Efficiency Award Honorable Mention
  — Sustainable Buildings Industry Council’s 2005 Best Sustainable Practice Award Honorable Mention for Educational Initiatives


• Recipient of 2003 International Honorary Member of the Society of Heating, Air-Conditioning & Sanitary Engineers of Japan (SHASE).

Scientific and Professional Societies

• American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), Fellow, Leadership in Policy and Regulatory Development: Applied Research and Strategic Management/Planning (1998-2007); President (2002-2003); Nominating Committee, Chairman (2004-2005), Vice Chair (2003-2004), Member (2006-8); ASHRAE Foundation (2006-2009); Society Vice President - Chair Technology Council; Society Vice President - Chair Education Council; Formed the ASHRAE Learning Institute (ALI); Founder and Chairman of the Advanced Energy Design Guide (AEDG); Steering Committee and Member of AEDG writing committees.

Service


• Member of the National Retail Alliance.
  — Led a development team for the US DOE National Residential Builder’s Challenge.
  — Chaired the Scale Working Group, which determined the base and measurement unit of how energy usage was to be evaluated.
  — Member of the Technical Working Group, which developed the residential energy rating scale which is analogous to the mpg rating for automobiles.

• Provided vision for KY Rural Energy Consortium.
  — Wrote initial white paper describing purpose of a statewide research and deployment consortium and identified seven missions.

• Chaired National Engineers Week. Co-Chair of 2003 National Engineers Week (co-chair with Vance Coffman, Chairman and COE, Lockheed Martin) and member of National Engineers Week Steering Committee 2002-present. Trustee National Engineers Week Foundation 2003-2005.
**CZARENA CROFCHECK, Ph.D., P.E.**

49% Research, 51% Teaching

**Professional Preparation**

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<td>Biosystems &amp; Agricultural Engineering</td>
<td>Ph.D., 2001</td>
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**Professional Licensure**

Professional Engineer (P.E.), since 2004, Kentucky License # 24390

**Appointments and Experience**

- Associate Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 2007 to present.
- Assistant Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, April 2001-June 2007.

**Principal Publications (last five years)**


Honors and Awards
• ASABE AW Farrall Young Educator Award, 2009.
• ASABE Honorable Mention Paper Award, 2007.
• College of Agriculture Student Council Early Career Outstanding Teaching Award, 2007.
• ASABE Honorable Mention Paper Award, 2006.
• Henry Mason Lutes Award for Outstanding Engineering Education, 2006.
• Provost’s Award for Outstanding Teaching Award, 2006.
• Gamma Sigma Delta Master Teacher Award, 2006.
• Outstanding Biosystems and Agricultural Engineering Teacher, 2006.

Professional Societies
• American Society of Agricultural and Biological Engineers (ASABE), member since 1998.
• Institute of Biological Engineering (IBE), member since 2000.

Service
• College: Graduate Student Awards Committee, Gamma Sigma Delta, 2005, C.E. Barnhart.
DWAYNE R. EDWARDS, Ph.D., P.E.
60% Research, 20% Teaching, 20% Administration

Professional Preparation

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Professional Licensure
Professional Engineer (P.E.), since 1992, Arkansas License #7998

Appointments and Experience

• Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, Lexington, KY, 2000-present.
• Associate Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, Lexington, KY, 1994-2000.
• Associate Professor, Biological and Agricultural Engineering, Department, University of Arkansas, Fayetteville, AR, 1993-1994.
• Assistant Professor, Biological and Agricultural Engineering Department, University of Arkansas, Fayetteville, AR, 1988-1993.

Professional Societies

• American Society of Agricultural and Biological Engineers
• American Society of Engineering Education
• American Water Resources Association
• Arkansas Society of Professional Engineers
• National Society of Professional Engineers
• Alpha Epsilon (Honor society of Agricultural Engineering)
• Gamma Sigma Delta (Honor society of Agriculture graduate students)
• Phi Kappa Phi (Honor society for graduate students)
• Tau Beta Pi (Honor society for Engineering)

Service

• Director of Graduate Studies, Biosystems and Agricultural Engineering Department, University of Kentucky, 2003-present.
• University of Kentucky, Kentucky Water Resources Institute Oversight Committee, 1997-present.
• Regional Research Project S-273, 1996-present.

Awards

• ASAE New Holland Young Researcher Award, 2000.
• Honorable Mention, ASAE Paper Competition, 1999.
• Environmental Excellence Award, U.S. Environmental Protection Agency, 1993.
• Outstanding Researcher, Biological and Agricultural Engineering Department, University of Arkansas, 1992.
• Outstanding Researcher, Biological and Agricultural Engineering Department. — University of Arkansas, 1991.
• Honorable Mention, ASAE Paper Competition, 1988.

Papers Presented at Professional Meetings

ROBERT L. FEHR, Ph.D., P.E.
90% Extension, 10% Research

Professional Preparation

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Professional Licensure

Professional Engineer (P.E.), since 1980, Kentucky License #11961

Appointments and Experience

- Extension Professor, Biosystems and Agricultural Engineering, University of Kentucky, 1984 to present.
- Computing Section Manager, Agricultural Communications Services, University of Kentucky, 1995-2004.
- Director, Agricultural Data Center, University of Kentucky, 1983-1991.
- Associate Extension Professor, Biosystems and Agricultural Engineering, University of Kentucky, 1980-1983.
- Assistant Extension Professor, Biosystems and Agricultural Engineering, University of Kentucky, 1976-1980, Structures and Environment areas.

Manuscripts


Presented Papers (last five years)

- Fehr, Robert L. 2006. Mold and Vapor Barriers, National Frame Builders Association, Builders Expo, Nashville, TN.
- Fehr, Robert L. 2006. Improving Energy Efficiency on Your Farm, Kentucky Fruit and Vegetable Growers Conference and Trade Show, Lexington, KY.
- Fehr, Robert L. 2005. Collaboration versus Conferencing - Where We Are and How We Got Here, ASABE 2005 Annual Meeting, Tampa, FL.

Training Modules Developed For DOE Deployment Grant

Controlling InfiltrationDuel Fuel Heating System Overview
Energy Efficient Homes OverviewEnergy Issues and Building Solutions
Goldie Envelope and the Three BarriersHeat Loss and Gain Calculations
Home Systems CertificationsInsulating the Envelope
Kentucky and 2006 IRC Energy CodeMath for HERS Raters
Psychrometric Basics The House as a System
Reducing Energy Use for Heating and Cooling Thermal Bypass
Understanding ENERGY bills Windows and Doors
ENERGY STAR® Homes Overview Energy Efficient Green Homes
Alternative Methods of Meeting the 2006 IRC Air Leakage Measurement & Terms
Ceiling Insulation R Reduction
2006 International Energy Conservation Code for Climate Zone 4
Home Builder Association of Kentucky Green Building Project Overview

Web Sites

- Web calculators for residential energy
  - Fuel Price Comparison
  - Upgrade a Natural Gas Furnace and/or Air Conditioner
  - Replace a Natural Gas Furnace with a Air Source Heat Pump
  - Replace a Natural Gas Furnace with a Geothermal Heat Pump
  - Upgrade an Air Source Heat Pump
  - Replace an Air Source Heat Pump with a Geothermal Heat Pump
- Enhanced Building Energy Efficiency Technology Deployment Grant Final Products
  - Public Site and Secure Site of Publications Distribution
- Created College Energy Web Site, February 2006
- Energy and Radon Publications Web Site, October 2004

Honors and Awards

- Honor Societies: Tau Beta Pi; Alpha Epsilon; Phi Kappa Phi; Gamma Sigma Delta; Epsilon Sigma Phi.
- 2007 and 2006 — Wethington Award for Research.

Professional Societies

- American Society of Agricultural and Biological Engineers, member since 1976.

Service

- 2010 and 2009 Midwest Regional ENERGY STAR® Conference - Planning Committee – Building Science Track Chair.
- University of Kentucky Sustainability Task Force, 2004-2007; Operations sub-committee.
- Home Builders Association of Kentucky.
  - Green Building Program Steering Committee.
  - Green Build Program Web Site Planning Committee.
- Home Builders Association of Lexington.
  - Green Build Council.
SAMUEL G. MCNEILL, Ph.D., P.E.
80% Extension, 20% Research

Professional Preparation

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Professional Licensure
Professional Engineer (P.E.), since 2000, Kentucky License # 21820

Appointments and Experience

- Associate Extension Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, January 2004-present.
- Assistant Extension Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, January 1998-December 2003.
- Extension Agricultural Engineer, Agricultural Engineering Department, University of Kentucky, January 1979-December 1997.

Principal Publications (last five years)


Honors and Awards

• Service Award (30 years). UK Cooperative Extension Service. 2009.
• Wethington Award. University of Kentucky. 2006.
• Outstanding Program Award as member of UKCA Wheat Science Group. KASEP. 2006.

Professional Societies

• American Society of Agricultural and Biological Engineers (ASABE), member since 1979.
• Kentucky Association of State Extension Professionals (KASEP), member since 1979.

Service (last five years)

• University: Faculty Senate, 2006-2009.
• Kentucky Association of State Extension Specialists (KASEP), Board Member (7/04 – 6/05); Representative to Western Region Planning and Issues Committee (7/04 – 6/06).
• Research and Education Center: Faculty-Staff Advisory Committee (2005-2006 term); UKCA 2005 Field Day Committee – Past Chair; Exhibit Committee – Chair 2006.
MICHAEL D. MONTROSS, Ph.D., P.E.

68.3% Research, 26.7% Teaching, 5% Extension

Professional Preparation

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<td>M.S., 1995</td>
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<td>Purdue University</td>
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<td>Ph.D., 1999</td>
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Professional Licensure
Professional Engineer (P.E.), since 2003, Kentucky License #23403

Appointments and Experience

- Associate Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 2005 to present.
- Assistant Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, November 1999-June 2005.

Principal Publications (last five years)


Honors and Awards
• Loys Mather Teaching Award 2007.

Scientific and Professional Societies
• American Society of Agricultural and Biological Engineers, member since 1994.

Institutional and Professional Service
• Graduate committee (2000 to present).
• Computer committee (2000 to present).
• NC-213, (2000 to present), objective co-chair (02/03 to present), secretary (02/04 - 02/05), chair (02/06 - 02/07).
• ASAE, FPE-702 Grain and Feed Processing and Storage (1998 to present), program chair (07/04 - 07/06), chair (07/06 - 07/07).
• ASAE, PM-23/7/2 Forage and Biomass Engineering (2004 to present).
• ASAE, FPE-709 Biomass Energy and Industrial Products (2006 to present).

90
SUE E. NOKES, Ph.D., P.E.  
41.67% Research, 38.33% Teaching, 20% Administration

Professional Preparation

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<td>M.S., December 1983</td>
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<tr>
<td>North Carolina State University</td>
<td>Biological and Agricultural Engineering, Biomathematics (minor)</td>
<td>Ph.D., May 1990</td>
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Professional Licensure
Professional Engineer (P.E.), since 1995, State of Ohio

Appointments and Experience

- Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 2007-present.
- Associate Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 2001-June 2007.
- Assistant Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 1995-June 2001.
- Research Scientist, Department of Agricultural Engineering, The Ohio State University, July 1990-June 1995.

Principal Publications (last five years)


Honors and Awards
• Recognized at half-time at the UK men’s basketball game for receiving the Excellence in Teaching Award, January 28, 2004.
• Superior ASAE Paper Award. 2002. (2.5% of the papers published in 2002 were selected as Superior.)

