ABET
Self-Study Report

for the

Biosystems Engineering Program

at

University of Kentucky

Lexington, KY

October 2016

CONFIDENTIAL

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for
EAC of ABET
Accreditation or Reaccreditation

BACKGROUND INFORMATION

A. Contact Information

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B. Program History

The Department of Biosystems and Agricultural Engineering resides in the College of Engineering and the College of Agriculture, Food and the Environment at the University of Kentucky. The EAC of ABET most recently accredited the biosystems engineering program in 2010.

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 2016, the program has granted over 520 BS degrees (120 since our 2010 review).

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 BS 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. 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. The degree name changed to Bachelor of Science in Biosystems Engineering in 2009.

In 2011, UK revised their general education requirements to the UK Core system at the university level. The new system requires the typical social studies, humanities, and cross cultural courses, but also includes statistical inferences and arts and creativity courses. With the new system, individual programs can have their own classes approved to be used for UK Core credit. In BAE, we worked to have BAE 202 Statistical Inferences for Biosystems Engineers and BAE 402/403 Senior Design approved for UK Core Statistical Inferences and Arts and Creativity requirements, respectively.

At the program level, there have not been any major changes to the BAE program since 2010. Additional technical electives have been added and either assigned a permanent course number (BAE 535) or offered as an experimental class (BAE 599s). Pre-requisites have also been revised in response to course changes (e.g., BIO 150 became BIO 148), or to strengthen the student's preparedness for upper level courses.

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, accredited by the EAC of ABET.)
b. Master of Science in Biosystems and Agricultural Engineering (MSBAE)
c. Doctor of Philosophy (PhD)

The areas of specialization offered are:

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

D. Program Delivery Modes

The biosystems engineering 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. Students are typically full-time, although we do have a non-traditional student who is attending classes part-time. Courses consist of traditional lecture/laboratory experiences.

The biosystems engineering undergraduate program is offered on the Lexington campus. There are students who choose to participate in the co-operative education program, where a student will be employed by an industrial partner, typically outside of Lexington. While the number is

not significant, there are more students taking advantage of this opportunity, and we work with them to ensure that they graduate in a timely manner.

Within the department, one of our technical electives (BAE 532 Introduction to Stream Restoration), is taught as an online, asynchronous distance learning class in the Fall, and as a traditional face-to-face classroom lecture based course in the Spring. Our hope is to offer additional distance learning opportunities in the future, (e.g. online and/or hybrid). To support pedagogy and program delivery of distance learning, one full-time staff member is tasked with designing and implementing educational programs tailored to web delivery, developing curriculum for distance learning courses, and conducting training sessions on the latest pedagogical and technical tools for effective distance learning and on-line content delivery. This staff member works closely with pedagogy and assessment experts at the institutional level (UK Center for Enhancement for Learning and Teaching, UK Analytics and Technology, UK Instructional Designers Group) to ensure that BAE's distance learning programs address student needs using quantifiable measures.

E. Public Disclosure

The Program Education Objectives (PEOs) and Student Outcomes (SOs) are published on the web at http://www.uky.edu/bae/educational-objectives. Annual student enrollment (http://www.engr.uky.edu/enrollment-stats/) and graduation data (http://www.engr.uky.edu/graduation-stats/) are posted on the web as well.

F. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

During the previous review in 2010 there was a concern about whether our program educational objectives were accessible. We revised our program educational objectives before the final report was completed, such that in the final recommendation there were no program deficiencies, weaknesses, or concerns.

GENERAL CRITERIA

CRITERION 1. STUDENTS

The written BAE Advising Procedure is included in Appendix E.

A. Student Admissions

There are three types of admissions into the program: admission as a freshman, admission as a transfer student from another institution, and admission into the College by change of major within the University of Kentucky. These are described below:

1. <u>Admission as a Freshman</u>

Students applying to the University as a freshman submit an application to the University Admissions Office. In addition to the University's admission requirements, students requesting admission to the College of Engineering must satisfy at least one of the following requirements:

- ACT math score of 23 or higher, or the SAT equivalent;
- Advanced Placement Exam score of 3 or above on the Calculus AB portion;
- Eligible for MA 110, Analytical Geometry, and Trigonometry based on result of the UK Math Department Placement Exam;
- Completion of, or the equivalent of MA 110 with a grade of C or higher;
- Completion of, or the equivalent of MA 109 College Algebra and MA 112 Trigonometry with a grade of C or higher.

Additionally, students must meet the minimum Kentucky statewide academic readiness requirements for Reading and Writing to be admitted to the College of Engineering:

- Reading: Students must have an ACT Reading sub score of 20 or above (or SAT of 470 or above in Critical Reading);
- English/Writing: Students must have an ACT English sub score of 18 or above (or SAT of 430 or above in Writing).

International freshman applicants must have both the minimum ACT/SAT scores and must obtain a Test of English as a Foreign Language (TOEFL) score of 100 or above with no sub score under 20; or an International English Language Testing System (IELTS) score of 7.5 with no sub score under 6.0.

The University Admissions Office screens applicants based on these criteria and admits students into the College of Engineering if they have met the criteria as stated.

Newly admitted engineering students have the opportunity to choose an open major for one semester (Undeclared Engineering – 12 credit minimum). These students must select a program before the end of their first semester, preferably when they register for classes for their second semester.

If a student does not choose undeclared, application must be made for admission to a specific pre-engineering program. However, subsequent transfer between programs will be permitted and may be accomplished by applying and satisfying the appropriate specified criteria for the chosen program.

All undergraduate degree programs are divided into pre-engineering and engineering. Pre-engineering is defined as the first three semesters of a program, prior to the student receiving Engineering Standing. The application process and requirements for Engineering Standing are described in Section 1B.

2. Admission as a Transfer Student

Admission of transfer students is described in Section 1.C, Transfer Students and Transfer Courses.

3. Admission as a Change of Major

Students admitted to the University of Kentucky may change their major to the College of Engineering provided they meet the entrance requirements for the College. Students who do not originally meet the admission criteria but desire to be in the College of Engineering will typically major in Undergraduate Studies until they have met the College of Engineering admission criteria.

B. Evaluating Student Performance

Student performance is monitored at the freshman level by the College of Engineering, and during the senior year, the College of Engineering processes applications for graduation and the final degree audit. The College of Engineering also monitors all students under academic probation and suspension. Student performance at the sophomore through senior level are monitored in the BAE department by an advising team made up of the Engineer Associate for Academics (EAA, Dr. Modenbach), the Director of Undergraduate Studies (DUS, Dr. Crofcheck), and faculty from the various areas of specialty (Dr. Agouridis for bioenvironmental and Drs. Sama and Dvorak for machine systems). The Engineer Associate for Academics is unique to BAE, with responsibilities similar to those usually assigned to a student service coordinator and a professional advisor.

A student's performance in each class is monitored through midterm grades and 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 process of monitoring a student's progress and advising entering freshman is shown in Figure 1 and discussed below.

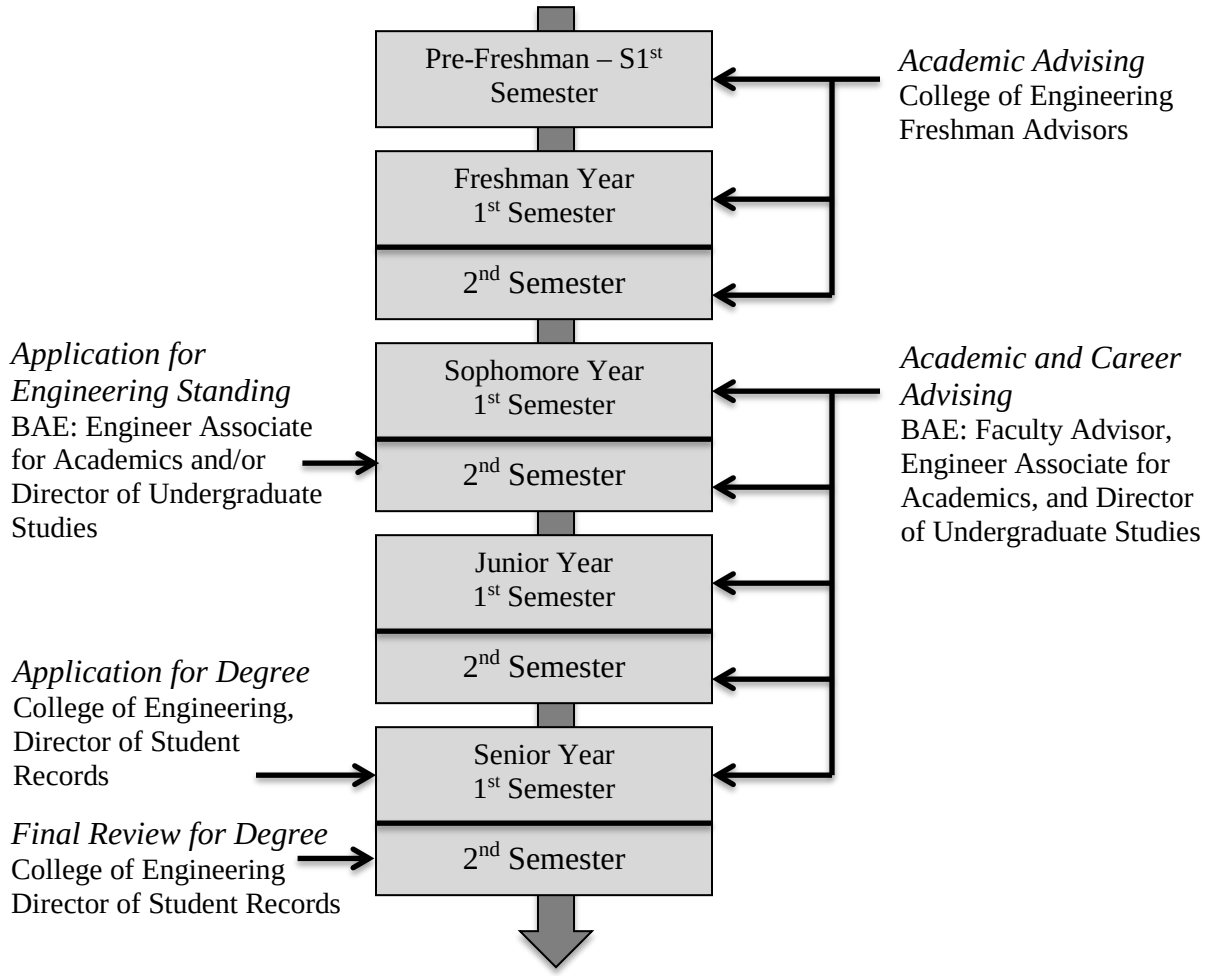

Figure 1. Advising and Evaluation of Students. In addition to the above, students are also monitored for academic probation and suspension each semester by the College of Engineering, Director of Student Records. Co-Op students also receive academic advising through the Engineering Career Development Office.

Evaluation during Student Advising Each Semester: Prior to entering their freshman year, all students attend a See Blue U Orientation where the curriculum and academic requirements are presented. At this time, the College of Engineering Freshman Advisors assist the students with registering for their first semester courses. During their freshman year, all students are required to meet individually with their freshman advisor in the College of Engineering where grades are reviewed and recommendations are made for future classes. These advising sessions are held in

October and March prior to course registration. An advisor hold is placed on the students' records inhibiting them from registering for courses until they have met with their advisor. Each semester in the sophomore – senior years, students must meet with a professional advisor in the Department and/or their faculty advisor. During these sessions, both academic advising occurs (i.e. progression to degree) along with career advising. Details regarding the advising process can be found in Section 1.D.

Evaluation during Application for 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. The move from Pre-Biosystems Engineering to Biosystems Engineering requires that the student achieve Engineering Standing. In Biosystems Engineering, Engineering Standing requires (from the *2015-2016 UK Bulletin*) the following:

> "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 CIS/WRD 110, 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 Engineer Associate for Academics. 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.

Evaluation during Academic Probation/Suspension: The College of Engineering reviews student performance each semester for academic probation and suspension issues.

The College of Engineering's probation and suspension rules are as follows:

1. Any engineering student who has completed two or more semesters at UK and who fails to maintain a cumulative UK GPA of 2.0 or higher will be suspended from the College of Engineering and will not be readmitted until this GPA is 2.0 or higher.
2. Any student enrolled in the College of Engineering who earns a UK GPA of less than 2.0 in any semester will be placed on academic probation.
3. Any student on academic probation who fails to earn a 2.0 or higher semester GPA will be suspended from the College of Engineering and will not be readmitted until he or she has obtained a semester GPA of 2.0 or higher for one semester and the student's cumulative UK GPA is 2.0 or higher.
4. Students who are suspended twice from the College of Engineering will not be readmitted.