Professional Societies
• American Society of Agricultural and Biological Engineers (ASABE)
• American Society for Engineering Education (ASEE)

Service
• UK BAE Department:
  — Director of Undergraduate Studies, June 2007-present.
  — Curriculum Committee, 2008-present.
• UK College of Engineering:
  — Academic Area Advisory Committee for the Physical and Engineering Sciences; 2009-2011.
  — SWE Scholarship selection committee, Spring 2009.
  — Dean’s Advisory Committee, 2007-2009.
• UK College of Agriculture:
  — Faculty Senate, Fall 2009-May 2012.
  — Honors Committee, 2005-2006.
  — Agricultural Biotechnology Coordination Committee, 2005-2007
• ASABE Finance Committee, July 2009-June 2014.
• ASABE Publications Council Liaison, July 2009-June 2014.
• ASABE PAK committee for Professional Engineering Exam Summer 2008-Summer 2009.
• University of Kentucky, Serve on the Turner Leadership Academy advisory board, Fall 2008-present.
• University of Kentucky, Participated in Pre-Vet day organizational meetings and on-campus visit, Search Committee for Ornamental Greenhouse Mechanization position, Department of Horticulture, Fall 2007-Spring 2008.
DOUGLAS G. OVERHULTS, Ph.D., P.E.
85% Extension, 15% Research

Professional Preparation

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<td>University of Nebraska</td>
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Professional Licensure
Professional Engineer (P.E.), License #10370 State of Kentucky

Appointments and Experience

- Associate Extension Professor, Biosystems & Agricultural Engineering Department, University of Kentucky, July 1988-present.
- Assistant Extension Professor, Agricultural Engineering Department, University of Kentucky, April 1982-June 1988.
- Instructor & Research Assistant, Agricultural Engineering Department, University of Nebraska, June 1978-April 1982.
- Extension Specialist, Agricultural Engineering Department, University of Kentucky, November 1972-May 1978.

Principal Publications (last five years)


Consulting
Court appointed expert for a special judge in litigation regarding the construction of broiler production houses. 1997.

Honors and Awards
KASEP Outstanding Program Award. 2005. Presented to the Master Cattleman team for the Master Cattleman program.
ASAE Blue Ribbon Awards for Educational Aids (6).
American Society of Agronomy “Certificates of Excellence (2),” Extension publication.

Professional Societies
American Society of Agricultural and Biological Engineers (ASABE)
Council for Agricultural Science & Technology (CAST)
Kentucky Association of State Extension Professionals (AKES)
National Frame Building Association

Service
Departmental: Extension Planning Committee, Awards Committee.
Professional: KY/TN Chapter, National Frame Builders Association - Board of Directors, Chair Education Committee; Past Chairman of ASAE SE-302 Environment of Animal Structures Committee, Past Chair ASAE SE-02 Structures & Environment Division Steering Committee, Member ASAE SE-404 (Swine Housing) and SE-405 (Poultry Housing) Committees.
FRED A. PAYNE, Ph.D.
61.67% Research, 13.33% Teaching, 25% Extension

Professional Preparation

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Appointments and Experience
Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, 1993-present.
Associate Professor, Agricultural Engineering Department, University of Kentucky, 1985-1993.
Associate Professor, Agricultural Engineering Department, Clemson University, 1984-1985.
Assistant Professor, Agricultural Engineering Department, Clemson University, 1980-1984.
Research Specialist, Agricultural Engineering Department, University of Kentucky, 1977-1980.
Project Engineer, Research Food Engineer, General Mills, 1972-1977.

Principal Publications (last five years)


Recent Patents (selected from 7 patents and 4 patent applications)

Honors and Awards
• Named Fellow of ASABE, July 2006.
• Received Distinguished Food Engineering Award IAFIS Foundation/FPEI, July 2005.
• Elected to the ASABE Board of Directors 1994-1996.
• Received six ASABE paper awards that are given to the top 2.5% of papers.

Professional Societies
• American Society of Agricultural and Biological Engineers, member 1977-present.
  — member of ASABE finance committee, 2000-present.
  — member of ASABE Foundation Board of Trustees, 2004-present.
  — member of ASABE FPE-703 Food Processing.
• Institute of Food Technologists (IFT), Professional member, 1972-present.
• SPIE — The International Society for Optical Engineering. member 1998-present.
• University of Kentucky Intellectual Property Committee, 2003-2006.
• University of Kentucky Research Conflict of Interest Committee, 2007-2013.

Service
• Managed a professional research group of three Kentucky Universities (2006 – present) in the successful development of a Milk Transport Security System funded by DHS through NIHS ($1.5 million, 3 yrs, 2006-2008; $1.2 million 2008-2009).
• 2007 - Co-Formed *TranSecurity Systems, Inc.* ([www.transecuritysystems.com](http://www.transecuritysystems.com)) in March 2007 to commercialize the security, traceability and data management system developed under a grant from the Department of Homeland Security for securing milk between the farm and processor. Currently President.
MARK A. PURSCHWITZ, Ph.D.
50% Extension, 40% Research, 10% Teaching

Professional Preparation

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Appointments and Experience

- Extension Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, August 2008-present.
- Associate Extension Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, January 2008-August 2008.
- Adjunct Associate Professor, Department of Biological Systems Engineering, University of Wisconsin-Madison, 2003-2007.
- Associate Professor, (75% Extension, 25% Research) and Extension Agricultural Safety and Health Specialist, Department of Biological Systems Engineering, University of Wisconsin-Madison, 1997-2003.
- Assistant Professor, (75% Extension, 25% Research) and Extension Agricultural Safety and Health Specialist, Department of Agricultural Engineering, University of Wisconsin-Madison, 1993-1997.
- Assistant Professor, (100% Extension) and Extension Safety Specialist, Department of Agricultural & Biological Engineering, Clemson University, Clemson, SC, 1990-1993.

Principal Publications (last five years)


Professional Societies
• American Society of Agricultural and Biological Engineers (ASABE), member since 1979.
• National Institute for Farm Safety (NIFS), member since 1986, (past president).

Service
• University of Kentucky, College of Agriculture, NCERA-197, North Central Education/Extension and Research Activity Committee on Agricultural Safety and Health Research and Extension (including subcommittee for High Speed Tractors). secretary, 2008-present.
• University of Kentucky, College of Public Health, Feasibility Project Program review committee, Southeast Center for Agricultural Health and Injury Prevention, chair, 2008-present.
• University of Kentucky, Department of Biosystems and Agricultural Engineering, Solar Decathlon Team, Safety Advisor, 2008-2009.
• American Society of Agricultural and Biological Engineers, ESH-03/1 External Standards Development Subcommittee (v. chair, 2006; chair, 2007-2008).
• University of Kentucky, College of Agriculture Planning Committee, School of Human Environmental Sciences, “University of Kentucky Conference on Physical Activity and the Built Environment,” 2008.
• University of Kentucky, College of Agriculture Safety Advisor to UK Occupational Health and Safety and Health Department on an agricultural machinery issue, 2008.
• Kentucky Farm Bureau, Member, State Safety and Rural Health Advisory Committee, 2008-present.
• University of Kentucky, Department of Biosystems and Agricultural Engineering Co-lecturer in AEN 463G, Agricultural Safety and Health, 2008.
• National Institute for Farm Safety, Research and Development Committee (chair), 2006-2007.
• American Society of Agricultural and Biological Engineers, ESH-01 (Ergonomics, Safety, and Health Division Executive Committee), 2006-present.
SCOTT A. SHEARER, Ph.D., P.E.
40% Research, 25% Extension, 20% Administration, 15% Teaching

Professional Preparation

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Professional Licensure
Professional Engineer (P.E.), since 1994, Kentucky License #18094

Appointments and Experience

- Professor and Chair, Department of Biosystems and Agricultural Engineering, University of Kentucky, August 2007-present.
- Professor, Department of Biosystems and Agricultural Engineering, University of Kentucky, July 2002-August 2007.
- Associate Professor, Department of Biosystems and Agricultural Engineering, University of Kentucky, July 1993-June 2002.
- Assistant Professor, Department of Agricultural Engineering, University of Kentucky, July 1986-June 1993.

Principal Publications (last five years)


Patents

Honors and Awards
Joe T. Davis Outstanding Advisor Award. University of Kentucky, College of Agriculture Student Council, 2008.

Professional Societies
American Society of Agricultural and Biological Engineers (ASABE), member since 1986.

Service
Biosystems Engineering Program Advisory Council, University of Tennessee, 2006-present.
Jessamine Career and Technical Center Pre-Engineering Advisory Committee, Jessamine County Schools, Nicholasville, KY, 2006-present.
ASABE, M-113 Engineering Concept of the Year Award Committee, 2005-present.
University of Kentucky, Dean’s Advisory Council, College of Engineering, 2004-2007.
Faculty Advisor to the 1999 through 2010 ASABE 1/4 Scale Tractor Design Teams.
TIMOTHY S. STOMBAUGH, Ph.D., P.E.
35% Extension, 34% Teaching, 31% Research

Professional Preparation

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Professional Licensure
Professional Engineer (P.E.), since 2003, Kentucky License #23424

Appointments and Experience

- Associate Extension Professor, Biosystems and Agricultural Engineering, University of Kentucky, Lexington, KY, 2006-present.
- Assistant Extension Professor, Biosystems and Agricultural Engineering, University of Kentucky, Lexington, KY, 2000-2006.
- Assistant Professor, Food, Agricultural and Biological Engineering, The Ohio State University, Columbus, OH, 1998-2000.
- Visiting Instructor, Agricultural Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, 1991-1998.

Principal Publications (last five years)

- Zandonadi, R.S., T.S. Stombaugh, S.A. Shearer, D.M. Queiroz, and M.P. Sama. 2010. Laboratory performance of a mass flow sensor for dry edible bean harvesters. Accepted for publication in Applied Engineering in Agriculture.

Extension Publications

Honors and Awards
• ASAE Blue Ribbon Award for Educational Aids, 2009.
• College of Agriculture Outstanding Teacher Award, 2008.
• ASABE Nolan Mitchell Young Extension Worker Award, 2006.
• 2 ASAE Blue Ribbon Award for Educational Aids.

Professional Societies
• American Society of Agricultural and Biological Engineers, member since 1990.
• Gamma Sigma Delta and Alpha Epsilon.

Service
• Convener, ISO TC23/SC19/WG7 - committee to develop standards for GNSS-based equipment.
• Associate editor, ASABE Power and Machinery Division, 2007-present.
• Associate editor, ASABE Information and Electrical Technology division, 2005-2009.
• Past Chair, ASABE PM-54 Precision Agriculture Committee, 2006-2008.
• Program Chair, ASABE PM-54 Precision Agriculture Committee, 2004-2006.
• NCERA-180 Regional committee on precision agriculture.
  — Hosted annual meeting in Lexington, Jan. 6-8, 2009; chair, 2009; secretary, 2008.
JOSEPH L. TARABA, Ph.D.
70% Extension, 30% Research

Professional Preparation

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Appointments and Experience

- Extension Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, 1995-present.
- Associate Extension Professor and Extension Specialist, Agricultural Engineering Department, University of Kentucky, 1982-1995.
- Assistant Extension Professor and Extension Specialist, Agricultural Engineering Department, University of Kentucky, 1976-1982.
- Graduate Teaching Associate. Department of Chemical Engineering, The Ohio State University, Columbus, Ohio, 1972-1974.
- Research Associate, Max Planck Institute fur Stromungsforschung, Gottingen, Germany, Summer 1971.

Principal Publications (last five years)


Honors and Awards


Professional Societies

Associate Member, American Society of Agricultural and Biological Engineers, 1977 to present.

Member, Technical Committee SE 412, Agricultural Sanitation and Waste Management, 1977 to present and Member Kentucky Section ASABE, 1977 to present.

Associate Member, American Institute of Chemical Engineers, 1969 to present.

Member, Louisville Section AIChE, 1977 to present.

Member, American Chemical Society, 1971 to present.

Member, American Association for the Advancement of Science, 1977 to present.

Member, Association Kentucky Extension Specialists, 1980 to present.

Service

Technical Advisor, Natural Resources Advisory Committee, Kentucky Farm Bureau, 1991-2010.


University of Kentucky, College of Agriculture


Natural Resource Conservation and Management Steering Committee Member. 2004-2006.

University of Kentucky, Biosystems and Agricultural Engineering Department

Extension Committee, 1990-2010.

Graduate Student and Research Committee, 2006-2010.

RICHARD C. WARNER, Ph.D.
70% Extension, 30% Research

Professional Preparation

<table>
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<th>University of Illinois-Chicago</th>
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Appointments and Experience

- Extension Professor, Biosystems and Agricultural Engineering Department, University of Kentucky. July 2002-present.
- Associate Extension Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 1986-June 2002.
- Assistant Extension Professor, Agricultural Engineering Department, University of Kentucky, May 1981-July 1986.
- Extension Specialist, Agricultural Engineering Department, University of Kentucky, October 1980-May 1981.

Principal Publications (last five years)


Consultations
• Irrigation/fertilization design to enhance growth of trees on mined lands for biomass production. January 6, 2007.
• In-situ stream flow controls to reduce CO₂ release from drained peat lands in Indonesia. March 13, 2007.

Honors and Awards
• United States Department of Interior’s 2007 Cooperative Conservation Award to ARRI Core and Academic Teams (member of the Academic Team).
• American Society of Mining and Reclamation 2nd place poster award at the 2006 7th ICARD Annual Meeting, Hydrologic and Water Quality Characteristics of Loose-Dumped Mine Spoil.
• University of Kentucky Commonwealth Collaborative selected project, Reforestation of Surface Mined Lands, 2006.

Professional Societies
• American Society of Agricultural and Biological Engineering (ASABE), member since 1981.
• American Society of Agricultural Engineering, Kentucky Section, 1981-present.

Service
• University of Kentucky, College Advisory Committee on Appointment. Promotion and Tenure. 2007 and 2008.
• University of Kentucky, BAE Promotion and Tenure Chair 2007-2008.
• Solid Waste Collection and Waste Reduction Tiger Team: UK.
• University of Kentucky, BAE, Promotion and Tenure Chair, 2004-2006.
• University of Kentucky, Alumni Development Committee: BAE 2005-2006.
• University of Kentucky, Extension Planning Committee: BAE 2005-2006.
LARRY G. WELLS, Ph.D., P.E.
69.3% Research, 30.7% Teaching

Professional Preparation

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<tr>
<td>North Carolina State University</td>
<td>Biological and Agricultural Engineering</td>
<td>Ph.D., 1975</td>
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Professional Licensure
Professional Engineer (P.E.), since 1979, Kentucky License #11206

Appointments and Experience
- Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 1986 to present.
- Associate Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 1980 - July 1986.
- Assistant Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, October 1974 - July 1980.

Teaching

Patents

Principal Publications (last five years)

Papers and/or Presentations at Technical Conferences and Symposia
• Bodapati, V.S. and L.G. Wells. 2007. Evaluation of a mechanical system for reconstructing soil without traffic compaction. Procs. of Amer. Soc. For Mining and Reclamation, Gillette, WY.
• Wells, L.G. and C. Crofcheck. 2005. Educational objectives and outcomes at the University of Kentucky: Perspectives from a recently reviewed program. ASAE paper no. 057059, St. Joseph, MI.

Professional Societies
• American Society of Agricultural and Biological Engineers (member).
• American Society of Mining and Reclamation (member).

Institutional and Professional Service
• Chair, AGCO Student Design Competition Committee, American Society of Agricultural and Biological Engineers (2008-2009).
• Director of Undergraduate Studies, Biosystems and Agricultural Engineering, University of Kentucky (2005-2007).
• Scholarship Selection Committee, Biosystems and Agricultural Engineering, University of Kentucky (1978 to present).
• Department Review Committee, Biosystems and Agricultural Engineering, University of Kentucky (2006).
• Undergraduate Studies Team, College of Engineering, University of Kentucky (1998 to present).
JOHN WILHOIT, Ph.D., P.E.
60% Extension, 20% Research, 20% Teaching

Professional Preparation

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<tr>
<td>Virginia Polytechnic Institute and State University</td>
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<td>Ph.D., 1989</td>
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Professional Licensure

Professional Engineer (P.E.), since 1989, Virginia License # 0199489

Appointments and Experience

• Extension Associate Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, September 2007-present.
• Instructor (part-time), Biosystems and Agricultural Engineering Department, University of Kentucky, January 2000-2007.
• Owner-Operator, Thistles End Farm, Woodford County, Kentucky, August 1999-present.
• Associate Professor, Biosystems Engineering Department, Auburn University, July 1995-August 1999.
• Assistant Professor, Biosystems Engineering Department, Auburn University, July 1989-June 1995.
• Visiting Scientist, Instituto de Silvicultura e Industria de la Madera (Silviculture and Industrial Forestry Institute), Juarez University of the State of Durango (UJED), Durango, Mexico June-December 1996.
• International Education Specialist, Western Universities Agricultural Education Project (USAID), Sriwijaya University, Palembang, Indonesia, October 1983-October 1985.

Principal Publications (last five years)


**Honors and Awards**

- Phi Beta Delta Honor Society for International Scholars
- Gamma Sigma Delta Agr. Honor Society; Alpha Epsilon Agr. Engr. Honor Society
- Pi Tau Sigma Mechanical Engineering Honor Society

**Professional Societies**

- American Society of Biological and Agricultural Engineers, sixteen years.

**Service**

- Member, Woodford County Agricultural Advisory Review Committee, 2006-present.
- Member, Versailles-Midway-Woodford County Planning Commission, 2002-2006.
- President of the Woodford County Farmers Market from 2001 to 2006.
STEPHEN R. WORKMAN, Ph.D., P.E.
90% Administration, 10% Research

Professional Preparation

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<td>The Ohio State University</td>
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</tr>
<tr>
<td>North Carolina State University</td>
<td>Biological and Agricultural Engineering</td>
<td>Ph.D., 1990</td>
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Professional Licensure
Professional Engineer (P.E.), since 1999, Kentucky License #20726

Appointments and Experience

- Assistant Dean and Associate Director, KY Ag Experiment Station, College of Agriculture, University of Kentucky, Lexington, Kentucky. July 2009-present.
- Professor, Department of Biosystems and Agricultural Engineering, University of Kentucky, Lexington, Kentucky. July 2009-present.
- Natural Resources Coordinator, College of Agriculture, Agricultural Experiment Station, Lexington, Kentucky, February 2007-July 2009.
- Associate Professor, Department of Biosystems and Agricultural Engineering, University of Kentucky, Lexington, Kentucky. July 2001-present.
- Assistant Professor, Department of Biosystems and Agricultural Engineering, University of Kentucky, Lexington, Kentucky. July 1995-July 2001.
- Agricultural Engineer (Adjunct Assistant Professor in Agricultural Engineering) USDA-ARS Soil Drainage Research Unit, Columbus, Ohio. July 1994-June 1995.

Principal Publications (last five years)


Honors and Awards
• Loys L. Mather Outstanding Career Teaching Award, College of Agriculture Student Council, University of Kentucky, 2006.
• Lead-21 Leadership for the 21st Century, member of 2006-2007 Leadership Development Class.

Service
• National Committees: SW-05 Publication Review Committee, ASABE; SW-23 Drainage Group, ASABE; SW-21 Hydrology Group, ASABE; ASABE Section Steering Committee (1998-2008); Special Programs Committee, 7th International Drainage Symposium.
• Member, KY Agriculture Water Quality Authority, 2007-present.
• University of Kentucky, Natural Resources Coordinator, 2007-present.
• University of Kentucky, Tracy Farmer Center for the Environment Board, 2007-present.
• University of Kentucky, Precision Resource Management Committee, 2005-2008.
APPENDIX C – LABORATORY EQUIPMENT

- Electronics laboratory with 7 stations equipped with pc, microcontroller programmers, and basic electronics test equipment including digital oscilloscope, power supply, function generator, and digital multimeters
- 2 NIST traceable dewpoint hygrometers
- Soil bin for tillage, compaction, and traction testing
- Flumes for hydrology exercises
- 2 Thermal imaging cameras
- Armfield hydraulics training bench
- Various GPS equipment including 13 handheld GPS receivers, 12 PDA’s with CF GPS, 6 submeter GPS receivers, and 8 RTK GPS receivers.
- Dynamic GPS test facility
- Air flow calibration chamber
- Grain storage and handling laboratory with several large bins and various conveyors
- 8 pneumatic and fluid power trainer benches
- PTO-driven dynamometer
- Yield monitor test facility
- Various farm equipment including 3 tractors with autosteer, combine, high clearance self propelled sprayer, planters, tillage tools, and manure handling and application equipment
- Instron universal testing apparatus
- 7 temperature/humidity environmental chambers
- Various wood and metal fabrication equipment including a CNC milling machine, computerized plasma cutting table, and state-of-the-art welding equipment.
- UV- Visible spectrophotometer (UV-Vis spec)
- High Performance Liquid Chromatography (HPLC)
- Gas Chromatography (GC)
- Fourier Transform Infrared Spectroscopy (FTIR)
- Near Infrared Analyzer (NIR)
- YSI 7100 Multiparameter Bioanalytical System (MBS)
APPENDIX D – INSTITUTIONAL SUMMARY

Provided by the College of Engineering as a separate document.
Alumni Survey Instrument
BAE Alumni Survey 2009

I. Personal Information
First Name: ___________________ Middle Name: ___________________ Maiden Name: ___________________
Last Name: ___________________ Gender: male / female
Telephone: (____) -_____-______

Mailing Address
Preferred Contact address:  Personal / Employer (Please circle one)
Address 1: ____________________________ City __________________ State __________________
Country _________ Zip_________ (For Zip + 4, please include hyphen) Int. Postal Code __________
Address 2: ____________________________ City __________________ State __________________
Country _________ Zip_________ (For Zip + 4, please include hyphen) Int. Postal Code __________
Email Address: ___________________________________________________________

Employer Address
Employer ________________________________
Address 1: ____________________________ City __________________ State __________________
Country _________ Zip_________ (For Zip + 4, please include hyphen) Int. Postal Code __________
Address 2: ____________________________ City __________________ State __________________
Country _________ Zip_________ (For Zip + 4, please include hyphen) Int. Postal Code __________
Work Phone: (____) -_____-______ Extension: __________
International Phone Number: ____________________________

II. Professional Information
Do you intend to become a Licensed Professional Engineer? Yes / No
Did you take the FE or EIT Exam? Yes / No
If “Yes”, date passed FE of EIT exam. ____________________ (mm/dd/yyyy)
Did you take the PE Exam? Yes / No
If “Yes”, date passed PE exam. ____________________ (mm/dd/yyyy)

Please give us information on your first non-student employment, after graduating from the BAE Program.
Date Employed: ____________________ (mm/dd/yyyy)
Employer ________________________________ Position ________________________________
Title ________________________________ % Engineering: ________________ (0-100) ** See explanation below
Starting Salary Range:_______________________ Employees Supervised:_________________

*Please give us information on your most recent promotion or current position.*
Date Promoted or Current Date:_________________ (mm/dd/yyyy)
Is your most recent promotion your current position? Yes / No (Please circle one)
Position Title:___________________________________
% Engineering_____________(0-100)**see explanation below
Starting Range when promoted or current salary:_______________
Employees Supervised:__________

*Please indicate your memberships in professional organizations:*

III. Education Information
Degrees from University of Kentucky: BS_____ MS_____ PhD _____(mm/dd/yyyy)

*Based on your BAE education, please rank your acquired skill level for each of the following. Consider 5 to be very well prepared and 1 to be less than prepared.*
Technical engineering knowledge_____
Communication ______
General non-technical knowledge (social factors, manufacturability, ethics, etc.):_____

Please list your advanced degrees:

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<th>Institution</th>
<th>Degree</th>
<th>Date (mm/dd/yyyy)</th>
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Continuing Education:
Training received during first year of employment.