The University also has probation and suspension rules that are not as strict. Therefore, it is possible for a student to be suspended from the College of Engineering but remain at the University.

Evaluation upon Application for Degree: Prior to the last expected semester for a student, the student is to submit an Application for Degree to the College of Engineering. The Director of

Student Records then reviews and verifies that all requirements for graduation are met. Students are required to submit their application for degree six months prior to their anticipated graduation date. We encourage students to submit their application immediately following registration for their last semester courses. Submitting the application at this time allows for problems to be detected early so that they might be rectified during the student's last semester. A final review of the student's record is performed immediately after completion of the final semester to ensure that all requirements for the degree have been completed before it is awarded. Details regarding graduation requirements are provided in Section 1.F.

C. Transfer Students and Transfer Courses

Students wanting to transfer to the University of Kentucky's College of Engineering from other colleges or universities, including community colleges, apply through the University Admissions Office. The applications are then forwarded to the Engineering Student Records Office for review and acceptance. The Director of Student Records follows the general admission requirements of the University of Kentucky which include the following:

- Would have been selectively admitted to UK when they entered the first institution attended provided they have a cumulative grade-point average of 2.0 or better for all college-level work attempted. Applicants must also have a cumulative grade-point average of 2.0 or better for all college-level work attempted at the last institution attended, provided at least 12 credit hours (or the equivalent thereof) were attempted there.

- Would not have been selectively admitted to UK but have completed 24 semester hours or more and achieved a cumulative grade-point average of 2.0 or better for all college and university work attempted. Applicants must also have a cumulative grade-point average of 2.0 or better for all work attempted at the last institution attended.

Transfer of Credit for Transfer Students: The University has policies for transfer of credit from other public schools in Kentucky and from other institutions.

- *Transfer Policy for Credits from other Kentucky public colleges and universities:* The Kentucky Postsecondary Education and Transfer Policy facilitates the transfer of credits earned in general education and twelve hours of course work in a major for students moving from one Kentucky public college or university to another Kentucky public college or university. The general education core transfer component reflects the distribution of discipline areas universally included in university-wide lower division general education requirements for the baccalaureate degree. Under this agreement, a student may satisfy the general education discipline requirements at their current college and have that requirement completion accepted at the university or college to which they may transfer. In addition, the Baccalaureate Program Transfer Frameworks identify 12 hours of course work in a major, which may be successfully transferred. Each framework represents a specific guide to the exact courses a student needs; therefore, students who plan to transfer from one public institution to another to complete their Baccalaureate degree work closely with their advisor to take full advantage of the Policy. Students enrolled in Engineering must complete the requirements for the respective engineering degree regardless of the transfer agreement.

- *Credit Earned at Kentucky Community and Technical Colleges and other Institutions:* The University accepts collegiate-level degree credits earned at a fully accredited college or university. "Fully accredited" means that the institution is a member in good standing of one of the six regional academic accrediting associations. Transfer work from institutions outside the United States is evaluated on an individual basis from the official transcripts. The office of Undergraduate Admission and the University Registrar generally determines the transferability of completed course work. Then, the College of Engineering in consultation with the Director of Undergraduate Studies for the academic program determines how the transferred course work applies towards degree requirements.

The transferability of course credit earned at two-year institutions is limited to a total of 67 hours by University policy. Also, as explained under Section F, Graduation Requirements, regardless of the number of transfer hours that the University may accept, all candidates must complete at UK a minimum of 24 credit hours of departmental courses at or above the 300 level.

The College of Engineering has a *Policy on the Transfer of Engineering Courses*. This is a uniform procedure for an institution to obtain prior approval for the transfer of lower-division courses for credit as College of Engineering courses. This is for institutions that are not accredited by the Engineering Accreditation Commission of ABET, but which want to establish a credit-transfer, twinning, or other similar program or arrangement. The Policy states that the College must be provided with a syllabus, sample tests and examinations, and examples of graded student papers for evaluation. The policy came into effect in the spring 2006 semester. After approval of a course is given, the approval will remain in force for a period of six years.

Initial Advising of Transfer Students: Transfer and readmitted students are initially advised by the Departmental Engineer Associate for Academics in consultation with the Director of Undergraduate Studies. An evaluation is conducted of each student's transfer courses for suitability with the academic program. This evaluation follows the validation of transfer credit hours by the University and College. A detailed course syllabus is required for evaluation of course equivalencies if they have not been pre-determined at an earlier time. During this initial advising session, the Engineer Associate for Academics helps the student complete his/her schedule and answers questions the student may have on the transfer course evaluation. For this first advising conference, the Engineer Associate for Academics inputs the student schedule and helps with any conflicts or changes that arise. The student is also informed who his or her permanent Career Advisor will be, and is given a printed copy of the course schedule. In all subsequent registrations, the student will meet with their Academic Advisor or Career Advisor as described in Section 1.D.

D. Advising and Career Guidance

Pre-Freshman and Freshman Academic Advising: The College of Engineering employs three academic advisors who assist each freshman student throughout the admission, orientation, advising, and registration process. During the summer, two-day advising conferences (See Blue U Orientations) are held to orient the incoming freshmen to UK and the College of Engineering. Academic requirements, expectations, and opportunities within the College of Engineering are presented at special sessions with the College of Engineering staff and administration. On the second day of the conference, the students meet with their College of Engineering freshman advisors to register for their classes for fall semester. While maintaining student confidentiality,

parents are encouraged to take an active role in their students' first advising experience by participating in a special parent session where requirements, expectations, opportunities and important deadlines are discussed. Contact numbers are also provided and parents are encouraged to contact the Freshman Advisors or other Student Support Services if they have concerns that do not violate the student's privacy.

Freshman students who attend an advising conference with extensive prior college work are advised by the freshman advisors during the conference, but are then transferred to their program of interest for advising for the remainder of their time in the College of Engineering. Typically, students from the Gatton Academy (Western Kentucky University), the Craft Academy (Morehead State University) and students with an Associate degree are beyond the traditional freshman year curriculum and many are ready for engineering standing after their first semester. Thus, it is imperative that they are transferred to their department for advising for the upper level curriculum.

First and second semester freshmen are required to meet *individually* with their freshman advisors to prepare their academic schedule for spring semester, possibly summer term and fall semester of their sophomore year. Academic plans and programs are discussed as well as the student's strengths and weaknesses. Suggestions are offered as to class order, teacher choice, and services offered within the University which might address a particular problem the student may be experiencing; i.e. time management, learning styles, study habits. Students are encouraged to visit their freshman advisor at other times other than their scheduled advising appointment to discuss any issues and receive guidance on typical stresses of the freshman year. Clearly, this message is effective as many of the students will return during their sophomore, junior and senior years just to talk with their freshman advisors. Knowing that they are more than a number and that they are an integral part of the College of Engineering, makes most students willing to work harder to be successful.

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.

Sophomore-Senior Academic Advising: After the students have completed their freshman year course registrations, their records are transferred to their program of interest.

The BAE Engineer Associate for Academics (EAA) 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 and making progress to graduation. Sophomore BAE courses offered in 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 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 environment systems. Students can also concentrate in a formally developed pre-veterinary medicine or pre-biomedical engineering area of specialization as preparation for pursuing

advanced degrees in those fields. Due to the flexibility in our curriculum, resulting from having these various specialty areas, students can also fulfill the requirements for admission to medical school, while taking classes for one of the formal specialties or may choose to forgo a formal specialty.

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. Students usually select an area of specialization by the fall semester of their junior year.

The BAE department has two types of advisors: Academic Advisors and Career Advisors. The Academic Advisors are the DUS and the Engineer Associate for Academics. The Career Advisors are faculty members to whom upper level students are matched based on area of specialization. The DUS serves as the Career Advisor for the pre-biomed, pre-vet, and pre-med students.

All students are required to meet with their Academic Advisor or their Career Advisor at least once during both the fall and spring semesters to discuss coursework for the following semester and to review their overall advising plan and progress towards graduation. This meeting also provides the student with an opportunity to discuss progress and/or concerns in current courses, as well as appropriate technical elective courses, internship and/or co-op opportunities and potential career opportunities, based on their area of specialization. The Academic Advisor can direct the student to campus resources as appropriate. The Academic Advisor is responsible for lifting the "Advisor Hold" placed on the student's account, which allows the student to register for courses during their open Priority Registration window. The Academic Advisor for BAE sophomores and transfer students in their first semester at UK is the Engineer Associate for Academics. The Academic Advisor for juniors and seniors is the Director of Undergraduate Studies. The Academic Advisors review the advising plan for each student prior to lifting the "Advisor Hold".

We have implemented two significant changes to our advising policy since the last ABET cycle in 2010 to better serve our students. The first change made was hiring the Engineer Associate for Academics in 2014 to assist with advising students. This position is currently held by an individual with a terminal degree in Biosystems and Agricultural Engineering, and as such understands the curriculum and its rigor. Previous Student Affairs Officers assisted with administrative tasks but did not participate in advising students. Another change that was implemented is the delineation of advising roles of the Academic Advisors and the Career Advisors. Academic Advisors monitor the academic progress of students, while the Career Advisors speak to specifics (i.e. technical elective selection, internship/co-op opportunities, research, careers) within their own areas of specialization.

Career Advising: In addition to the University of Kentucky James W. Stuckert Career Center, the College of Engineering has a Career Development Office with 3.5 full time staff. The office was created to specifically meet the unique needs of UK engineering students. Its mission is to assist current students and recent graduates with developing job search skills, building career networks, and securing employment including internships, co-ops, and permanent positions in their field of study. The College of Engineering Career Development Team works closely with the staff of the University Career Center to provide a number of services including the following;

1. Weekly Job and Career Info Emails: Weekly email announcements are sent to College of Engineering students regarding job opportunities, companies visiting campus, as well as upcoming events and workshops related to the student job search. These emails are targeted based on engineering discipline.

2. Wildcat CareerLink: Wildcat CareerLink is UK's online job/internship database. The database allows students to apply for jobs and sign up for on-campus interviews online 24 hours a day, 7 days a week.

3. Career Counseling: The Career Development Team provides career counseling to engineering students including writing resumes, writing cover letters, and interviewing skills. The office, which promotes networking with employers also hosts "Resumania" events once per semester. The event invites employer representatives to review student resumes and provide mock interviews. About 120-150 students attend each event, and about 15-20 companies lend their time to give students an employer perspective on resumes and interviewing skills. Students use the event to network with employers in addition to improving their future application materials.

4. Career Fairs: Engineering Career Fairs are held in September and March of each year. These career fairs provide opportunities for engineering and computer science students to meet with prospective employers to discuss employment opportunities including co-ops, internships, and full-time employment. Participation by both employers and students has grown steadily each year since its inception. For Fall 2015, 109 engineering employers and 1000 students participated. For Spring 2016, 98 engineering employers and 600 students participated. In conjunction with the Fall Career Fair, UK Society of Women Engineers (SWE) sponsors "Evening with Industry". This event is only open to graduating seniors within the College and provides them with the opportunity to meet industry representatives in a more one-on-one setting to discuss opportunities for full time employment. "Evening with Industry" is held the night immediately preceding the Career Fair. In order to accommodate smaller employers who might only need one co-op or intern, the College of Engineering also hosted a "Co-op and Internship Fair" in the Fall semesters of 2014 and 2015, and the spring semester of 2015. Each of these events drew 12-15 employers and about 100 students.

5. Employer Relations: In addition to student career services, the Director of Career Development spends time traveling to companies to cultivate career opportunities with prospective employers for engineering and computer science students.

6. Cooperative Education: The office's co-op program also works with companies and students to refer students into alternating semester co-ops, which provides employers with year-round engineering student support, and allows employers to train future full time employees. Traditionally, the number of BAE specific co-op opportunities have been limited. Recently, we have had student participate in co-op experiences at Alltech (animal feed), C&H, Toyota, and Hershey. BAE typically has 1-2 students co-oping each year. The office's co-op coordinator works with advisors and students to ensure seamless integration of the co-op semesters into the curriculum.

7. Employment and Salary Assessment: The Career Development Team collects data and generates reports for employers and departments on graduates' plans after graduation. The office also coordinates data collection for experiential education (internships and co-operative education) and average salaries from these positions.