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<th>Description</th>
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Training received after first year of employment.

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**% Engineering- This measures whether our graduates are employed in the practice of engineering- the profession for which they sought an education. Estimate of the amount of time (percentage) in this position that was devoted to the practice of engineering. If you are working as an engineer of in management of engineers or other management that is aided by your engineering degree then your percentage will likely be high. If you work for a bank, became a medical doctor, or a trial lawyer then your percentage will be low. If you are not employed as an engineer and you planned as a student to use your engineering degree to prepare you for a profession other than engineering (such as veterinary science, medical, etc) then put NA.
BAE Advisory Council Bylaws

April 25, 2001; Revised August, 2009
Biosystems and Agricultural Engineering Advisory Council
College of Agriculture, University of Kentucky

ARTICLE I. MISSION STATEMENT
A) The purpose of the Biosystems and Agricultural Engineering (BAE) Advisory Council is to:
   i) Support undergraduate and graduate education by providing input to the faculty on curriculum development and industry's expectations of program graduates.
   ii) Provide input and guidance to the faculty regarding overall programs, discovery (research) programs, and engagement (extension/outreach) programs of the department.

ARTICLE II. MEMBERSHIP
A) The membership of the Council shall include a Chair and at least eleven other members of the council composed of a significant proportion of alumni of the Biosystems and Agricultural Engineering program and/or appropriate engineering and agriculture professionals. The Department Chair or her/his designated representative shall serve as ex officio non-voting member and will be responsible for maintaining a record of meetings and business of the Council.
   i) The members shall serve three-year terms with equal or nearly equal number selected each year (approximately four members per year).
   ii) The Council may add such additional members as it may from time to time approve on a temporary basis.
B) New members will be confirmed by the Council annually upon recommendation by the Department Chair or her/his designated representative. Members may serve multiple and consecutive terms.
C) The Chair, Vice Chair, and Past Chair along with the Department Chair or representative shall form an Executive Committee and shall be authorized to act on behalf of the Council after seeking input from Council members.

ARTICLE III. OFFICERS
A) The Council shall have three officers, a Chair, Vice Chair, and Past Chair. The term of each officer shall be approximately one year, from one regular annual meeting to the next.
   i) Each year at the fall meeting the Council shall elect a Vice Chair. Upon such election the previous Vice Chair shall succeed to the office of Chair and the previous Chair shall succeed to the office of Past Chair.
   ii) Each officer of the Council must at the time of his/her election be a member of the Council. An officer may continue to serve after his/her term of Council membership may have ended and a successor may have been elected. If this occurs the officer shall continue to have all the rights and privileges of Council membership including the right to vote on any item before the Council until such time as his/her term as Past Chair of the Council shall end.
B) Duties of the Chair:
   i) Conduct annual business meetings of the Council
ii) Cooperate with BAE Department Chair and Staff in timely setting of times and places for Council meetings.
iii) Provide an agenda to each Council member 2 to 4 weeks prior to each meeting.
iv) Carry out Council decisions directly or by appropriate delegation.
v) Arrange for an orderly transfer of the Chair's file(s) and a copy of the then current bylaws at the close of the Chair's term.

C) Duties of the Vice Chair:
   i) Assist the Chair in arranging and conducting Council business meetings.
   ii) Serve as a member of the Executive Committee of the Council.
   iii) Assume the duties of the Chair in the event of the resignation or disability of the Chair.

ARTICLE IV. PROCEDURES
A) The Council shall act in an advisory role to the Department Chair and faculty of BAE.
B) The Council shall receive reports from the Department Chair and faculty of BAE as needed to help handle its responsibilities, shall have the power to create special sub-committees of the Council, and shall discharge its special committees when their assignments have been completed or their usefulness otherwise ended.
C) The Council shall consider the failure of a Council member, from inability or otherwise, to perform the duties of his/her office, and may, by two-thirds vote, declare any position vacant. The Council shall thereupon appoint a member to fill the vacancy until the end of the normal term for that Council member. Such appointment shall not render the appointee ineligible for appointment or election to any office.

ARTICLE V. CONDUCT OF BUSINESS
A) Meetings. Regular Council meetings shall be held on at least an annual basis in the fall generally timed to coincide with BAE alumni events. The regular official meeting of the Council will be held at this time. Additional interim meeting(s) in the Spring or other selected time may be held to assist in accomplishing the purposes of the Council. Robert's Rules of Order will prevail unless modified by these bylaws. Members unable to attend may express their opinion in writing concerning agenda items to the Council Chair or the Department Chair. Other meetings may be called by the Chair or Department Chair using techniques such as conference calls, e-mail or "listserves".
B) Quorum. A quorum shall consist of 40% of the members of the Council. In the absence of a quorum, official business may be conducted by written ballot.
C) Voting. All matters except amendments to the bylaws and removal of members under Article IV, Section C, shall be decided by a simple majority vote of members present.

ARTICLE VI. CHANGES TO BYLAWS
A) Changes in the bylaws may be discussed at any meeting of the Council. Passage requires a two-thirds vote in writing of the Council membership within 30 days after receipt of the written proposed revision.

REINITIATION OF ADVISORY COUNCIL
A) Initial Officers. The initial officers of the Council shall be as follows:
i) The Chair shall be elected initially from the current Council membership prior to the fall meeting, 2009. Email ballot will be an acceptable means of election.
ii) The Vice Chair shall be elected by the membership of the Council at the first regular meeting in the fall of 2009.
iii) The Past Chair position shall remain vacant for the first year.  
Terms filled will include the following classes:
   iv) Class I (2009) (To be rotated off in Fall of 2011)  
   v) Class II (2009) (To be rotated off in Fall of 2012)  
   vi) Class III 2010 (To be rotated off in Fall of 2013)  

New members will be nominated and recruited by the faculty prior to the Fall Meeting of 2009.  At the fall meeting, the final slate of classes for all three terms will be recommended by the BAE Chair, considered, and voted upon by the new Council.
Advisory Council Meeting Minutes

1:00 PM to 8:30 PM, Friday, June 11, 2010

Afternoon portion, Room 249, C.E. Barnhart Building
In attendance: Julia Parakkat, Erin Webb, Liz Bullock, Kristyn Ratliff, Jonathan Waits, Arlyn Wilcox, Ruth Wilcox, Grant Wonderlich, JP Jones, Scott Shearer, Sue Nokes, Czar Crofcheck

Meeting was called to order at 1:05 pm

The advisory council and the faculty members present introduced themselves.

Scott Shearer presented to the advisory council about the history and current activities in the department.

Sue Nokes presented to the advisory council about the ABET process and the purpose of the Self-Study.

Czar Crofcheck presented to the advisory council the specific areas that the advisory council needs to review and recommend actions.

- **Criterion 2: Objectives**
- **Criterion 3: Outcomes**
- **Criterion 4: Continuous Improvement Process**
- **Criterion 5: Curriculum**

During the discussion the advisory council made several helpful suggestions.

- The advisory council provided valuable feedback about word choice and even grammar. All of these editorial improvements are not documented, but have been incorporated into the Self Study.
- The absence of the word “environmental” from the department’s mission statement was questioned by Liz Bullock.
- The difference in the introductory words of the two objectives was questioned by Ruth Wilcox.
- There was discussion about whether the FE exam is really a measure of the abilities of the graduates 3-5 years after graduation. The wording in the metric was emphasized, “as a predictor of competence” and the advisory council was satisfied.
- The use of the PE was also questioned, since a large portion of graduates do not take the PE because it is not expected in their line of work. The faculty indicated that it is not held against us that all of the graduates take the PE and our goal is that the ones that do take it are able to pass it. The faculty asked the advisory council if they had any suggestions about what else could be measured.
- It was also noted that the metrics call for the percentage passing the PE the first time, but the data is not based on the initial passing rate.
• The metrics for objective 2 call for quantification of salary increases for the alumni. Some of the surveys returned did not include a current salary, there was no clarification if this meant that the individual had lost their job. Due to the lack of data, these data points were removed from the sample. The advisory council remarked that this didn’t seem fair. It was suggested that the metric clearly state that increase percentage is based on employed alumni.

• The standard and goal for the FE metric were based on the average for the COE at UK. It was noted that this average was unavailable. It was suggested to use the national average instead.

• For outcome 5, the score from BAE 417 is a 61%, which is below standard. The draft of the self-study marked this as “No” action, with an explanation of why the score was low (not enough time to complete the assignment) and the intent of the instructor to give additional time next time. The advisory council advised that this should be marked as “yes”, since there was in fact action taken.

• For outcome 8, student performance in a national design competition is one of the metrics. In the 2008-2009 year, there were no student competition entries. The advisory council discussed the importance of student design competitions and suggested that just participating in a student design competition should be reported as a success, not just when the students place in the completion.

• The advisory council provided feedback about the choice of verbs in Table 10.

• The advisory council reviewed Table 13. Percentage of Course Dedicated to each Outcome. The advisory council recommended that Outcome 11 (multi-disciplinary) and Outcome 14 (global appreciation) could have additional course time, because both topics are of greater importance in the workplace today. Maybe multi-disciplinary roles could be covered in senior design.

The advisory council agreed on the following recommendations:
1. The mission statement should include “environmental”.
2. The wording of the objectives should be clarified.
3. For continuity, there should be a “tool” column in Table 5.
4. The standard and the goal for the FE in the objectives should refer to a national average, not a COE average.
5. The standard for passing the PE should be 70% and the goal should be 90%.
6. The metric for the PE should not include reference to taking the PE for the first time.
7. The metric for salary increase should clearly state that it is based on employed alumni.
8. The participation in student design competitions should be a success, not just when the students place in the competition.
9. The evaluation for outcome 5 should indicate that action was taken and the action should be included in Table 10.
10. There should be more class time on Outcome 11 & Outcome 14.

Czar Crofcheck presented about the current structure of the capstone senior design course. The advisory council was encouraged to submit ideas on how the course could be improved. Topics suggested during the meeting included troubleshooting, retrofits, decision making, lean systems, 6-sigma, impact analysis, and focus analysis.

General curriculum comments were also made.
Students need to understand where their salary will come from someday, for example in water resources salaries are basically paid with tax money, through a consulting agency. The professions class should also cover “informal” communication.

The afternoon portion of the meeting was adjourned at 6:05 pm.

**Evening portion, 6:30 pm at Malone’s Banquet**

In attendance: Julia Parakkat, Erin Webb, Liz Bullock, Kristyn Ratliff, Jonathan Waits, Arlyn Wilcox, Ruth Wilcox, Grant Wonderlich, JP Jones, Scott Shearer, Sue Nokes, Czar Crofcheck, Sarah Short, and Christina Lyvers

Sarah Short and Christina Lyvers presented on their Brazil Study Abroad Trip

Scott Shearer discussed the bylaws and the need to elect new members to the Advisory Council. Due to time constraints, it was decided to do so by email.

The evening portion of the meeting was adjourned at 8:35 pm

ABET Subcommittee Meeting after Advisory Council Meeting
June 15, 2010

In attendance, Czar Crofcheck and Sue Nokes

Order of business: to decide what recommendations from the alumni board can be incorporated immediately and which recommendations will have to be forwarded to the UGCC and the faculty.

Recap of the recommendations:

1. The mission statement should include “environmental”.
2. The wording of the objectives should be clarified.
3. For continuity, there should be a “tool” column in Table 5.
4. The standard and the goal for the FE in the objectives should refer to a national average, not a COE average.
5. The standard for passing the PE should be 70% and the goal should be 90%.
6. The metric for the PE should not include reference to taking the PE for the first time.
7. The metric for salary increase should clearly state that it is based on employed alumni.
8. The participation in student design competitions should be a success, not just when the students place in the competition.
9. The evaluation for outcome 5 should indicate that action was taken and the action should be included in Table 10.
10. There should be more class time on Outcome 11 & Outcome 14.

The following items will be incorporated into the Self Study immediately: 2, 3, 4, 5, 6, 7, and 9.

The following items will need to be forwarded to the UGCC: 1, 8, and 10.
APPENDIX F – DATA FOR ASSESSING PROGRAM OBJECTIVES

Table 19. FE, PE, and Membership Data for Objective Assessment.

<table>
<thead>
<tr>
<th>Graduation Year</th>
<th>n</th>
<th>Sat for the FE</th>
<th>Passed the FE</th>
<th>Took the PE</th>
<th>Passed PE</th>
<th>Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td>98-99</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>99-00</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>00-01</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>01-02</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>02-03</td>
<td>10</td>
<td>8</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>03-04</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>04-05</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>05-06</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>06-07</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>07-08</td>
<td>12</td>
<td>9</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>99-08</td>
<td>67</td>
<td>54</td>
<td>48</td>
<td>12</td>
<td>11</td>
<td>39</td>
</tr>
</tbody>
</table>

Table 20. Employment and Salary Data for Objective Assessment.

<table>
<thead>
<tr>
<th>Graduation Year</th>
<th>n</th>
<th>Employed*</th>
<th>First Salary (adjusted)</th>
<th>Current Salary</th>
<th>Increase in Pay</th>
<th>Increase in Adj. Pay**</th>
<th>Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>98-99</td>
<td>5</td>
<td>5</td>
<td>$42,408</td>
<td>$65,000</td>
<td>206%</td>
<td>160%</td>
<td>3</td>
</tr>
<tr>
<td>99-00</td>
<td>5</td>
<td>4</td>
<td>$40,651</td>
<td>$79,000</td>
<td>258%</td>
<td>207%</td>
<td>1</td>
</tr>
<tr>
<td>00-01</td>
<td>3</td>
<td>3</td>
<td>$48,232</td>
<td>$91,667</td>
<td>285%</td>
<td>236%</td>
<td>1</td>
</tr>
<tr>
<td>01-02</td>
<td>5</td>
<td>5</td>
<td>$44,708</td>
<td>$63,000</td>
<td>173%</td>
<td>145%</td>
<td>0</td>
</tr>
<tr>
<td>02-03</td>
<td>10</td>
<td>10</td>
<td>$37,765</td>
<td>$50,500</td>
<td>158%</td>
<td>136%</td>
<td>3</td>
</tr>
<tr>
<td>03-04</td>
<td>6</td>
<td>6</td>
<td>$50,734</td>
<td>$66,667</td>
<td>151%</td>
<td>133%</td>
<td>3</td>
</tr>
<tr>
<td>04-05</td>
<td>7</td>
<td>7</td>
<td>$45,949</td>
<td>$60,000</td>
<td>143%</td>
<td>129%</td>
<td>4</td>
</tr>
<tr>
<td>05-06</td>
<td>8</td>
<td>8</td>
<td>$41,261</td>
<td>$43,571</td>
<td>111%</td>
<td>104%</td>
<td>1</td>
</tr>
<tr>
<td>06-07</td>
<td>6</td>
<td>6</td>
<td>$46,940</td>
<td>$34,000</td>
<td>84%</td>
<td>81%</td>
<td>2</td>
</tr>
<tr>
<td>07-08</td>
<td>12</td>
<td>11</td>
<td>$44,013</td>
<td>$33,333</td>
<td>81%</td>
<td>81%</td>
<td>2</td>
</tr>
<tr>
<td>99-08</td>
<td>67</td>
<td>65</td>
<td>$43,713</td>
<td>$53,906</td>
<td>149%</td>
<td>129%</td>
<td>20</td>
</tr>
</tbody>
</table>

* Employed is defined as students that are employed within 6 months or attend graduate school.
** Salaries were adjusted to 2009 dollars.
APPENDIX G – DATA FOR ASSESSING OUTCOMES

The following data was collected and evaluated in 2008-2009. Revised assessment tools were established in Fall 2009. The complete assessment given in Criterion 3 is based on the assessments from 2008-2009 and additional data collected in 2009-2010. The additional data is contained in the discussion above in Criterion 3.

For all of the assessments that are based on class assignments in BAE courses, the data are collected each semester. For all of the assessments that are based on FE scores, the data are collected in June of every year and the scores from the fall and the spring exam may be combined for a single year average.

Outcome 1- Graduates must demonstrate their ability to apply knowledge of mathematics, science and engineering to solve problems.

Assessment
a) BAE 427/447. Homework assignments in each course were selected that included problems with an emphasis on math and science content. The average for the 2008-2009 year on these assignments was 88% for BAE 427 and 87% for BAE 87%. These scores indicate that the students are able to utilize their understanding of math and science to solve problems.

b) In order to determine the capabilities in mathematics of students nearing completion of the BAE program, performance in the math sections of the Fundamentals of Engineering (FE) examination were analyzed. Average FE exam scores of University of Kentucky BAE students were normalized by average scores of all students in the nation taking the ‘Agricultural Engineering’ examinations from 2005 through 2009. The metric standard for normalized FE scores is 1.0 or above. Normalized scores of 1.0 or greater indicate that our students did better than the national average on that particular portion of the exam. Figure 10 shows normalized scores in mathematics. There appears to be an increase in the normalized score over time. The overall average (2004-2009) and the average for the last review year (2008-2009) were both 1.0 (meets standard).
Response

On balance, these results indicate that Outcome 1 has been attained over the evaluation period.

Outcome 2- Graduates should demonstrate an ability to use techniques, skills and modern engineering tools necessary for engineering practice.

Assessment

a) BAE 402/403. This assessment was added in Fall 2009, hence there is no data for 2008-2009.

b) The apparent success in attaining Outcome 2 is supported by plotting BAE student scores from the ‘computer’ section of the FE examination normalized by the average scores of all students taking ‘Agricultural Engineering’ examinations between 2004 and 2009 (see Figure 11). University of Kentucky BAE students consistently achieved normalized scores well above the metric goal of 1.0 over the period (meets standard). We will continue to monitor these results regarding possible implications relative to attainment of Outcome 2.
Response

All target assessment thresholds are exceeded relative to Outcome 2.

**Outcome 3- Graduates should be able to design and conduct experiments, as well as to analyze and interpret data.**

**Assessment**

a) In the Spring 2009 BAE 202 class (Probability and Statistics for Biosystems), the final lab assignment focused on design of experiments and analyzing and interpreting data (the same assignment that had been assigned in 2007). The average score on the lab assignment was 92% (the score in 2007 was 91%), which **meets goal**. The class performed well on the assignment. Unlike 2007, all of the students mentioned that the treatments needed to be assigned randomly. However, there were still problems with identification of the experimental unit. Several students thought that the response variable was the experimental unit. In the next class, the definition of experimental unit will be emphasized.

b) In 2004, students in BAE 305, DC Circuits and Microelectronics, were given open-ended laboratory assignments to evaluate their ability to formulate experiments, acquire and analyze data, and determine required results. All laboratory experiments in this class are designed to be open-ended task assignments that force students to formulate experiments and decide what data are needed to report the requested results. Two specific metrics were used. The first was the average score of the final laboratory experiment, which was a culmination design laboratory. The second was a comparison of average lab scores from the first half of the semester to the second half. The average score of culmination laboratory was 95.6% (in 2008, the score was 92.3%), which **meets goal**. In addition, the average for the lab reports done in the second half of the course was higher than the average of the lab reports done in the first half of the course, 92.7% for the first half and 95.7% for the second half. In 2008, these averages were 92% and 90%, respectively. The data show that the overall class scores increased in the latter half of the semester. BAE 305 students handled the open-ended laboratory assignments better as the semester progressed; the students’
ability to design experiments and then select an appropriate method to communicate the experiment’s results increased. Students are achieving Outcome 3.

c) In BAE 403 (BAE Design II), each final senior design report included a statistical analysis. A grade was assigned to each team for their statistical analysis. In 2008, the team grades were A, B, B, B, B, C, and C. As a result, additional class time was allotted for discussion of statistical analysis. In 2009, both teams received an A on their statistical analysis, which meets goal. This was a combination of the additional class time and the difference in the nature of the statistical analysis due to the different design problems. The recommendation for the coverage of statistical analysis in the senior design course is to continue to stress the importance of sound statistical analysis.

Response

The assessments in BAE 202, BAE 305, and BAE 403 indicate that BAE students have demonstrated the capability of achieving Outcome 3. We plan to continue current presentation of curriculum content relating to this outcome pending future assessment.

Outcome 4- Graduates must demonstrate an ability to identify, formulate, and solve engineering problems.

Assessment

a) BAE 427/447. Homework assignments in each course were selected that included problems with an emphasis on solving engineering problems. The average for the 2008-2009 year on these assignments was 88% for BAE 427 and 87% for BAE 87%. These scores indicate that the students are able to solve engineering problems.

b) The normalized scores for the various FE sections used to assess Outcome 4 are shown in Table 21. Overall, the scores appear to be improving over time. This is most likely because more students are taking the exam. For this analysis, the averages of the scores for the entire review period (2005-2009) and for the previous year (2008-2009) were considered (the last two columns in the table). FE scores for 2004-2005 are not included in this review because the test prior to Oct 2005 contained different sections divisions, making it difficult to compare to newer data.
For 2005-2009, the overall combined FE normalized score is a 0.948, which does not meet standard (this includes sections Engineering Mechanics, Strength of Materials, Material Properties, Fluid Mechanics, Thermodynamics, Application of Engineering Mechanics, Engineering of Materials, Fluids, and Thermodynamics and Heat Transfer). The same score for the 2008-2009 review period is 1.0 (meets standard).

Depending how the numbers are interpreted (considering the 2005-2009 average or the 2008-2009 average) all of the metrics are meeting at least standard, except Thermodynamics. The BAE Department is taking a closer look at how thermodynamics is reinforced in BAE courses, specifically BAE 447, Bioprocess Engineering Fundamentals. In addition, the UGCC decided to analyze how Applications of Engineering Mechanics is reinforced in BAE courses, specifically BAE 417 (Design of Machine Systems) and BAE 437 (Land and Water Resources Engineering).