8. Study Abroad Opportunities: The College of Engineering maintains partnerships with universities in China (China University of Mining and Technology), Japan (Nagoya University), Malaysia (INTI College), Brazil (University of Visçosa), and Germany (Karlsruhe Institute of Technology) where our students have the opportunity to study for a semester or a year. In addition, the University has multiple partnerships that offer all students opportunities to study abroad for a year, a semester, or short term. In the College of Engineering, we have also developed a number of summer programs tailored towards engineers. These include two 5-6 week summer programs in Karlsruhe/Germany, one summer program in Pamplona/Spain, and a short-term program in Nagoya/Japan. In 2016, we offered for the first time, an "embedded" program, where a group of students enrolled in a spring semester Global Energy Issues course traveled to Costa Rica for one week site visits over spring break.

The number of students studying abroad has steadily increased over the past 10 years. Over 10 percent (n=50) of the May 2015 graduating class had study abroad experience, up from 9.6 percent (n=40) of the 2014 graduating class. Typically, BAE has 2-4 students studying abroad per year.

Much of the student study abroad program advising, as well as the two summer programs in Germany, are handled by the Engineering Career Development team.

E. Work in Lieu of Courses

The University of Kentucky allows students to earn degree credit by successfully completing selected examinations according to standards published in the University Bulletin. Exams accepted for earning degree credit include Advanced Placement (AP), International Baccalaureate Program (IB), and CLEP program. UK does not award duplicate credit in the event that a student repeats an exam or if the credit awarded is the same for two or more exams. In the event a student takes the same exam more than once, credit is awarded for the best score only. College credit is also granted to Project Lead the Way (PLTW) engineering graduates from PLTW-certified high schools. University of Kentucky engineering students may earn one college credit for each of the PLTW Engineering courses (IED, POE, DE, CIM, CSE, CEA, BE, AE) completed while enrolled in secondary schools up to a maximum of six UK College of Engineering credits. Three of these credits may be used in approved engineering majors as supportive electives.

F. Graduation Requirements

Students wanting to graduate must submit an Application for Degree. Once an Application for Degree is submitted, a thorough review of the student's academic record begins to ensure that all graduation requirements are met. Students are required to submit their application for degree six months prior to their anticipated graduation date. We encourage students to submit their application immediately following registration for their last semester courses. Submitting the application at this time allows for problems to be detected early so that they might be rectified during the student's last semester.

Graduation is certified at several levels. Legally, the Board of Trustees confers degrees. Practically, there are three gatekeepers who assess the completion of graduation requirements.

At the departmental level, the Engineer Associate for Academics prepares and approves a graduation plan sheet certifying that a student has completed all requirements to satisfy the

departmental requirements. This includes verification of necessary courses, required course grades, and the achievement of Engineering Standing. The advising check sheet is used to communicate the completion of departmental requirements. The Engineer Associate for Academics then certifies that the student (with successful completion of the last classes in progress) will complete all degree requirements in the last semester.

The second check is performed at the College level. The Director of Student Records, after verifying that department requirements are met, checks each student record to verify that college and university requirements are also met. Finally, a third check is performed by the University Registrar's Office.

The College prepares the official list of graduating seniors for all programs within the College of Engineering and submits that to the Board of Trustees for pro forma approval.

In addition to the curriculum requirements, the College of Engineering requires that the student must also satisfy the following:

1. Complete the University and College requirements relating to writing and the UK Core;
2. Complete a minimum of 128 hours, exclusive of those earned in freshman college algebra and freshman college trigonometry with a cumulative standing of not less than 2.0 on a 4.0 scale;
3. Be admitted to Engineering Standing in an engineering program for at least the final semester, and complete the requirements of that program;
4. Complete a minimum of 24 credit hours of departmental courses at or above the 300 level;
5. Complete all departmental courses and technical electives with a cumulative standing of 2.0 or higher;
6. A minimum of 30 of the last 36 credits presented for the degree must be taken from the University (known as the University residency requirement);
7. BAE does not require any additional program requirements.

These requirements ensure that students progressing through the curriculum have satisfactorily demonstrated their abilities with the course outcomes that map into the overall program outcomes. The department and university residency requirements detailed above ensure that all students, including transfer students, will be in the program long enough (and at high-level courses) to have sufficiently demonstrated the program outcomes.

G. Transcripts of Recent Graduates

The program will provide transcripts from some of the most recent graduates to the visiting team along with any needed explanation of how the transcripts are to be interpreted. There are no options that can be completed with Biosystems Engineering. The degree will be posted as shown in Figure 2.

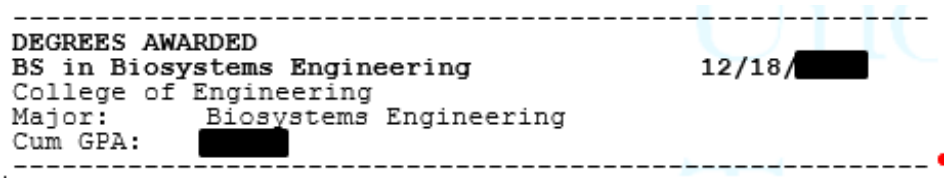

Figure 2. Transcript designation of Biosystems Engineering graduates.

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Vision and Mission Statements

University of Kentucky
Found on the website, http://www.uky.edu/sotu/2015-2020-strategic-plan#UK%20Mission

Mission: The University of Kentucky is a public, land grant university dedicated to improving people's lives through excellence in education, research and creative work, service and health care. As Kentucky's flagship institution, the University plays a critical leadership role by promoting diversity, inclusion, economic development and human well-being.

B. Program Educational Objectives

The program educational objectives of the Biosystems Engineering program are based on the intellectual and professional development of our students. Graduates of the Biosystems Engineering program are expected within a few years of graduation to have:

1. Established themselves as practicing professionals or engaged in advanced study in agricultural, biological, environmental engineering, or other related area.
2. Demonstrated their ability to work successfully as a responsible professional and function effectively on a professional team.

These objectives are published on the web at: http://www.uky.edu/bae/educational-objectives.

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 citizens of Kentucky. The Commonwealth of Kentucky's economy is driven in large part by the agricultural industries of the state, and many of Kentucky's citizens are impacted daily by environmental and/or agricultural systems. Our educational objectives are consistent with the mission of the University of Kentucky in that 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 global economy. The education of Kentucky's Biosystems Engineers is essential to move these industries forward in a safe and an environmentally sustainable way.

Program Educational 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. Graduates of the Biosystems Engineering program will emerge as future leaders, making professional advancement and development essential to retain relevancy in the Commonwealth and global community.

D. Program Constituencies

Our constituents include students, alumni, and employers of our graduates. We collect input from these constituents about the appropriateness of our program educational objectives to allow for continuous improvement. Table 1 shows the various constituents, input methods, and schedule.

Table 1. Program Constituents

Constituent	Input Method	Schedule
Alumni 2-5 years out	Alumni survey	Every six years
Students; retrospective discussion of PEOs and their intended career paths	Senior exit interview	Annually
Industrial and academic representatives, including employers and alumni	Advisory Council discussions	As needed—available annually
Faculty and students	Curriculum Committee meetings	Available as frequently as needed

E. Process for Review of the Program Educational Objectives

The program educational objectives are periodically reviewed by various constituents to determine if they are still appropriate to meet the needs of the constituents. Every six years we conduct an alumni survey for all alumni from the last 2-5 years. This survey is done three years into each ABET cycle, with the most recent completed in the summer of 2013. Twice a year the department has an advisory board meeting where the program educational objectives are reviewed and necessary changes are made. At the end of each semester, the department chair conducts exit interviews with all graduating seniors, during which students are asked for feedback concerning the appropriateness of the program educational objectives. Finally, the program educational objectives are reviewed by the Undergraduate Curriculum Committee, and recommendations from the other constituents are taken into consideration. Once all of the constituents have reached consensus, any changes to the program educational objectives are then brought to the faculty for approval.

CRITERION 3. STUDENT OUTCOMES

A. Student Outcomes

The biosystems and agricultural engineering faculty has adopted the engineering criteria “a” through “k” student outcomes.

In order to fulfill the Program Education Objectives, the student graduating from BAE should have:

a) an ability to apply knowledge of mathematics, science, and engineering;

b) an ability to design and conduct experiments, as well as to analyze and interpret data;

c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;

d) an ability to function on multidisciplinary teams;

e) an ability to identify, formulate, and solve engineering problems;

f) an understanding of professional and ethical responsibility;

g) an ability to communicate effectively;

h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;

i) a recognition of the need for, and an ability to engage in life-long learning;

j) a knowledge of contemporary issues;

k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

As described in the Background and Criterion 2 sections, both these student outcomes and the program educational objectives are available to the general public and documented at: http://www.uky.edu/bae/educational-objectives.

B. Relationship of Student Outcomes to Program Educational Objectives

The first program educational objective is directly related to the acquisition and mastery of knowledge that is required to be an engineer, either in industry or as a graduate student. The second program educational objective is more related to being a successful engineer with additional skills and traits that our constituents are looking for, including the ability to work in a team and contributing to the engineering profession. While the student outcomes taken as a whole should ensure that our graduates are meeting both program educational objectives, there does exist a loose relationship between the student outcomes and the program educational objectives.

Table 2. Relationship between the two program educational objectives and the a-k student outcomes.

Program Educational Objective	Student Outcomes
1	a, b, c, e, k
2	d, f, g, h, i, j

CRITERION 4. CONTINUOUS IMPROVEMENT

We have carefully developed a continuous improvement process that takes into account our stakeholders feedback and our student achievement. Within the process we assess the student outcomes as well as review the program educational objectives, based on established metrics, standards, rubrics, and artifacts. The overall process is shown in Figure 3.

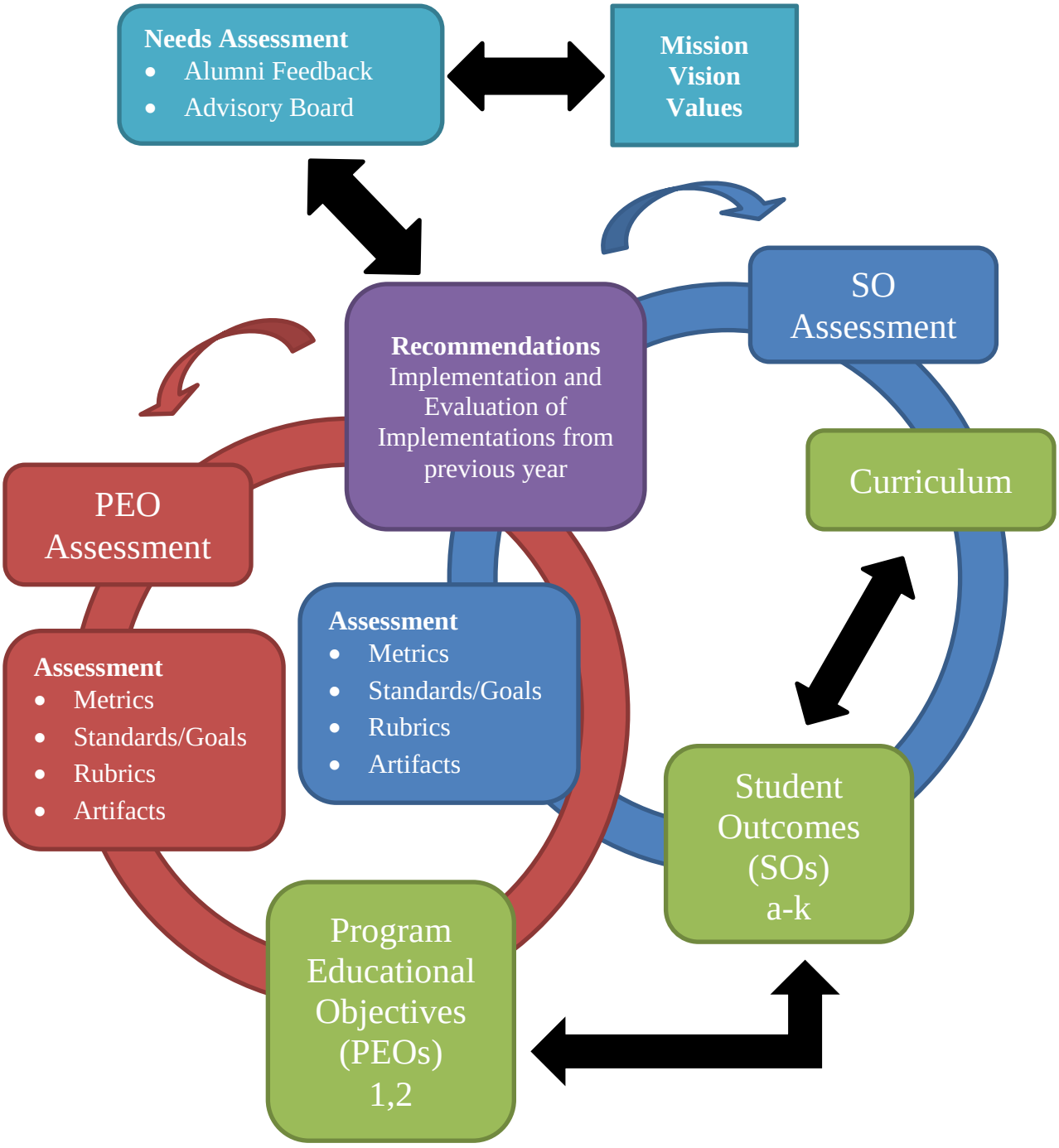

Figure 3. Continuous improvement process.

A. Student Outcomes

Assessment artifacts are collected annually and the evaluation of the artifacts is done over the summer. After the 2010 ABET review, we developed rubrics for each of the outcomes and performed our first assessment for the 2011-2012 school year. The results of this cycle made it clear that the rubrics needed to be further refined and several assessment instruments needed to be updated and improved. For the 2012-2013 school year, we revised our outcomes (to directly align with ABET outcomes a-k), revised our rubrics, and improved our assessment instruments to align more closely with the rubrics. As a result, we have reliable assessment data for three assessment cycles: 2013-2014, 2014-2015, and 2015-2016. This results in three assessment cycles for this review period. For the next review period, we're planning to perform an assessment cycle every other year, again providing three assessment cycles per review period.

All assessments are done in our required courses: BAE 202 (sophomores), BAE 400 (seniors), BAE 305 (juniors), and BAE 402/403 (seniors). Details about the assessment assignments for each outcome are shown in

Table 3.

Table 3. Biosystems Engineering Student Outcomes with artifact descriptions (2015-2016).

Student Outcomes In order to fulfill the Program Education Objectives, the student graduating from BAE should have:	**Artifact Descriptions**
a. an ability to apply knowledge of mathematics, science, and engineering	BAE 305: Homework assignments applying mathematics, science, and engineering to a biosystems problem, rubric scored, separately. Requires students to use formal structure for problem solving, specifically with respect to the structure of the problem statement.
b. an ability to design and conduct experiments, as well as to analyze and interpret data	BAE 202 & BAE 402/403: Homework assignment(s) focused on the design of experiments and interpretation of data, rubric scored, separately.
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	BAE 402/403: Senior design team deliverables will be assessed, including written reports, presentations, engineering notebooks, and faculty evaluations.
d. an ability to function on multidisciplinary teams	BAE 402/403: Performance in design teams, assessed by professional/faculty advisors and peers.
e. an ability to identify, formulate, and solve engineering problems	BAE 305: Homework assignments which evaluate the ability of our students to identify, formulate, and solve engineering problems, rubric scored separately.
f. an understanding of professional and ethical responsibility	BAE 402/403: Homework focused on ethics assignment, rubric scored, separately.
g. an ability to communicate effectively	BAE 400 Final oral presentation, rubric scored, separately. BAE 402/403 Written and oral final reports, rubric scored, separately.
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	BAE 400: Homework assignment focused on the evaluation of the students' perspective of global and social issues around engineering solutions, rubric scored, separately.
i. a recognition of the need for, and an ability to engage in life-long learning	BAE 400: Homework assignment focused on the need for life-long learning, rubric scored, separately.
j. a knowledge of contemporary issues	BAE 402/403: Homework assignment focused on contemporary issues in engineering, rubric scored, separately.
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	BAE 402/403: Homework assignments applying techniques, skills and modern engineering tools, scored separately.

Our rubrics are based on a 4 point scale, such that 4: Exceeds Standards, 3: Meets Standards, 2: Partially Meets Standards, and 1: Does Not Meet Standards. Our goal is for 70% of our students to meet or exceed standards, thus achieving a rubric score of 3 or 4. The 2015-2016 rubrics for outcomes a-k are included in Appendix D.

The assessment artifacts are all stored on the secure ABET drive on the department's server. Most of the artifacts are printed and stored in a binder for each yearly assessment cycle. The senior design final reports (written and oral) are not included in the folder. These files are kept on the server and are easier to review electronically. There are also separate folders for each year of senior design that are archived.

B. Continuous Improvement

Assessment results for 2013-2014 and 2014-2015 are shown in Table 4. For 2013-2014, the outcomes that had a rubric category that did not meet standard (shown in red) were a, b, e, g, j, and k (6 of 11 outcomes) for a total of 17 rubric categories. For the assessment cycle the next year, the outcomes that had a rubric category that did not meet standard were a, b, e, g, h, and k (6 of 11 outcomes) for a total of 10 rubric categories.

Assessment results with recommendations are shown in

Table 5 for 2013-2014 and

Table 6 for 2014-2015. The recommendations from the course instructor and from the UGCC are included. The course instructor suggestions are based on course and assessment with respect to the course, while the UGCC attempts to make recommendations that will improve the overall program. The UGCC follows up on all recommendations during the subsequent assessment cycles, shown in the “Status” column in

Table 5. While there are many instances of student outcome improvement, there are still recommendations for further improvement. Our experience over the last two assessment cycles has shown that the development of artifacts, rubrics, and course content is an iterative process, but does lead to improvements in the overall success of our students.

Table 4. Results for the 2013-2014, 2014-2015 and 2015-2016 assessment cycles, including class/artifact details and specific results for each section of the rubric. Rubric sections that meet our goal of 70% with a rubric score of 3 or 4 are shown in green, while the rubric scores that do not meet our standard are shown in red. (Revised September 2016)

SO	Artifact	Rubric Category	% 3 or 4		
			2013-2014	2014-2015	2015-2016
a	Homework (13-14: BAE 417; 14-15: BAE 305)	Problem statement	40%	60%	80%
		Procedure	60%	90%	100%
		Final Solution	60%	90%	100%
b	Stats article review (BAE 402/3)	Purpose	70%	90%	90%
		Methods	60%	70%	70%
		Stats Analysis	N/A	40%	90%
		Conclusion	50%	60%	80%
		Reference	50%	100%	100%
b	Case Study 2 (BAE 202)	Intro	50%	100%	70%
		Methods	30%	90%	70%
		Analysis	30%	90%	70%
		Conclusions	40%	100%	80%
c	Final Design Report (BAE 402/3)	Problem Statement	100%	100%	80%
		Procedure	88%	100%	80%
		Final Design	88%	80%	80%
d	Teamwork report (BAE 402/3)	Contributions	100%	100%	100%
		Facilitates		94%	70%
		Outside of Meetings		94%	90%
		Conflict		94%	70%
		Overall	88%	100%	80%
e	Homework (13-14: BAE 417; 14-15: BAE 305)	Problem statement	40%	60%	80%
		Procedure	60%	90%	100%
		Final Solution	60%	90%	100%
f	Homework ABCD/Case Studies (BAE 402/3)	Recognition	79%	90%	90%
		Application	80%	90%	80%
g	Final design oral presentation (BAE 402/3)	All categories	100%	100%	100%
g	Final design report (BAE 402/3)	Visual Format	88%	80%	100%
		Organization	75%	100%	100%

SO	Artifact	Rubric Category	% 3 or 4		
			2013-2014	2014-2015	2015-2016
		Language	63%	60%	100%
		Tables/Figures	25%	40%	100%
		References	75%	80%	40%
		Appendices	75%	N/A	N/A
g	Oral presentation (BAE 400)	All categories	100%	90-100%	90-100%
h	Homework (BAE 400)	Knowledge	N/A	40%	20%
		Curiosity		40%	N/A
		Openness		70%	N/A
i	Homework (BAE 400)	Understanding	90%	90%	80%
j	Homework (BAE 402/3)	Issues	70%	90%	20%
		Conclusion	50%	70%	N/A
k	Excel file (BAE 402/3)	Methods	60%	100%	90%
		Results	N/A	100%	70%
k	Drawing file (BAE 402/3: 13-14 groups, 14-15 individuals)	Methods	86%	50%	70%
		Results	N/A	50%	70%

Table 5. Assessment results for 2013-2014 that did not meet our standard, including the recommendation for continuous improvement and the status after one year. (Revised September 2016)

Key: ✓(Good); R (Revise); X (Eliminate); N (New)

SO	Rubric Category	% 3 or 4	Rubric	Assignment	Class	Recommendation	Status 2014-2015 **Issues to be addressed in the next cycle are shown in red.**
a	Problem statement	40%	✓	R	✓	• **UGCC:** require students to use formal structure for problem solving, with respect to the problem structure • **UGCC**: move assessment artifact to BAE 305	• SO a. assessed in BAE 305. • % 3 or 4 of 60%, 90%, 90%, respectively. • Further improvements suggested: rubric, assignment and class content reviewed by UGCC and BAE 305 instructor.
	Procedure	60%					
	Final Solution	60%					
a	All categories	20%	X	X	X	• **UGCC**: move assessment artifact to BAE 305	
b	Methods	60%	R	R	✓	• **Instructor:** revise assignment; assign articles instead of students choosing • **UGCC:** update rubric	• Rubric revised; % 3 or 4 of 90%, 70%, 40%, 60%, respectively. • Further improvements suggested: addition of stats analysis rubric category.
	Conclusion	50%					
	Reference	50%					
b	All categories	--	--	--	--	• **UGCC**: drop artifact from assessment plan (too few artifacts to assess)	• Change made, no data for this cycle.
b	Intro	50%	R	R	✓	• **Instructor:** revise assignment to focus on critical thinking • **UGCC**: update rubric	• Rubric and assignment revised • %3 or 4 of 100%, 90%, 90%, 100%, respectively. • The UGCC will continue to closely monitor.
	Methods	30%					
	Analysis	30%					
	Conclusion	40%					
e	Problem statement	40%	✓	R	✓	• **UGCC**: require students to use formal structure for problem solving	• SO a. assessed in BAE 305. • % 3 or 4 of 60%, 90%, 90%, respectively.
	Procedure	60%					

SO	Rubric Category	% 3 or 4	Rubric	Assignment	Class	Recommendation	Status 2014-2015 Issues to be addressed in the next cycle are shown in red.
	Final Solution	60%				• **UGCC:** include class discussion on formal structure of problem solving • **UGCC:** move assessment artifact to BAE 305	• Further improvements suggested: rubric, assignment and class content reviewed by UGCC and BAE 305 instructor.
e	Problem statement	20%	X	X	X	• **UGCC**: move assessment artifact to BAE 305	• SO a. assessed in BAE 305. • % 3 or 4 of 60%, 90%, 90%, respectively. • Further improvements suggested: rubric, assignment and class content reviewed by UGCC and BAE 305 instructor.
	Procedure	20%					
	Final Solution	20%					
g	Language	63%	R	✓	R	• **Instructor**: include more lectures about captions, formatting, consistency and format of equations	• Rubric and class content revised • % 3 or 4 of 60%, 40%, respectively. Improvements in formatting, but need more attention to language.
	Equations	25%					
h	--	--	R	N	✓	• **UGCC**: faculty with international experience lecture about global engineering	• New assignment introduced. • % 3 or 4 of 40%, 40%, 70%. • Further improvements suggested: Revise rubric.
j	Conclusion	50%	✓	R	✓	• **Instructor**: revise assignment to include more details for what is expected	• Assignment revised. • % 3 or 4 of 90%, 70%. • The UGCC will continue to closely monitor.

SO	Rubric Category	% 3 or 4	Rubric	Assignment	Class	Recommendation	Status 2014-2015 **Issues to be addressed in the next cycle are shown in red.**
k	Methods	60%	✓	✓	R	• **Instructor**: include more lecture content about creating Excel spreadsheets	• Class content revised. • Results category added to rubric. • % 3 or 4 of 100%, 100%, 50%, 50%. • Further improvements suggested: Revise assignment.