Changing the standard for the metric was also discussed. It was decided that a better approach would be to use the assessment to identify areas that could be improved. It should be noted that the last area identified as a concern was dynamics (several years ago) and that these scores are now noticeably at or above standard.

It should also be noted that the BAE students do well on the Thermodynamics and Heat Transfer section of the FE examination, but our students are not getting high grades in these classes. This supports the belief of the UGCC that our students do in fact receive additional training in these subjects after taking the EM and ME courses.

### Table 21. Normalized scores of BAE students on FE exam (Outcome 4 sections).

<table>
<thead>
<tr>
<th>Normalized FE Results</th>
<th>Oct-05</th>
<th>Apr-06</th>
<th>Oct-06</th>
<th>Apr-07</th>
<th>Oct-08</th>
<th>Apr-09</th>
<th>05-09 Ave.</th>
<th>08-09 Ave.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Mechanics (Statics and Dynamics)</td>
<td>1.2</td>
<td>0.9</td>
<td>0.7</td>
<td>1.1</td>
<td>1.0</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Strength of Materials</td>
<td>0.6</td>
<td>0.9</td>
<td>0.4</td>
<td>0.8</td>
<td>0.4</td>
<td>1.1</td>
<td>1.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Material Properties</td>
<td>0.2</td>
<td>0.6</td>
<td>1.2</td>
<td>1.1</td>
<td>0.8</td>
<td>0.9</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Fluid Mechanics</td>
<td>1.1</td>
<td>1.0</td>
<td>0.7</td>
<td>1.1</td>
<td>0.8</td>
<td>1.0</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Thermodynamics</td>
<td>0.6</td>
<td>0.8</td>
<td>0.9</td>
<td>1.2</td>
<td>0.8</td>
<td>1.1</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Application of Engineering Mechanics</td>
<td>0.5</td>
<td>0.8</td>
<td>1.2</td>
<td>1.0</td>
<td>0.9</td>
<td>1.0</td>
<td>1.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Engineering of Materials</td>
<td>0.8</td>
<td>0.9</td>
<td>1.2</td>
<td>0.4</td>
<td>0.6</td>
<td>0.9</td>
<td>1.4</td>
<td>1.3</td>
</tr>
<tr>
<td>Fluids</td>
<td>0.6</td>
<td>1.0</td>
<td>0.7</td>
<td>0.8</td>
<td>1.0</td>
<td>1.0</td>
<td>1.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Thermodynamics and Heat Transfer</td>
<td>0.9</td>
<td>0.7</td>
<td>0.6</td>
<td>1.2</td>
<td>0.5</td>
<td>1.1</td>
<td>1.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Overall</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
<td>0.7</td>
<td>1.0</td>
<td>1.1</td>
<td>1.0</td>
<td>0.9</td>
</tr>
<tr>
<td>Fluids Average</td>
<td>0.9</td>
<td>1.0</td>
<td>0.7</td>
<td>0.9</td>
<td>0.9</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Response

The tracking the FE examination scores in engineering science during the past review period offers strong evidence that Outcome 4 is being achieved. Although, the coverage of thermodynamics and application of engineering mechanics should be reinforced.

Outcome 5- Graduates must demonstrate an ability to design a system, component, or process to meet desired needs.

Assessment

a) The primary means of assessment of Outcome 5 is the evaluation of assignments and examinations administered in the BAE core design courses:

   BAE 417 Design of Machine Systems
   BAE 427 Structures and Environment Engineering
   BAE 437 Land and Water Resources Engineering
   BAE 447 Bioprocess Engineering Fundamentals

   The students’ capabilities in design application in a variety of disciplines are measured by carefully structured exercises. Students are required to take three of these courses along with three or four additional technical elective courses.

BAE 417 - Design of Machine Systems

Measurement Method: Students were tasked with designing a mechanical winch mechanism, which required appropriate specification of a V-belt drive, a roller chain drive and a helical gear drive. They were also required to specify dimensions and material properties for one shaft contained in the mechanism and to specify bearings for that shaft. The design required 6-8 hours of work: students were given 2 weeks to complete the assignment.

Results: The average score on this assignment was a disappointing 61% with a standard deviation of 14.8% (the score in 2007 was 85.1%). Previous homework assignments had indicated that students had mastered the methods needed to complete the assignment and it appears that students were not willing to commit the necessary time to complete the assignment.

Instructor Recommendation: My first inclination is to give the students the assignment early in the semester so that they can work on it as they have more time (Larry Wells).

BAE 427 - Structures and Environment Engineering

Measurement Method: BAE 427 students were assigned >45 design-oriented problems in 12 distinct homework assignments throughout the course during the Spring 2008 semester. Students were required to analyze the problem, identify both prescriptive code requirements and explicit design methodologies, report technical citations used, and list assumptions made in recommending a design solution.

Results: An example homework assignment required use of beam superposition theory to determine design loads prior to recommending the appropriately sized
timber for a structural application. The average score on the homework assignment was an 87.6%, where the highest grade was an A and the lowest grade was an E (where the highest possible grade was an A). Adjusting values by omitting one student’s grade who did not have prerequisite courses yielded an average score of 93.5% for this particular example.

<table>
<thead>
<tr>
<th>BAE Course</th>
<th>Outcome</th>
<th>Score</th>
<th>Std Dev</th>
<th>N</th>
<th>P S</th>
<th>% of course</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>427</td>
<td>5</td>
<td>87.6%</td>
<td>23.9%</td>
<td>15/15</td>
<td>14/15</td>
<td>adjusted</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>93.5%</td>
<td>2.39%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

_Instructor’s Recommendation:_ All students enrolled in the course and having the prerequisites demonstrated a satisfactory level of competency in analysis and design for both the structural and environmental aspects of this course. Students were surprised to find that there may be many general solutions to a problem; and that often, they must modify some of their initial assumptions in the beginning to move toward an optimized solution in the end. This methodology was used to develop and enhance the students’ engineering judgment (Rich Gates, who is no longer on faculty at UK).

**BAE 437 - Land and Water Resources Engineering**

**Measurement Method:** Four exams and a final were given to the students during the course. In all cases, the students were required to demonstrate an ability to use their design capabilities.

**Results:** The first exam covered rainfall distribution, determination of the design storm, and runoff potential. The class average on this exam was 15.4/18 (86%) indicating that the students had a good grasp of the material. This average was about 4% higher than the previous year. One student did poorly on the exam, with most students performing at or above the average. The low on the exam was a 7.75/18 with a standard deviation of 2.9.

The second exam covered erosion and the design of channels including the determination of stream channel stability, design of culverts, and the design of stable grassed waterways. The class average on this exam was 15.2/18 (84%), which was 5 percentage points lower than the previous year. One student scored a 7.75/18 and the test had a standard deviation of 2.9.

The third exam covered the design of treatment wetlands, groundwater hydraulics, and surface drainage. The class average was 16.7/18 (93%) with the low being 12.5/18 and the test standard deviation was 1.6. Three years ago, the average was 88% with most of the errors occurring because of the notation of \( \log_e \) in the text rather than \( \ln \). This was a fundamental error caused by a lack of understanding of basic algebra. The students seemed to be unaware that the two notations were the same quantity (an elementary math problem). In 2008 and 2009, the instructor emphasized the notation. The result was the highest test average in each case.

The fourth exam covered water table management, sprinkler irrigation principles and the sizing of pipes in a sprinkler system. The class average was 15.6/18 (87%).
low on the exam was 13/18 with a standard deviation of 2.1. Overall, the class did about the same on this exam compared to the previous year, but similar to previous years. The primary problem was with irrigation, which was reinforced on the final.

The final exam primarily covered key material that was part of the overall course objectives (runoff, culvert design, grassed waterways, subsurface drain size, and sprinkler design). The average on the final was 17.3/20 (87%). The low was 12.5/20 with a standard deviation of 2.4. Overall, the class did well, considering that the exam included most of the more difficult design problems of the course.

**Instructor’s Recommendation:** Throughout the semester, the students were required to complete numerous designs of systems or components within hydrology. Their performance on exams and the final indicates that most of the students were capable of designing these systems by the end of the course. Many of the students came into the class will little or no background in hydrology (Steve Workman).

**BAE 447 - Bioprocess Engineering Fundamentals**

**Measurement Method:** In fall of 2008, a homework assignment was selected to be representative of the material presented in BAE 447.

<table>
<thead>
<tr>
<th>BAE Course</th>
<th>ABET Outcome Number</th>
<th>Score</th>
<th>Std. Dev.</th>
<th>N</th>
<th>P</th>
<th>S</th>
<th>% of Class</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>447</td>
<td>5</td>
<td>9/10</td>
<td>2.8</td>
<td>12</td>
<td>P</td>
<td></td>
<td>100</td>
<td>Fall, 08</td>
</tr>
</tbody>
</table>

(the score in 2007 was also 9/10)

**Instructor’s Recommendation:** The performance of the class was slightly lower than in 2007. The problem required the students to select and size a tube and shell heat exchanger for a corn ethanol plant. The project was open-ended and a few students had difficulty with the problem, although the majority of the students completed the problem successfully. The projects were considerably more involved than typical PE exam questions (Mike Montross).

**Response**

The assessment indicates that BAE students are able to effectively apply engineering principles in design, as indicated in the four BAE core area design courses. Most scores exceeded the metric goals. We must continue to monitor these instruments to determine that design proficiency is acceptable.

In 2008, there was a decrease in the metric score for BAE 417. This will be addressed by giving the students additional time and motivation to complete the assignment.

**Outcome 6- Graduates should gain experience in solving BAE problems that are vague or poorly constrained.**

**Assessment**

a) Students completed three formal oral presentations and one boardroom style question and answer presentations. The presentation skills of the students were varied, from
adequate to excellent. The goal of the presentations was to convey the current progress status and likelihood of completion. The students prepare four written reports over the course of the two semesters. Both teams did an adequate job of putting together their written reports. The average grades for the oral and written reports are shown in Figure 12.

![Average grades of BAE students on oral and written reports in the capstone design course, 2004-2009.](image)

**Instructors’ Comments 2008-2009:**

“Written and oral reports met the overall requirements of both courses. However, because of the dysfunctional nature of the team, the students failed to fully utilize the constructive feedback provided by the course instructors. In general the team had to be goaded into making changes. Written reports often lack sufficient detail to insure clear communications between the team and management (course instructors). None of the team members took leadership to make a very good report into a superior report. The oral progress and final presentations would have benefitted from more preparation and rehearsals, a fact that should be considered for future course offerings.” – Dr. Shearer

“Written and oral reports met the overall requirements of both courses. However, because of the frustration of the team in being able to actually install the system in a house due to the timing of the design of the rest of the house, the team never did really gel into getting a completed project. In general the team had to be lead into defining what decisions needed to be made and then making decisions on how to progress. The written reports typically lacked sufficient detail to insure clear communications and review drafts required extensive revision. The oral progress and final presentations would have benefitted from more preparation and rehearsals.” – Dr. Colliver

Additional instructors’ comments are available in previous yearly assessment documentation.
Response

By the very virtue of our senior design experience, the students are given the opportunity to approach and solve a vague design problem. Our assessment of individual design projects indicates that we are achieving Outcome 6.