Table 6. Assessment results for 2014-2015 that did not meet our standard, including the recommendation for continuous improvement and the status after one year. (Revised September 2016)

Key: ✓(Good); R (Revise); X (Eliminate); N (New)

SO	Rubric Category	% 3 or 4	Rubric	Assignment	Class	Recommendations	Status in 2015-2016 **Issues to be addressed in the next cycle are shown in red.**
a	Problem statement	60%	✓	✓	R	• **UGCC**: require students to use formal structure for problem solving	• Formal problem solving procedure introduced in all BAE courses. • % 3 or 4 80%. • UGCC will continue to closely monitor.
b	Stats Analysis	40%	✓	R	R	• **UGCC**: Content or assignment revision • **Instructor**: revise assignment; drop one of the articles reviewed due to difficulty; students review a common article in class	•Assignment revised •Improvements made when expectations were explicitly outlined in assignment •% 3 or 4 90%, 80%, respectively. •UGCC will continue to closely monitor.
	Conclusion	60%					
e	Problem statement	60%	✓	✓	R	• **UGCC**: require students to use formal structure for problem solving	• Formal problem solving procedure introduced in all BAE courses. • % 3 or 4 80%. • UGCC will continue to closely monitor.
g	Language	60%	✓	R	✓	• **UGCC:** students need to be more serious about	• Grade distribution was shifted to indicate
	Tables/ Figures	40%					

SO	Rubric Category	% 3 or 4	Rubric	Assignment	Class	Recommendations	Status in 2015-2016 Issues to be addressed in the next cycle are shown in red.
	Appendices	N/A				language and table/figure usage. • **Instructor:** shift the grade distribution.	importance of the areas needing improvement • "Appendices" removed from rubric. • % 3 or 4 100%. • UGCC will continue to closely monitor.
h	Knowledge Curiosity	40% 40%	R	✓	✓	• **UGCC**: revise rubric	• Rubric reduced to "knowledge" level. • % 3 or 4 20%. • There was a disconnect between the assignment and the rubric. It was suggested that the class content should be revised to focus more on global issues for the next cycle.
k	Methods Results	50% 50%	✓	R	R	• **UGCC**: revise assignment; increase course content • **Instructor:** more class time to work with the drawing program; clearer expectations on assignment	• Lecture content and assignment revised and additional in-class time provided. • % 3 or 4 70%, 70%, respectively. • UGCC suggests that efforts should continue to improve performance on this outcome.

Table 7. Assessment results for 2015-2016 that did not meet our standard, including the recommendation for continuous improvement. The status after one year will be updated following the completion of the assessment cycle in August 2017. (Revised September 2016)

Key: ✓(Good); R (Revise); X (Eliminate); N (New)

SO	Rubric Category	% 3 or 4	Rubric	Assignment	Class	Recommendation	Status 2016-2017 (to be updated August 2017)
g	Reference	40%	R	✓	✓	• **UGCC**: focus on correct formatting for bibliography	•
h	Knowledge	20%	✓	R	✓	• **Instructor**: revise assignment to complement the guest lecture	•
j	Issues	20%	✓	R	R	• **UGCC:** revise assignment and assess in a different course	•

C. Yearly SO Assessment Results

There have been several changes due to the continuous improvement plan. We would like to start with the progress we have made specific to the end of the last ABET cycle in 2010. There were two main goals going in to this ABET cycle:

1. 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.
2. Develop and refine rubrics for the a-k outcomes and incorporate these rubrics into the assessment cycle process.

We feel we have successfully closed the loop with respect to these two main goals:

1. Efforts were made to increase the rigor for both of these topics, in addition to retaining the rigor for the other topics. Specifically in BAE 417, several thermodynamic-related topics are covered including internal combustion engine thermodynamic cycles, engine cooling package design, fluid power system cooling, and design of operator space in mobile machinery. Engineering mechanics principles are reinforced in sections on mechanics of internal combustion engines; traction, hitching, and weight transfer; design of biomass harvesting machinery, and conveying of agricultural materials. Unfortunately, the financial incentives for our students to take the FE exam have diminished. Not only has the cost of the test increased, but the state decided to stop covering the cost of the test for those that passed the test on the first attempt. The result is that we have little FE data

and are forced to accept that it is inconclusive. We have also eliminated FE test scores as a student outcome metric.

2. Over the course of the last six years, we have successfully developed and refined our rubrics for student outcomes a-k. As a result, we have three years of reliable assessment data. While we will continue to improve our rubrics when appropriate, we believe we will be able to focus on increasing student success moving forward. These new rubrics have made it possible to identify several specific parts of our program that needed improvement.

Over the course of the last six years, we have made additional improvements to our program and assessment process:

3. The rubric scores for the math/science (a) and engineering problems (e) outcomes were below standard for our initial assessment cycles (40%, 60%, 60% rubric scores of 3 or 4 for both outcomes in 2013-2014). It was clear, based on the outcome artifacts, that the students were not using the appropriate procedure for problem solving. While the final answer could have been correct, the rubric score would fall below expectation due to formatting and omissions of procedure. Our first attempt to remedy this shortfall was to increase the coverage of a proper Problem Solving Procedure in the class that was doing the assessment. There was an improvement in all rubric categories, but two were still below standards (60%, 90%, 90% rubric score of 3 or 4 for both outcomes in 2014-2015). As a result, the next year we decided to adopt a formal **BAE Problem Solving Procedure** and enforce **all** BAE classes to require students to follow the BAE Problem Solving Procedure (Appendix E). While the assessment data for 2015-2016 has not yet been analyzed, some faculty have already remarked that the students are turning in homework that does follow the BAE Problem Solving Procedure.

   September 2016 Update*: The assessment for this latest cycle had rubrics scores of 3 or 4 of 80%, 100%, and 100%, showing a definite improvement in our student performance on outcomes (a) and (e). The UGCC will continue to monitor this outcome closely and work with the faculty to continue to require that all classes use the BAE Problem Solving Procedure.*

4. The rubric scores on the written communication (g) and statistics (b) student outcomes were below standard for our initial assessment cycle. For written communication, 63% of the students met expectations in the rubric category Language, while 25% of the students met expectations for Tables/Figures. For statistics, only 30-50% of the students met expectations for all rubric categories. It was clear that students needed additional instructions on proper grammar, formatting, and writing clarity. For the statistics outcome, the artifact was an essay about experimental design. The writing was so poor that the rubric scores for the underlying experimental design concepts suffered. One factor that could have contributed to this was a shift in the required freshman English requirement, so one change we made was to **require all students to take WRD 204 Technical Writing**. We worked with the WRD department to ensure that our students would be learning about technical writing specific to our discipline. In addition, the importance of proper grammar and formatting was reinforced in BAE classes, specifically BAE 202 Statistical Inferences for Biosystems Engineering, BAE 305

Circuits in Biosystems, and BAE 402/403 Senior Design. We compiled a **Technical Writing Checklist** (Appendix E) that students could use while preparing and proofreading their technical writing documents. In addition, the assignment for the statistics outcome for BAE 202 was shifted to an essay that focused on real, less complicated experiments, so that the students could focus on writing about the experimental design and data analysis and less time trying to understand the underlying phenomena of the experiment. The first experiment the students were asked to analyze was a MS project from the instructor's lab group, while the second set of experiments was based on elementary school science fair projects. The result was that the students could write more effectively about their knowledge of experimental design and data analysis with rubric scores ranging from 90-100% in 2014-2015.

5. The rubric scores on the computer tools outcome (k) were below standard. The percent of students meeting expectations for our Excel assessment was 60% and for computer aided-drawing was 86% in 2013-2014. The assignments and course content was revised for both assessments. In the next assessment cycle, the students that met expectations for the Excel assessment were 100%, while the students that met expectations for computer-aided drawing was 50%. This low score was attributed to an assignment that did not align as well with the rubric as it should have, as well as our students' ability to use AutoCAD effectively. We have **increased the lecture time for drawing** and the use of computer programs to complement the design process and written and oral communication in senior design. We have discussed the possibility of offering a computer-aided drawing class specific for BAE students, but decided we do not have the resources to be able to teach such a class. Currently, we are working to further improve our lectures about computer aided drawing.

   September 2016 Update*: The % 3 or 4 rubric score for the AutoCAD assignment was 70% and 70% in the latest assessment cycle. This improvement is attributed to having the additional class time in the Senior Design class and to the refinement of the assignment to be aligned with the rubric. The UGCC will continue to monitor this outcome closely.*

6. The rubric scores for contemporary issues (j) were below standard in 2013-2014 and the rubric scores for global issues (h) were below standard in 2014-2015. We are continuing to try to improve our assignments and rubrics for these two student outcomes. We are confident that our students are aware of both issues, but we have a hard time getting them to articulate their knowledge. It addition, it became apparent that we were expecting too much from the students in terms of the rubric. The contemporary (j) outcome uses the action word "appreciate" and the global (h) outcome uses the action word "understand", which are aligned with our first rubric category "Explanation of issues" (level 1 or 2 on Bloom's Taxonomy). However, the second rubric category "Conclusions and related outcomes (implications and consequences)" required evaluation of the issue, which is from level 6 on Bloom's Taxonomy. As a result, it was decided to **drop the second rubric category** for each outcome.

   September 2016 Update*: The % 3 or 4 rubric score for outcomes (j) and (i) in the latest assessment cycle were 20% and 20%, respectively. While attempts were made to improve the class discussion, assignment, and rubric, these attempts appear to have failed. The goal will be to make another attempt in the next cycle.*

At the college level, there have been two significant changes to improve student performance.

7. A center for student success has been established to help identify at-risk students and provide resources to help students succeed.
8. A common first year experience for engineering students has been developed and will start in the Fall of 2016.

Alumni Survey 2013

Every six years we conduct a survey for all alumni from the last 2-5 years. This survey is done three years into each ABET cycle, with the most recent completed in the summer of 2013. For this survey cycle, there were 136 alumni with known email addresses that were asked to participate, and we received 86 responses. Out of the 86 responses, 42 engineering titles were reported (including 31 single titles, 5 double titles, 4 triple titles, and 2 quadruple titles), as well as 6 non-engineering titles and 10 instances of extended education. Our alumni have acquired various professional titles including Assistant Extension Professor, Civil Engineer, Executive Director, Senior Engineer, Mechanical Engineer, Senior Biomedical Engineer, Senior Forensic Engineer, Water Resources Engineer, and Environmental Engineer. The majority of reporting alumni obtain salaries ranging from $45,000-$60,000. The highest salary range of alumni is $90,000-$120,000, while the lowest is less than $30,000. Out of the responding alumni, 53 reported that they had passed the FE exam, while 27 did not. Fifteen alumni reported that they had passed the PE exam. When asked if they would take the FE or PE exams in the future if they had not already, 36 answered no while 17 answered yes. Of the 15 alumni that passed the PE, 3 took the Agricultural Engineering exam, 11 took the Civil Engineering exam, and 1 took the Mechanical Engineering exam. The majority of our alumni are members in the ASABE organization, with others in organizations such as ASHRAE, ASCE, BMES, IBE, and IFT. Out of our alumni, 47 have received promotions in their career field.

When asked if the education received in BAE prepared for a career in terms of technical knowledge (corresponding to SO a, b, c, e, and k), **89% of responding alumni agreed**.

When asked if the education received in BAE prepared for a career in terms of non-technical knowledge (corresponding to SO d, f, h, i, and j), **93% of responding alumni agreed.**

When asked if the education received in BAE prepared for a career in terms of communication (corresponding to SO g), **88% of responding alumni agreed.**

When asked to give general feedback concerning BAE, there were many good, helpful, and honest answers. Many believed that the program prepared them well for the workforce, and appreciated the problem-solving and hands-on experience offered by the program. The two main critiques of the program were to provide greater emphasis on building resumes and to present various internship or career opportunities with organizations to which the department may be connected.

We tried to incorporate additional job hunting advice in the lectures of BAE 400 and BAE 102. Fortunately, the College of Engineering has made significant efforts to improve the college's Career Development Office.

D. Additional Information

The yearly assessment binders will be available during the site visit. The binders include assignments, assignment keys, student work, rubric scores, recommendations resulting from the assessment, and reflections about past year changes. The minutes from UGCC meetings, advisory board meetings, and faculty meetings are also available, especially when they pertain to student outcomes and program educational objectives.

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 through a thorough set of engineering science courses. This preparation 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. We strategically constructed our curriculum to teach the material necessary for our students to achieve the student outcomes, while ultimately ensuring that our curriculum is consistent with the Program Educational Objectives. Outcomes assessment at appropriate junctures in the curriculum allow us to track our progress towards achieving this goal.

Table 8 (ABET Table 5-1) presents a listing of the basic curriculum of the BS biosystems engineering 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 50 semester credit hours of engineering science and design courses (this would be a minimum, since technical electives typically 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, university social studies, humanities and citizenship requirements and one free supportive elective.

Table 8. (ABET Table 5-1 Curriculum) Biosystems Engineering Curriculum.