Outcome 7- Graduates should be exposed to research and technical literature and have the ability to interpret key issues and concepts.

Assessment

a) To assess Outcome 7, assignments were administered in the BAE core design courses BAE 417, BAE 427, BAE 437 and BAE 447 (see the assessment for Outcome 5 for further details about the content in these courses). The assignments involved finding and interpreting information from technical literature for use in design applications in these courses.

BAE 417 - Design of Machine Systems

Measurement Method: Students were given two laboratory assignments in which they were required to utilize ASABE standards in assessing a mechanism. In one assignment, students were tasked with examining a John Deere 7220 tractor and assessing compliance with standards associated with ergonomic aspects operator controls. In the second assignment, students were tasked with applying requirements of equipment safety standards to a prototype mechanism under development.

Results: The average score on the ergonomic standards assignment was 94.7 with a standard deviation of 6.1, while the average score and standard deviation on the safety standards assignment were 94.7 and 3.2, respectively.

Instructor Recommendation: The students demonstrated a thorough understanding of the standards and were able to apply them to typical agricultural machines (Larry Wells).

BAE 427 - Structures and Environment Engineering

Measurement Method:

In the Spring 2008 semester, BAE 427 students were required to obtain the latest edition of the National Design Specification for Wood Construction, which was used extensively in the first half of the course. Students were provided access to design/reference materials including ASABE Standards, the 2006 International Building Code, Manual of Steel Construction, and the ASHRAE Handbook of Fundamentals, among others. The second half of the course focused on development and maintenance of the environments within the various structures, which were designed in the first half of the course. Use of each of these references required the student to make judgments on the applicability of the standard or formula under consideration, and ultimately to evaluate the design recommendation against practical standards. The major metric for evaluation of this outcome is based in the homework assignments.
Results: Each homework assignment required the use of at least one of the previously listed technical references. Students were required to use and cite the appropriate document to obtain design solutions. Time permitting, “different” results were discussed in class. The average score on all homework assignments taken together was an 82%, where the highest grade was an A and the lowest grade was an E (where the highest possible grade was an A). Adjusting values by omitting one student’s grade who did not have prerequisite courses yields an average score of 86% for this analysis.

<table>
<thead>
<tr>
<th>BAE Course</th>
<th>Outcome</th>
<th>Score</th>
<th>Std Dev</th>
<th>N</th>
<th>P S</th>
<th>% of course</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>427</td>
<td>7</td>
<td>82.0%</td>
<td>16.9%</td>
<td>15/15</td>
<td></td>
<td></td>
<td>adjusted</td>
</tr>
<tr>
<td></td>
<td></td>
<td>86.0%</td>
<td>7.39%</td>
<td>14/15</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Instructor’s Recommendation: The homework assignments present the best opportunity for the student to gain design experience in a “controlled environment”. That is to say, they have the opportunity to succeed or fail in a recommended design solution without fear for loss of life or limb, based on their results. This is essential in learning the basic concepts of design and the continuing development of engineering judgment. It was initially thought that end-of-semester deadlines and conflicts affected the students’ participation in homework assignments, however, the average grades (both adjusted and unadjusted are within 2 percentage points of each other for the two halves of the semester). A considerable amount of time was required to complete the homework assignments and those that put in the time received the higher grades (Rich Gates).

BAE 437 - Land and Water Resources Engineering

Results: Outcome 7 refers to the student’s ability to utilize and interpret available information in their work. All exams in BAE 437 are open book, to allow the student to develop their skills in assessing key information for the solution of problems. The text for BAE 437 is in a handbook format with numerous tables and figures for solving problems and is the primary resource for the PE exam. In addition to the text, the students were provided material from the ASABE Standards for use in waterway design and the design of subsurface drains. Finally, the students used technical literature from irrigation manufacturers for the design of sprinkler and drip systems.

Although all of the exams required extensive use of the text in BAE 437, the technical literature from irrigation and the ASABE Standards were used in exam 4. The students scored 87% on this exam indicating they were capable of utilizing reference material in the exams.

In addition to the use of these materials in the exam, a midterm project was assigned to obtain and summarize a research article from the library. The research articles included topics such as the effect of climate variations on flooding, routing models for stream flow, and the efficacy of vegetated waterways. These reports were the best I have received for this assignment. The students, many of whom had never had a
hydrology course, were able to read the articles and discuss the results in some detail. The average for the journal review was 97%. (Steven Workman)

**BAE 447 - Bioprocess Engineering Fundamentals**

**Measurement Method:** In fall of 2008, a homework assignment was given in which the students were required to consult published design standards and/or use technical literature (journal articles) to arrive at a final solution.

**Results:**

<table>
<thead>
<tr>
<th>BAE Course</th>
<th>ABET Outcome Number</th>
<th>Score</th>
<th>Std. Dev.</th>
<th>N</th>
<th>P</th>
<th>S</th>
<th>% of Class</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>447</td>
<td>7</td>
<td>7/10</td>
<td>4.0</td>
<td>12</td>
<td>P</td>
<td>100</td>
<td>Fall, 08</td>
<td>(07:8/10)</td>
</tr>
</tbody>
</table>

**Instructor’s Recommendation:** Two projects were assigned during the semester that required students to use technical literature to solve the projects. The measurement was based on the students that had to ask me for material properties or to explain the technical drawings for the heat exchangers. I will try to assign more projects that require the students find technical data on vendor web sites or in their literature (Mike Montross).

**Response**

Assessments from the 2008-2009 yearly assessment, presented here, and assessments from previous years indicate that Outcome 7 is being achieved.

**Outcome 8- Graduates must demonstrate effective interpersonal, formal and technical communication skills whether oral or written.**

**Assessment**

a) In BAE 400, the last speech in the class is designated as a formal oral presentation. This presentation highlighted oral technical presentation skills learned in the BAE program. The presentation is evaluated by three evaluators (faculty members or toastmaster members) and a grade assigned between 0 and 10, with 0 being the lowest and 10 being the highest possible. The average and standard deviation of this measurement is reported for the class as well as the number of students in the class.

<table>
<thead>
<tr>
<th>BAE Course</th>
<th>ABET Outcome Number</th>
<th>Score</th>
<th>Std. Dev.</th>
<th>N</th>
<th>P</th>
<th>S</th>
<th>% of Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>8</td>
<td>8.67</td>
<td>0.56</td>
<td>11</td>
<td>P</td>
<td>95</td>
<td></td>
</tr>
</tbody>
</table>

(07: 8.74)

Evaluation was completed by three faculty members, who included the instructor; two of the evaluators had toastmaster experience. The instructor and the two other evaluators considered the speeches to be excellent. The students were well prepared. The score of 86.7% meets goal for this objective.
b) In BAE 402/403, students presented three formal oral presentations and one boardroom style question and answer presentation. The presentation skills of the students varied from being adequate to excellent. The goal of the presentations was to convey the current progress status and likelihood of completion. The students prepared four written reports over the course of the two semesters. Both teams adequately completed their written reports. Figure 19 shows the average grades for these written and oral reports over the 5 years of 2004-2009. All grades meet goal, except the oral grade in 06-07, which still meets standard. The two senior design teams from 2008-2009 were unable to enter the AGCO national student design competition (one of team members on both teams was a post baccalaureate student.)

Instructors’ Comments 2008-2009:

“Written and oral reports met the overall requirements of both courses. However, because of the dysfunctional nature of the team, the students failed to fully utilize the constructive feedback provided by the course instructors. In general the team had to be goaded into making changes. Written reports often lack sufficient detail to insure clear communications between the team and management (course instructors). None of the team members took leadership to make a very good report into a superior report. The oral progress and final presentations would have benefitted from more preparation and rehearsals, a fact that should be considered for future course offerings.” – Dr. Shearer

“Written and oral reports met the overall requirements of both courses. However, because of the frustration of the team in being able to actually install the system in a house due to the timing of the design of the rest of the house, the team never did really gel into getting a completed project. In general the team had to be lead into defining what decisions needed to be made and then making decisions on how to progress. The written reports typically lacked sufficient detail to insure clear communications and review drafts required extensive revision. The oral progress and final presentations would have benefitted from more preparation and rehearsals.” – Dr. Colliver

c) There were no student design contest entries during this academic year.

Response

A variety of assessment methods implemented over the evaluation period indicate that BAE students, for the most part, are acquiring excellent oral and written communication skills, at or above our metric goals. In the middle of the assessment period, the students were required to turn in rough drafts of their written reports to the faculty advisors for additional feedback. It appears that the change did increase the scores. Requiring feedback helped reinforce the concept that feedback is necessary and vital for any effective writing.

Outcome 9- Graduates must recognize the need for, and ability to engage in life-long learning.
Assessment

a) **Measurement Method:** The need for life-long learning was addressed briefly in a presentation on the benefits of professional organizations (Question #8). The students’ recognition of the necessity for life-long learning was addressed on the BAE 400 final exam. The average score (between 0 and 10) are reported.

<table>
<thead>
<tr>
<th>BAE Course</th>
<th>ABET Outcome Number</th>
<th>Score</th>
<th>Std. Dev.</th>
<th>N</th>
<th>P</th>
<th>% of Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>9</td>
<td>9.44</td>
<td>0.73</td>
<td>11</td>
<td>P</td>
<td>3</td>
</tr>
</tbody>
</table>

(07: 9.64)

The average score for Question #8 on the final was 9.44. The need for life-long learning was presented. The discussion during the presentation on professionalism was well received. This is considered an excellent score with no changes required.

Response

The students appear to recognize the need for life-long learning.

**Outcome 10- Graduates should be able to work within a team approach to complete projects that include multiple facets.**

Assessment

a) In BAE 402/403, evaluations of the teams were made by the team members and the project advisor. The team member evaluations were better than usual. Both teams worked very well together this year. Neither team really complained about teammates’ performance.

*Individual Advisor Comments*

“The students appeared to be functioning well as a team through the first semester where they defined the scope of the problem and identified and ranked potential solutions. However, as the team transition to assigning individual tasks, the performance of the team as a whole began to degrade. At one point none of the team members took responsibility for insuring that edited reports were submitted in a timely fashion. This was partially rectified when one of the team/advisor meetings was devoted to discussion of organization and responsibilities.

For the most part fabrication of the prototype sensing system was a team effort with good progress through most of this phase. The testing phase was somewhat more protracted than desired, and was attributed to a lack of leadership in the design of field test investigations. This phase of the project just happened, and was plagued by a number of mis-steps. In the end the students again showed creativity as a team when it can to developing a model to convert sensor reading to tank volume, going from a 27 term cubic model to a three term piecewise model.” – Dr. Shearer

“The students appeared to be functioning well as a team through there was not a clear leader in the team. The first semester where they defined the scope of the problem it
appears to be an overall discussion without clear delineation of responsibilities. During the second semester however the team did break into assigning individual tasks, however there was no clear direction due somewhat to a moving target that was presented by the architects and the other design teams.

The fabrication of the system initially was in the lab to be used for testing. As the second semester progressed the focus changed to a numerical analysis of the problem due to other design teams needing information from the hot water team design and the fact the house was not going to be completed enough to do testing. Individuals within the team served to interact with the other teams and provided leadership in the overall design of the rest of the house. In general the team made good progress during the design phase however they needed considerable guidance and traveled down several blind paths. In the end, the students showed creativity as a team and were able to meet the challenges presented to them.” – Dr. Colliver

Response

All assessments of BAE students with regard to teamwork effectiveness indicate that this outcome is being attained to a relatively high degree. There are occasional indications that a few students do not contribute to team assignments as would be expected by most employers of engineers. These situations must be diligently monitored so that corrective action can be taken if these instances persist or if assessment of teamwork effectiveness declines over time.