Course (Department, Number, Title) List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[1]	*Subject Area (Credit Hours)*				Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Maximum Section Enrollment for the Last Two Terms the Course was Offered[2]
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other		
YEAR ONE: FALL							
BAE 102 Intro to Biosystems Eng.	R		1			F2015 | F2014	41 | 34
CHE 105 Gen College Chemistry I	R	4				S2016 | F2015	Lecture: 267 Recitation: 31 | Lecture: 279 Recitation: 31
CIS/WRD 110 Comp. and Comm. I	R			3		S2016 | F2015	CIS 110: 27 WRD 110: 23| CIS 110: 27 WRD 110: 24
MA 113 Calculus I	R	4				S2016 | F2015	Lecture: 163 Recitation: 37| Lecture: 165 Recitation: 32
UK Core	SE			3		S2016 | F2015	
YEAR ONE: SPRING							
BAE 103 Energy in Biological Systems	R		2			S2016 | S2015	68 | 63
CHE 107 Gen College Chemistry II	R	3				S2016 | F2015	268 | 267
MA 114 Calculus II	R	4				S2016 | F2015	Lecture: 153 Recitation: 35 | Lecture: 131 Recitation: 35
CE 106 Computer Graphics	R		3			S2016 | F2015	Lecture: 120 Lab: 35 | Lecture: 86 Lab: 38
CIS/WRD 111 Comp. and Comm. II	R			3		S2016 | F2015	CIS 111: 29 WRD 111: 23| CIS 111: 26 WRD 111: 23
YEAR TWO: FALL							
BAE 201 Econ. Analysis. for Biosystems	R				2	F2015 | F2014	71 | 38
BIO 148 Introduction Biology	R	3				S2016 | F2015	306 | 276
MA 213 Calculus III	R	4				S2016 | F2015	Lecture: 122 Recitation: 31| Lecture: 128 Recitation: 32

PHY 231 Gen University Physics	R	4				S2016 | F2015	Lecture: 173 Recitation: 38| Lecture: 184 Recitation: 38
PHY 241 Gen University Physics Lab	R	1				S2016 | F2015	30 | 30
CS 221 First Course in CS for Engrs.	R		2			S2016 | F2015	Lecture: 172 Lab: 20| Lecture: 174 Lab: 20
YEAR TWO: SPRING							
BAE 202 Stats Inferences for Biosystems	R	3				S2016 | S2015	45 | 36
MA 214 Calculus IV	R	3				S2016 | F2015	63 | 63
ME 220 Engr Thermodynamics	R		3			S2016 | F2015	100 | 74
PHY 232 Gen University Physics	R	4				S2016 | F2015	Lecture: 182 Recitation: 37| Lecture:156 Recitation:35
PHY 242 Gen University Physics La	R	1				S2016 | F2015	30 | 30
EM 221 Statics	R		3			S2016 | F2015	80 | 76
YEAR THREE: FALL							
CE 341 Intro to Fluid Mechanics	R		4			S2016 | F2015	53 | 55
EE 305 Electrical Circuits	R		3			S2016 | F2015	76 | 139
EM 313 Dynamics	R		3			S2016 | F2015	69 | 99
BIO 152 Principles of Biology II	R	3				S2016 | F2015	298 | 185
WRD 204 Technical Writing	SE			3		S2016 | F2015	25 | 25
YEAR THREE: SPRING							
BAE 305 DC Circuits and Microelect.	R		3			S2016 | S2015	Lecture: 22 Lab: 12 | Lecture: 26 Lab: 16
ME 325 Heat Transfer	R		3			S2016 | F2015	52 | 94
EM 302 Mechanics of Deform. Solids	R		3			S2016 | F2015	69 | 72
Biological Science Elective	SE	3				S2016 | F2015	
Core Elective	SE		3(✓)			S2016 | S2015	
UK Core	SE			3		S2016 | F2015	
YEAR FOUR: FALL							
BAE 400 Senior Seminar	R		1			F2015 | F2014	33| 23
BAE 402 BAE Design I	R		2 (✓)			S2016 | F2015	9 | 23
Core Elective	SE		3 (✓)			F2015 | F2014	
Core Elective	SE		3 (✓)			F2015 | F2014	
Technical Elective	SE				3	S2016 | F2015	

Technical Elective	SE				3	S2016 | F2015	
UK Core	SE			3		S2016 | F2015	
YEAR FOUR: SPRING							
BAE 403 BAE Design II	R		2 (✓)			S2016 | S2015	23 | 17
ME 340 Intro to Mechanical Systems	R		3			S2016 | S2015	104 | 92
Technical Elective	SE				3	S2016 | S2015	
Technical Elective	SE				3	S2016 | F2015	
Supportive Elective	E				3	S2016 | F2015	
UK Core	SE			3		S2016 | F2015	
Add rows as needed to show all courses in the curriculum.							
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		**44**	**50**	**21**	**17**		
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM	**132**						
PERCENT OF TOTAL		33%	38%	16%	13%		
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours	32 Hours	48 Hours				
	Minimum Percentage	25%	37.5 %				

1. **Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group.
2. For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the maximum enrollment in each element. For selected elective courses, indicate the maximum enrollment for each option.

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). Students receive instruction in preparing and delivering technical oral presentations and are required to present four formal written presentations of their design work (proposal, preliminary design, progress and final design) and three oral presentations (proposal, preliminary design, and final design). Students are assigned to 2-5-person teams and select problems submitted by faculty from inside or outside of the department, where preference is given to projects inspired by contacts with industry. 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, the design process, estimating design costs, selection of design materials, statistical hypothesis testing, engineering ethics, sustainability and environmental issues, contemporary design issues, design safety, creativity, 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.

Table 9**Error! Reference source not found.** shows the extent to which each student outcome in addressed in each course, provided by the instructor. 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 9. Mapping of class instruction emphasis aimed at specific student outcomes for all of the BAE courses.

BAE Course Number	Outcome										
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
102			1	3	2		3				
103	3				3						2
201	3		2		3	2	2	2	2	2	2
202	2	3					1		2		2
305	2	3	3	1	3		1		1		2
400	1	2			2	3	3	3	3	2	1
402	1	2	3	3	3	3	3	1	2	2	3
403	1	2	3	3	3	3	3	1	2	2	3
417	3	2	2	1	3	2	2	2	2	2	3
427	2		3		3		1				
435G	3	1	3	2	1	3	2	3	3	3	1
437	3	2	2	1	3	1	1	1	1	2	1
447	3		3	1	3	2	2	1	1	2	3
502	3	1	3		3			1	1	2	3
504	2	1	2	3	3	1	2	1			1
515	2	2	3		3		2		2		2
532	2		3	2	3		2	1			2
536	3	2	3	3	3	1	2	1	1	2	3
549	3		1	2	3	1	2	3	3	3	3
580	3		3		3	2	1	2	1	3	3
599 (Energy Assessment)	3	2	3	3	2	1	3	2	2	1	3
599 (Solar Power)	2		3	2	3		1	2	1	1	3
599 (Component Design)	3	2	3	1	3		2			2	3
599 (Off-Road Vehicles)	3	2	3	1	3		2			2	3

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank – Unsupported

Prerequistes for BAE courses are approved by the faculty and must be approved by the university senate as well. Devaitions from the prerequiste structure must be approved by the instructor of the course and the director of undergraduate studies. The intention of the prerequiste stucture is to ensure that students have the appropriate background before taking a course, such that each student has a better chance to achieve the level of competiceny that is expected for our student outcomes. The current relationship between prerequistes and the BAE curriculum are shown in Figure 4.

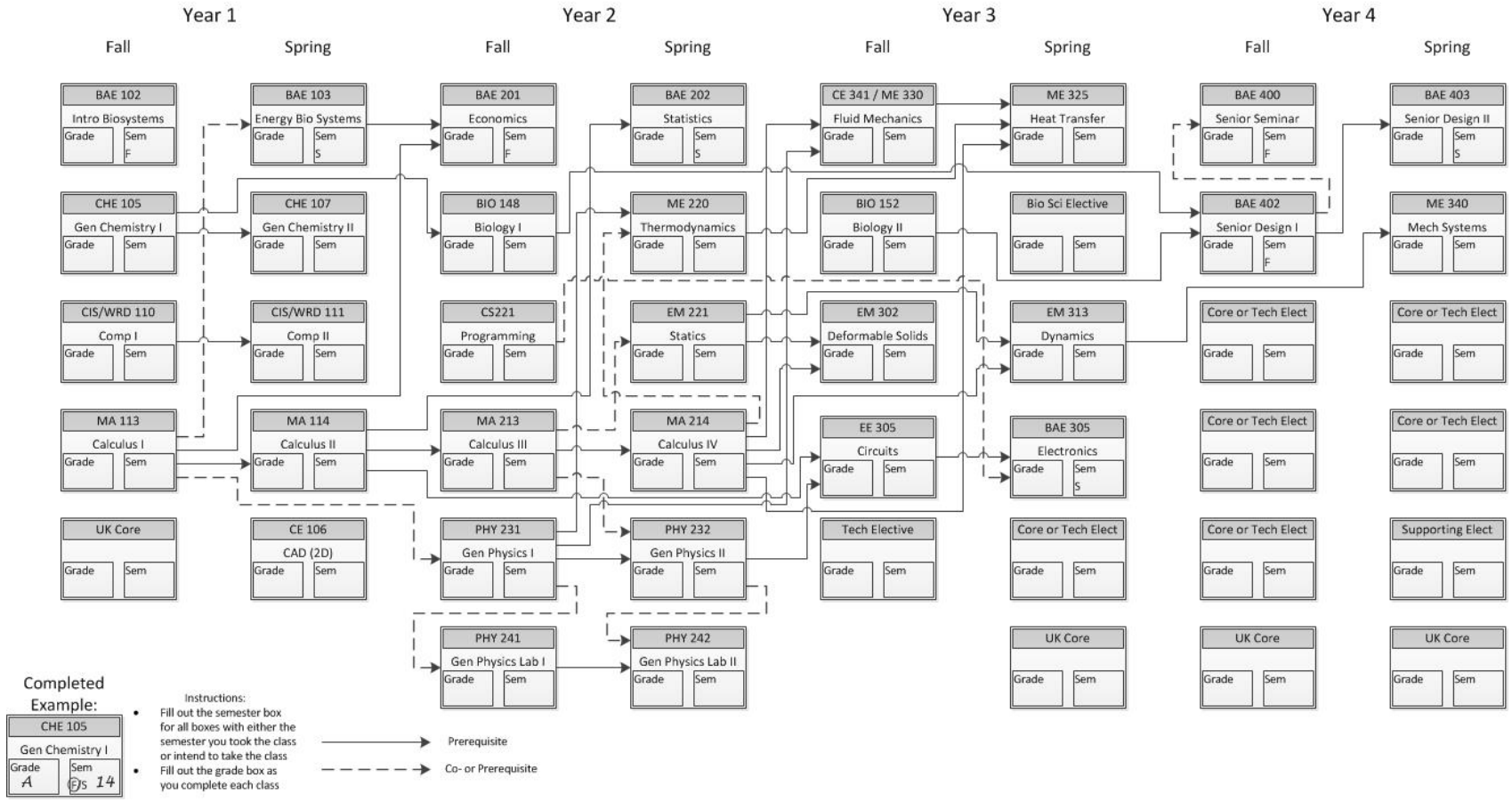

Figure 4. Prerequisites for the biosystems engineering program.

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 classes taught in BAE (required and elective courses), 2) binders each of the yearly ABET assessment cycles, and 3) binders for each outcome documenting the assessments for each outcome and examples of how each class addresses the outcome. The class binder will contain the syllabus, examples of course content as it addresses each outcome and examples of student work, including feedback from the instructor. The BAE ABET documentation folders contain information about the yearly assessments, including the assessment instruments, student artifacts, summary of results, summary of recommendations, and reflections. The outcome binders will in essence contain the same information as the class binders, but will be organized with just one outcome per binder with materials from all of the classes that address that respective outcome.

B. Course Syllabi

Course syllabi for each course used to satisfy the mathematics, science, and discipline-specific requirements are included in Appendix A.

CRITERION 6. FACULTY

A. Faculty Qualifications

The BAE faculty consists of thirteen individuals working at the Lexington Campus, including Assistant Dean (CAFE) Dr. Stephen Workman, and one Extension faculty at the Princeton facility. The faculty are listed in Table 10. (ABET Table 6-1.) Faculty qualifications with corresponding qualifications. All BAE faculty have Ph.D. degrees, granted from eleven different universities. Table 9 (ABET Table 6-1) also lists faculty with education and activity details as of June 2016.

Of the fourteen regular or Extension faculty affiliated with BAE (as of June 2016), excluding the Chair and Assistant Dean, four are Assistant Professors, two are Associate Professors and nine are Professors. Three members of the faculty have received the top teaching award in both the College of Agriculture, Food and Environment and College of Engineering and three have received the University Provost teaching award for non-tenured faculty and a USDA Southeast Region Teaching Award. Three 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, Food and Environment 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.

Eleven 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.

Table 10. (ABET Table 6-1.) Faculty qualifications for Biosystems Engineering.

Faculty Name	Highest Degree Earned- Field and Year	Rank [1]	Type of Academic Appointment[2] T, TT, NTT	FT or PT[3]	Years of Experience			Professional Registration/ Certification	Level of Activity[4] H, M, or L		
					Govt./Ind. Practice	Teaching	This Institution		Professional Organizations	Professional Development	Consulting/ summer work in industry
Akinbode Adedeji	PhD BRE, 2010	AST	TT	FT	0	18	2	PE (Nigeria)	H	H	M
Carmen Agouridis	PhD BAE, 2004	ASC	T	FT	1	17	15	PE (KY, WV)	H	H	M
Donald Colliver	PhD AE, 1979	P	T	FT	0	37	37	PE (KY)	H	H	H
Czarena Crofcheck	PhD BAE, 2001	P	T	FT	0	15	15	PE (KY)	H	M	L
Joseph Dvorak	PhD, BAE, 2012	AST	TT	FT	2	5	4	PE (KY)	M	M	M
Dwayne Edwards	PhD AE, 1988	P	T	FT	0	28	22	PE (AR)	L	L	L
Samuel McNeill	PhD AE, 1996	ASC	T	FT	0	0	0	PE (KY)	H	L	M
Michael Montross	PhD BAE, 1999	P	T	FT	0	17	17	PE (KY)	H	M	L
Sue Nokes	PhD BAE, 1990	P	T	FT	3	26	21	PE (OH)	H	H	L
Mark Purschwitz	PhD AE, 1989	P	T	FT	27	18	8		M	L	L
Michael Sama	PhD BAE, 2013	AST	TT	FT	0	10	10	PE (KY)	H	H	M
Jian Shi	PhD, BAE, 2007	AST	TT	FT	4	1	1	EIT	M	H	L
Timothy Stombaugh	PhD AE, 1998	P	T	FT	0.5	25	16	PE (KY)	H	M	L
Joseph Taraba	PhD ChemE, 1978	P	T	FT	0	39	38		M	L	L
*In addition, Emeritus Professors include: Robert Fehr, Frederick Payne, Larry Wells, Doug Overhults, Richard Warner, and William Murphy											

1. Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: TT = Tenure Track T = Tenured NTT = Non Tenure Track
3. At the institution
4. The level of activity, high, medium or low, should reflect an average over the year prior to the visit plus the two previous years.

B. Faculty Workload

Table 10 (ABET Table 6-2) lists the Faculty workload, including courses taught in the last academic year and distribution of effort to the biosystems engineering program.

Table 11. (ABET Table 6-2.) Faculty workload summary for Biosystems Engineering.

Faculty Member (name)	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to the Program[5]
			Teaching	Research or Scholarship	Other[4]	
Akinbode Adedeji	FT	BAE 549/3 F15;	16.25	83.75	0	100
Carmen Agouridis	FT	BAE 532/3 F15; BAE 103/2 S16; BAE 532/3 S16;	53.75	37.75	8.5	100
Donald Colliver	FT	BAE 580/3 S16; BAE 599/3 S16; BAE 599/3 S16;	55.2825	24.0625	20.655	100
Czarena Crofcheck	FT	BAE 402/2 F15; BAE 403/2 F15; BAE 549/3 F15; BAE 202/3 S16; BAE 402/2 S16; BAE 403/2 S16;	37.25	42.75	20	100
Joseph Dvorak	FT	BAE 515/3 F15; BAE 305/3 S16;	31.625	68.375	0	100
Dwayne Edwards	FT	BAE 536/3 F15; BAE 775/2 F15; BAE 437/3 S16; BAE 662/3 S16; BAE 775/2 S16;	45	55	0	100
Samuel McNeill	FT		0	20	80	100
Michael Montross	FT	BAE 201/2 F15; BAE 447/3 F15; BAE 502/3 S16;	39.5	56	4.5	100
Sue Nokes	FT		10	50	40	100
Mark Purschwitz	FT		9.58	21.25	69.17	100
Michael Sama	FT	BAE 400/1 F15; BAE 658/3 F15; BAE 599/3 S16	29.325	70.675	0	100
Jian Shi	FT	BAE 504/3 F15;	15	85	0	100
Timothy Stombaugh	FT	BAE 417/3 F15;	20	24	56	100
Joseph Taraba	FT	BAE 435G/3 F15;	17.5	20.41	62.09	100

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.

C. Faculty Size

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 Engineer Associate for Academics. The DUS and/or the Engineer Associate for Academics meets with potential students, advises incoming transfer students, monitors the progress of students, and works with faculty on the curriculum. The Undergraduate Curriculum 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.

Of the fourteen BAE faculty, 13 BAE faculty have formal teaching assignments, while five have a formal Extension appointment. The Extension faculty have a teaching assignment as well, typically teaching one course per year and primarily either an upper division undergraduate or graduate course. The average faculty teaching assignment was 27.14% in 2015-2016 for the 13 Lexington-based faculty, which equates to approximately two courses per year plus advising. The remaining faculty member is based in Princeton. Faculty teaching workload is fairly evenly distributed among teaching faculty; however the teaching efforts listed in Table 6-2 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 been growing steadily since 2010. We had approximately 60 undergraduate students in 2010, which increased to 100 in 2011, 108 in 2012, 121 in 2013, 144 in 2014, 170 in 2015, and 203 students in 2016. The program is attractive to students for a number of reasons, including: the only biological engineering and similarly named accredited undergraduate program in Kentucky, a broad-based curriculum focused on fundamentals of engineering, a unique pre-biomedical engineering and pre-veterinary program, and active recruitment that articulates the positive benefits of smaller class sizes and larger faculty: student interactions.

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 BAE 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 Midwest Student Rally). 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 2015), not only those with a machine systems focus. The team members are involved in all aspects of the project, including securing the majority of

direct expenses. Several faculty (Drs. Sama, Dvorak, and Stombaugh) and additional engineers on staff assist the students.

D. Professional 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 Agriculture, Food and Environment and Engineering, or the Department.

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 12 includes example professional conferences or other professional development travel for each faculty member.

Table 12. Professional development of BAE faculty and instructional staff.

BAE Faculty	Professional Societies	Conferences or Other Professional Development
Adedeji	ASABE; Canadian Institute of Biological Engineers (CSBE); Institute of Food Technology (IFT); Nigerian Institute of Food Technology (NIFST)	Attended Annual International Meetings of the ASABE: 2014 and 2015 2015 – Imaging Symposia: Biomedical Informatics, Dr. Zhang, University of Kentucky, Pavilion H Rm HX303; eLII (eLearning) Cohort 2 Workshop, University of Kentucky; "Working with Distressed and Distressing Students", University of Kentucky; NSF Career Proposal Writing Workshop, Northeastern University, Boston MA; STEM teaching enhancement workshop and forum, University of Kentucky
Agouridis	ASABE; Am. Soc. of Mining & Reclamation; Appalachian Regional Reforestation Initiative; Am. Soc. of Civil Engineers; Alpha Epsilon	Attended Annual International Meetings of the ASABE: 2011-2015 2015 - University of Kentucky eLearning Innovation Initiative (eLII) Faculty Skill Development: Community 1 (Online Learning), Cohort 1.5; Stream Restoration: In-Channel Structure Design and Placement American Society of Civil Engineers Webinar, December 28; 2012 - College of Agriculture Faculty Learning Community focused on Student Engagement Techniques; Stream Restoration in the Southeast: Innovations for Ecology, Wilmington, NC, October 15-18. 2011 - College of Agriculture Spring Teaching Seminar on Distance Learning, May 11
Colliver	American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE); Advanced Energy Design Guide (AEDG)	Attended Annual International Meetings of the ASABE: 2011-2015 Attended Industrial Assessment Center Directors Annual Meetings: 2013-2016 Attended ASHRAE Winter and Annual Conferences: 2013-2016
Crofcheck	ASABE, Institute of Biological Engineering (IBE), Alpha Epsilon, Gamma Sigma Delta	Attended Annual International Meetings of the ASABE: 2011-2015 Attended Institute of Biological Engineers annual meetings: 2011-2015 2015 - Canvas workshop, University of Kentucky

BAE Faculty	Professional Societies	Conferences or Other Professional Development
Dvorak	ASABE	Attended Annual International Meetings of the ASABE: 2012-2015 2016 - Kentucky Fruit and Vegetable Conference 2015 - Electric & Hybrid Vehicle Technology Conference, Novi, Michigan; 2014 - UK eLearning Innovation Initiative (eLII); Kentucky Cooperative Extension Professional Development Conference 2013 - Kentucky Innovations and Entrepreneurship Conference, Lexington, KY 2012 - UK College of Agriculture, College of Agriculture Teaching and Technology Fair; Seminar sponsored by the College of Agriculture: Using iPads for instruction and extension
Edwards	ASABE, American Society of Engineering Education (ASEE), Am. Water Resources Association, National Soc. of Prof. Engr., Tau Beta Pi, Gamma Sigma Delta, Alpha Epsilon, Phi Kappa Phi	2016 - Nuclear Instrument Safety and Hazardous Materials; Kentucky Water Resources Research Institute Symposium 2015 - Canvas Learning Management System 2013 - Attended Annual International Meeting of the ASABE, Kansas City 2012 - Senior Leader Development Program, University of Notre Dame
McNeill	ASABE, Kentucky Association of State Extension Professionals (KASEP)	Attended Annual International Meetings of the ASABE: 2011-2015 2015 - First International Congress on Postharvest Loss Prevention. Rome, Italy. Oct. 4-8; Global Food Security Symposium, Washington, D.C., Apr. 15 2014 - UK Winter Wheat Seminar. Hopkinsville, KY, Jan. 7 2013 - Tennessee Renewable Energy Seminar, Clarksville, TN, July 9; KY Association of State Extension Profs Spring meeting, Frankfort, KY, April 11; Grain Elevators and Processors Society Annual Meeting, Louisville, KY, Feb. 26; Workshop to reduce global post-harvest losses, Washington, D.C., Jan. 13

BAE Faculty	Professional Societies	Conferences or Other Professional Development
Modenbach	ASABE, American Society of Engineering Education (ASEE)	Attended Annual International Meetings of the ASABE: 2011-2015 2016 - Accommodating Accommodations: How to Work with Students with Disabilities or Emotional Concerns, College of Agriculture, Food and Environment Lunch-and-Learn Series presented by Dr. Leisa Pickering and Dr. Matt Ashton, April 13; Panel Discussion with Underrepresented Students in STEM, Facilitated by CELT and Dr. Renee Fatemi, April 7; SafeZone Workshop, University of Kentucky Office of LGBTQ* Resources presented by Lance Poston, March 2 2014 - Attended Institute of Biological Engineers Annual Meeting, Lexington, KY 2011 - Preparing for the Professoriate: What You Can Do Now to Optimize Your Success, Graduate Student Workshop presented by Morris Grubbs and Linda Worley, April 13
Montross	ASABE	Attended Annual International Meetings of the ASABE: 2011-2015
Nokes	ASABE, American Society for Engineering Education (ASEE)	Attended Annual International Meetings of the ASABE: 2011-2015 2016 - Engineering Research Council Annual Conference, March 7-9, 2016, ASEE; 2014 - Attended 18th World Congress of CIGR, Beijing, China September 16-19, 2014; American Institute of Medical and Biological Engineers Conference, March 2014
Purschwitz	ASABE, National Institute for Farm Safety (NIFS), International Society for Agricultural Safety and Health (ISASH), Tau Beta Pi, Gamma Sigma Delta	Attended Annual International Meetings of the ASABE: 2012 2015 - ASABE Agricultural Equipment Technology Conference, Feb. 9-10, 2015, Louisville; National Farm Machinery Show, Feb. 11, 2015, Louisville; National Green Industry and Equipment Expo, October 22, 2015, Louisville; Int. Soc. for Agr. Safety and Health Annual Mtg., June 22-25, 2015, Bloomington, IL. 2014 - National Farm Machinery Show, Feb. 12, 2014, Louisville; National Safety in Agriculture for Youth Conference, October 27-28, 2014, Louisville. 2012 - Nordic Mtg. on Agr. Occupational Health and Safety, Aug. 27-29, 2012, Ystad, Sweden