Outcome 11- Graduates should demonstrate an appreciation for working in a multidisciplinary environment.

Assessment

a) One of the speeches in BAE 400 was structured around a “Contemporary Issue”. Each student selected a non-engineering disciplinary role and had to research and develop a presentation based on the viewpoint of another profession. It is the intent of this speech to demonstrate an appreciation for working in a multi-disciplinary environment. The student’s participation in this effort was graded on a 0-10 point basis. In addition, two questions (#9 and #10) were included on the BAE 400 final regarding an appreciation of working in a multi-disciplinary environment.

<table>
<thead>
<tr>
<th>BAE Course</th>
<th>ABET Outcome Number</th>
<th>Score</th>
<th>Std. Dev.</th>
<th>N</th>
<th>P</th>
<th>% of Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>11</td>
<td>8.95</td>
<td>0.5</td>
<td>11</td>
<td>P</td>
<td>5</td>
</tr>
<tr>
<td>400</td>
<td>11</td>
<td>8.89</td>
<td>1.30</td>
<td>11</td>
<td>P</td>
<td>5</td>
</tr>
</tbody>
</table>

(07: N/A, 8.11)

The students selected their contemporary issue topic. This was an excellent method for selecting speech topics dealing with the engineer’s role in society and dealing with other professions. The students also benefited from their own classmates discussing a diverse set of topics dealing with applying engineering in society.
Final Questions 9 and 10. The students demonstrated an appreciation for working in multi-disciplinary teams. All metrics meet goal.

Response

The assessment for this outcome from BAE 400 indicates that we are meeting this requirements for Outcome 11.

The topic of multidisciplinary issues is discussed, but not assessed in BAE 402/403. Possible inclusion of an assessment for Outcome 11 in BAE 402/403 will be considered during the 2009-2010 review cycle.

**Outcome 12- Graduates should demonstrate an understanding of professional and ethical responsibility.**

**Assessment**

a) In BAE 400, one of the lectures focuses on professionalism and the opportunities for professional involvement, while another lecture tackles the issues of engineering ethics. A question was included on the BAE 400 final that addressed the student’s recognition of the need for and benefits of involvement in a professional organization. A second question concerned the students’ understanding of engineering ethics. The answers to these two questions were graded on a 0 to 10 point basis. The two scores were averaged and standard deviation reported with the number of students.

<table>
<thead>
<tr>
<th>BAE Course</th>
<th>ABET Outcome Number</th>
<th>Score</th>
<th>Std. Dev.</th>
<th>N</th>
<th>PS</th>
<th>% of Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>12</td>
<td>9.06</td>
<td>1.48</td>
<td>11</td>
<td>P</td>
<td>5</td>
</tr>
</tbody>
</table>

(Score in 2007: 8.58)

The scores on the final examination questions #11 and #12 increased over last year because the website of the National Society of Professional Engineers (NSPE) had been studied in detail throughout the semester. The BAE students obviously used this NSPE website to answer the questions. Overall, the students became aware of the role of professional societies. The metrics meet goal for this outcome.

b) For the review period of October 2005 through April 2009, the average score on the ethics section on the FE examination is shown in Figure 13. Average scores were normalized by the mean score of all students taking the ‘Agricultural Engineering’ version of the FE examination in any given year. The overall normalized average was 1.0, which meets standard. There does appear to be an increase in the score over time, although it also seems to have reached a plateau.
Figure 13. Normalized scores of BAE students in ethics on FE exams, 2005-2009.

Response
Current assessment indicates that Outcome 12 is being satisfactorily attained. These measurements will be monitored in the next evaluation period to assure continuance of this success.

Outcome 13- Graduates should demonstrate knowledge of contemporary issues.

Assessment
a) This assessment was introduced in Fall 2009, hence there is no data for 2008-2009. For Spring 2010, students in senior design were asked to write a paragraph about the contemporary issues associated with the various design projects in the class. The class did a very good job identifying the contemporary issue with an average score of 85%.

Response
These average grades indicate that Outcome 13 is being accomplished. We will continue to monitor these grades and seek other means of assessing this outcome.

Outcome 14 - Graduates should demonstrate the broad education necessary to understand the impact of engineering solutions in global and social contexts.

Assessment
a) Assignments were administered in two of the core BAE design courses, BAE 417 (Design of Machine Systems) and BAE 437 (Land and Water Resources Engineering) to assess this outcome. Since the BAE students are required to take 3 of the 4 design courses, by evaluating this outcome in 2 of the 4, the BAE Department is able to assess all students in one or both courses.
In BAE 417, students were tasked with describing how an existing agricultural machine, or one conceived of by a student, should be designed, manufactured and marketed to a developing country. Students were asked to specifically address how the government, economy and culture of the country of choice would affect determination of design features, manufacturing methods, cost and marketing methods. This was an optional extra-credit assignment and four of nine students completed the assignment. Most students addressed the economics conditions and governmental constraints in their reports. All of the students sought to address the needs of the developing countries, though not always using practical methods. Most reports were lacking in meaningful consideration of available or practical manufacturing methods with regard to societal or cultural conditions which would affect utilization of the mechanisms or systems recommended. Students did an adequate job of identifying and citing references relevant to their topic. The average score on the exercise was 7.5/10 with a standard deviation of 0.4, which meets standard. The instructor recommendation for next year is to assign this exercise early in the semester next fall and to require it of all students.

b) In BAE 437, a midterm project is assigned to search the popular press (newspapers, magazines, and Internet) to find articles that described a hydrologic event. The students were to relate the articles to material learned in BAE 437. Topics included storm sewer problems, the effects of global climate change, rain gardens, and the consent decree in Lexington. In their discussions, students related much of the findings back to the basic hydrologic principles, including runoff protection and rainfall intensity. Students questioned some of the information from the popular press. The class average on the project, to relate engineering information to real-life issues, was 96%, which meets standard. As with the assignment about journal reviews, students’ reports were well done.

Response

Assessment of this outcome meets standard and indicates that we are achieving Outcome 13.

**Outcome 15- Graduates should know the importance of and be engaged in the process of becoming a Registered Professional Engineer.**

**Assessment**

a) In BAE 102, the number of students who correctly understand the process to become a Registered Professional Engineer is reported as the Score below. The question is asked twice, once at the beginning of the semester and again at the conclusion of the class.

<table>
<thead>
<tr>
<th>BAE Course</th>
<th>ABET Outcome Number</th>
<th>Score</th>
<th>N</th>
<th>P</th>
<th>S</th>
<th>% of Class</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>102</td>
<td>15</td>
<td>16/21 step 1 7/21 step 2 4/21 step 3</td>
<td>21</td>
<td>P</td>
<td></td>
<td>76% 33% 20%</td>
<td>Question asked before topic introduced in class</td>
</tr>
</tbody>
</table>
The students’ knowledge of professional registration, at the end of the course, was deemed acceptable (meets goal). This is an introductory class to BAE: BAE majors will encounter this topic in other courses, and will have the necessary background to understand the steps involved in becoming a registered professional engineer.

b) In BAE 400, one class session was focused on the procedures, rules, and benefits of Professional Engineering Registration. Two questions on the BAE 400 final addressed the student’s recognition of the importance and benefit of Professional Registration. The answers were graded on a 0 to 10 point basis, summed into one score, and the average and standard deviation reported with the number of students (meets goal).

<table>
<thead>
<tr>
<th>BAE Course</th>
<th>ABET Outcome Number</th>
<th>Score</th>
<th>Std. Dev.</th>
<th>N</th>
<th>P</th>
<th>S</th>
<th>% of Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>15</td>
<td>9.17</td>
<td>1.8</td>
<td>11</td>
<td>P</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Response

The assessment results indicate that this outcome is being satisfactorily achieved. In both the BAE senior seminar and capstone design courses, the merits of professional registration must continue to be emphasized.

Outcome 16- Graduates should have been active in student clubs and professional organizations.

Assessment

a) Table 11 shows the number of students included in each graduation year along with the number of students involved in student clubs or professional organization. Members are considered to be those who actively participate, while the leaders are those individuals holding officer positions. The 2004 standard for membership was 70% and the goal was 80%. The data indicate that we are meeting standard only for 2005-2006 and 2006-2007.

Table 22. Student activity in extra-curricular clubs and organizations.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
<th>Members</th>
<th>Leaders</th>
<th>Members</th>
<th>Leaders</th>
</tr>
</thead>
<tbody>
<tr>
<td>04-05</td>
<td>10</td>
<td>6</td>
<td>5</td>
<td>60%</td>
<td>50%</td>
</tr>
<tr>
<td>05-06</td>
<td>12</td>
<td>9</td>
<td>3</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>06-07</td>
<td>8</td>
<td>6</td>
<td>2</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>07-08</td>
<td>28</td>
<td>19</td>
<td>6</td>
<td>68%</td>
<td>21%</td>
</tr>
<tr>
<td>08-09</td>
<td>17</td>
<td>8</td>
<td>4</td>
<td>47%</td>
<td>24%</td>
</tr>
<tr>
<td>04-09</td>
<td>75</td>
<td>48</td>
<td>20</td>
<td>64%</td>
<td>27%</td>
</tr>
</tbody>
</table>
During the 2008-2009 yearly evaluation, it was decided that an additional measure should be taken to ensure that we are meeting this outcome. The UGCC recommended and the faculty approved tracking the involvement of our students during the freshman and senior years as well. In BAE 102, students are expected to attend BAE Student Branch meetings. Hence, this attendance should be an additional metric for Outcome 16. The instructor of BAE 102 would be responsible for collecting the data, where the goal would be 100% and the standard would be 90%. In BAE 402/403, students are expected to be a member of ASABE. Hence, this membership would apply toward the metric for Outcome 16. The instructor of BAE 402/403 would be responsible for collecting the data, where the goal would be 100% and the standard would be 90%. Finally, the goal/standard for the current metric should be revised to 75% for goal and 50% for standard. The current metric deals with “active members” as indicated by the students themselves, during their exit interview. In summary, for Outcome 16, the recommendation is to add two new metrics and to change the current metric’s goal/standard to 75% for goal and 50% for standard.

Under the new goal and standard, we are meeting standard for all years, except 2008-2009. In part, this was why we decided to also track student involvement in the freshman and senior year.

An additional indicator of professional development with student organizations is our students’ performance in the ¼-scale tractor student design competition, sponsored by ASABE. In the last years (2004-2009), over 20 students have participated on design teams. Each year, a majority of the students travel to Peoria, IL for the tractor competition. They typically raise over $25,000 in gifts and in-kind donations each year to pay for expenses. In addition, several students have had the opportunity to travel to the annual ASABE meeting to present their designs.

In addition to attending the Southeast ASABE Student Rally and the Mid Central ASABE Student Rally each year (funding permitted), the UK BAE Student Branch has hosted the event twice in the last few years. Attendance ranges from about six to eighteen students, depending on the timing during the semester and finances.

Response

The outstanding annual involvement of students in both ¼-scale competition and the rally clearly indicates students’ appreciation of, and interest in, professional organizations. The move away from strictly ASABE involvement for students (i.e., ASHRAE and IBE) has somewhat complicated tracking. Additional exposure to local BAE Student Branch meetings in the freshman year and to the national professional societies in the senior year will further support this outcome.