BAE Faculty	Professional Societies	Conferences or Other Professional Development
Sama	ASABE	Attended Annual International Meetings of the ASABE: 2011-2015 2016 - ASABE Agricultural Equipment Technology Conference. Louisville, KY 2015 - AUTONAVx: Autonomous Navigation for Flying Robots, Technische Universität München; VDI Wissenforum 73. International Landtechnik. Hannover, Germany 2014 - Kentucky Corn Growers Association CORE Farmer Program. Louisville, KY 2013 - VDI Wissenforum 71. International Landtechnik, Hannover, Germany
Shi	ASABE, American Institute of Chemical Engineers (AIChE), Society for Industrial Microbiology (SIM)	Attended Annual International Meetings of the ASABE: 2011 and 2015 2016 -Attended NSF Supercommunicator Workshop 2015 - Attended University of Kentucky eLii workshops about hybrid teaching technologies and Canvas
Stombaugh	ASABE, Gamma Sigma Delta, Alpha Epsilon	Attended Annual International Meetings of the ASABE: 2011-2015 2016 – Agricultural Equipment Technology Conference: 2011, 2012, 2014, 2015, 2016 2014 - The International Conference and Exhibition of Ubiquitous Positioning, Indoor Navigation and Location-Based Services, Corpus Christi, Texas
Taraba	ASABE, Gamma Sigma Delta, Sigma Xi, Amer. Institute of Chemical Engineers, Am. Chem. Soc., Am. Association for the Advancement of Science, KY Association of Extension Professionals	Attended the KY Association of Extension Professionals Annual Meeting, 2012-2016 2016 - Dairyland Initiative Workshop, Tube ventilation for calf and holding areas; Annual Research Meeting - S 1032 USDA Regional Project 2015 - Annual Meeting of European Federation of Animal Science; Symposium in Brazil: Interleite Brasil, Dairy Housing, Urlandia MG, Brazil; Waste To Worth Conference, Livestock and Poultry Env. Learning Center 2014 - ADSA-ASAS CSAS Joint Annual Meeting (JAM), Kansas City, Missouri; Dairy Conference in Lins, S-P, Brazil 2013 - Annual Meeting, American Dairy Science Association, Indianapolis IN

Financial support for these activities comes from grants and contracts, departmental funds, and sometimes College of Agriculture, Food and Environment 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 FY2015, this totaled over $30,000. 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: ASABE, ABET, 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 12.

Participation in professional development activities associated with the University or Department

The University offers professional development activities through the Center for the Enhancement of Learning and Teaching (CELT). CELT 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, Food and Environment.

E. 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 the Engineering Associate for Academics 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. Czarena Crofcheck 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. Joe Dvorak, Chair; members: Dr. Edwards, Dr. Sama, Dr. Modenbach, Dr. Nokes, Ms. Wolfe (graduate student representative), and Dr. Crofcheck (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.

CRITERION 7. FACILITIES

A. Offices, Classrooms and Laboratories

1. **Offices**

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, Food and Environment complex south of central campus. The department has available 4,576 m^2 (49,252 ft^2) space in offices, classrooms and laboratories. It is approximately a twenty minute walk to the College of Engineering buildings. There is a bus route that leaves every 15 minutes for the main part of campus. In addition, the university is considering a proposal to extend the time between classes to 20 minutes.

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 m^2 (6,500 ft^2) and contains central rooms and 21 perimeter offices.

2. **Classrooms**

In the Barnhart Building, 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 for a total of three teaching spaces within the Department in addition to laboratory spaces.

Our larger classes (BAE 102, BAE 103, and BAE 201) have been taught in the classrooms controlled by the College of Engineering. Seventeen traditional classrooms are available in the various engineering buildings for teaching with capacities ranging from 17 - 72 seats. All of these rooms are equipped with a blackboard or whiteboard, and "smart" classroom technology consisting of a computer, a projector, laptop/table connections, and a document camera. In 2015-2016, only BAE 202 was taught on the engineering campus. BAE 102/103 were split into two sections, so that they could fit in the classrooms in the Barnhart Building.

A number of the computer labs located within the College of Engineering are configured for computer instruction. They include:

1. The Engineering Workstation Lab in 211 Ralph G. Anderson Building has 40 Windows-based workstations. The primary function of this lab is to support advanced technical software in a teaching environment.
2. The Computer Science teaching labs are located in 102 and 103 Ralph G. Anderson Building, and have a total of 32 Windows-based workstations. The primary function of these labs is for teaching students about languages, compilers and database programming.
3. The Mechanical Engineering Computer Labs located in 111 and 114 Ralph G. Anderson Building contain a total of 35 Windows-based desktops, and either room can support teaching with a number of technical software packages in small class settings.
4. Though normally functioning as a microcomputer lab, the Civil Engineering Lab located in 228 Oliver H. Raymond Building may be used as a 30-seat Windows-based classroom if the need exists.

Departmental PC labs that function as classrooms at various times include: the BAE instructional lab (19 seats), the Civil Engineering Design lab (24 seats), and the Mine Design Lab (25 seats). Engineering faculty also make use of other computer classrooms located throughout campus as needed.

In addition to the classrooms in the engineering buildings, engineering classes are also taught in other classrooms across campus such as in the Classroom Building, the Biological Sciences Building, Business and Economics, Patterson Office Tower, and the Chemistry-Physics Building.

3. **Laboratory Facilities**

Attached to the Barnhart office tower is the department's laboratory facilities, featuring 3,373 m^2 (36,306 ft^2) of laboratories. This space includes a long (>100 m) 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, machine 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. One current infrastructure challenge related to several years of budget shortfall is the need for a new roof.

The Department also maintains the Agricultural Machinery Research Laboratory and HVAC Training Facility, a 17,000 ft^2 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 2,600 ft^2.

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.

B. Computing Resources

The student computer lab located in the Barnhart Building includes nineteen personal computers, networked printers, and restricted access for BAE students, staff and faculty. The computers in this lab were updated in 2013 and will be updated in the summer of 2016. There are several specialized programs installed on these computers for our students' use, including Adobe Photoshop CC, ArcGIS, Arduino IDE, AutoCAD 2016, Autodesk Inventor 2016, Autodesk Navisworks 2016, Autodesk Simulation 2016, EndNote X7, HEC-RAS 4.1, HY-8 7.30, Matlab R2015a, MS Office 2013, MS Visio 2013, MS Visual Studio 2015, National Instruments Software (LabVIEW), Pro/Engineer, SAS 9.4, and Sigmaplot 12.3.

The Engineering Design Lab 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.

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.

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.

The following computer facilities are available for use in the engineering programs:

University Supercomputer and Cluster Facilities:

The University has two research clusters on campus, and access to the national XSEDE cluster. UK's primary cluster is the Linux based Lipscomb HPC cluster - named after UK alumnus and Nobel Laureate Dr. William Lipscomb. This cluster is built from a large number of commodity servers, a high speed interconnect, a unified file system, a large mass storage system, and is rated at 140 Teraflops (TF). Available software includes: Fieldview, Fluent, Gaussian, Amber, Octave, BLAS, and LAPACK.

Approximately 300 Macintosh computers utilize Apple, Inc.'s XGRID software to create an XGRID distributing computer cluster with a capacity of 3.74 TF if all nodes are available. UK's cluster resources can be accessed by undergraduates working with faculty on research and special projects, or if their course work requires it.

University Personal Computers and Virtual Environment:

Currently the University maintains 10 microcomputer labs throughout the campus with approximately 570 PCs and 160 Macs. Several of these labs are located within the Engineering Complex, with computer access controlled through individual Active Directory logins that are created when students enroll in the University.

1. Civil Engineering Lab (228 Raymond Bldg.), containing 48 Windows-based systems, is used for instruction and general computing work. Students have access to software ranging from MS Office to CAD, analysis and modeling, project management, and programming.

2. Engineering Workstation Lab (211 Ralph G. Anderson Bldg.) contains 40 Windows-based workstations running ANSYS, AutoCAD, PTC Creo, and Matlab. It is primarily used for instruction and homework in undergraduate computer-aided design courses.
3. Mechanical Engineering Computer Labs (111 and 114 Ralph G. Anderson Bldg.) contain a total of 35 computers that support software such as: ANSYS, AutoDESK suite, CATIA, PTC Creo, Matlab, and LMS Imagine Lab and Virtual Lab. Either of these rooms can function as a student lab or a classroom.
4. Computer Science Computer Labs (102 and 103 Ralph G. Anderson Bldg), contain a total of 32 Windows-based systems used primarily to support instruction in Computer Science courses.

Two 24 seat labs and three computer classrooms in the King Science Library, located near the Engineering Complex provide additional lab and classroom facilities for Engineering and Computer Science students. Software available in these labs include: SPSS, SAS, ArcView, C and C++.

The University maintains these labs through a leasing program that allows all University Microlab systems to be replaced every five years. A technology fee of $99 per semester is charged to University students to pay for these labs, and many other resources provided through the Office of the Senior Vice Provost for Analytics and Technology (UKAT).

The University of Kentucky, uses Citrix technologies, to provide a portal (Virtual Den) for students to access a number of software packages that are used in courses. The benefit of this technology is that it allows access to software and desktops anytime from anywhere. There is a limited number of Engineering software available in this environment including Matlab, LMS Imagine and Virtual Lab, West Point Bridge Designer, SAS, JMP, and SPSS.

College Super-minicomputers and Servers:

Engineering Computing Services maintains the college's web server that is used by the faculty and students for academic and research purposes. PHP and MySQL are available through this system, as is the ability to run blogs and wikis. Engineering also maintains file, backup, and database servers that support the academic, research, and administrative functions of the college. Additionally, students are able to use server instances on the campus virtual server farm for course and project work.

Departmental Personal Computers and Workstations:

Each department within the College of Engineering has its own personal computers and workstations. These computers are operated by the departments and are used for specialized instruction and research.

Faculty Computers:

All faculty have personal computers or workstations in their offices that they use for research, instruction, and administrative tasks. The specific type varies according to the wishes and the needs of each faculty member. Additionally, most have computers in their laboratories that are used for research and instruction.

Student Computers:

Previously, students were strongly encouraged to purchase their own personal computers, and to use them during their academic career at the University of Kentucky. Starting with the Fall 2016 semester, all incoming Engineering students will be required to purchase a laptop.

Through University, College of Engineering, and various vendor licenses, students have access to a number of software packages that they can use on their personal systems. These include: Microsoft Office 365, Adobe Creative Suite, Microsoft DreamSpark programs (Visual Studio, Visio Pro, Project Pro, operating systems, and server platforms), and AutoDESK software. There is also an extensive wireless network throughout campus that allows students to easily access digital resources at any time.

Other Departmental Systems:

The labs described in this section are provided by individual departments and are administered by those departments or Engineering Computing Services. Access to these systems is via a student's campus Active Directory login, or via logins assigned by the individual departments.

i. Chemical and Materials Engineering Microlab.

Chemical and Materials Engineering maintain a eighteen seat lab for their students. This lab is primarily for coursework and research and provides students with access to: ASPEN, ChemCAD, AutoCAD, Matlab, Maple, COMSOL, SciFinder, Visio, MiniTab, TecPlot360, and MS Office are also available.

ii. Computer Mine Design Lab.

This lab consists of twenty-five PCs maintained by the Department of Mining Engineering. It is primarily used for instruction and homework, and has the following software packages: AutoCAD, SurvCAD, TecPlot 360, Vulcan, REAME, Caterpillar FPC, AGG Flow, NIOSH Ground Control, Flac 3D, ANSYS, Visio, MS Office, Matlab, and Maple.

ii.b. Alpha Natural Resources Mine Design Lab

This lab consists of twelve PCs with the same software as the Mine Design Lab, and is used by students for homework, projects, and research.

ii.c. Mine Automation Lab.

This is a sixteen seat lab consisting of eight laptops and eight Allen-Bradley PLCs, and is used to teach mine automation and controls.

iii. BAE Instructional Microlab.

This lab is maintained by the Department of Biosystems and Agricultural Engineering, and has nineteen seats. Primarily used for instruction and homework, this lab provides students with access to the following software: AutoDESK software suite, ANSYS, MS Office, PTC Creo,

Visual Basic, Visio, ArcGIS, Matlab, and ground water and stream modeling / restoration simulation tools.

iv. Civil Engineering Labs.

Civil Engineering maintains a twenty-four seat PC lab for use by their students working on design coursework and projects. Software packages installed include: AutoCAD, AutoDesk Civil 3D and Revit, Bentley software, ANSYS, ArcGIS, KYPipe, HEC Products, R, Visual Studio, Visio Pro, Project Pro, and MS Office.

v. Computer Science.

The Computer Science Department operates the MultiLab in Engineering Annex 203. The MultiLab has 30 dual-boot workstations that students may reboot to run either Linux, Windows, or a student-created Linux kernel. Multilab servers provide file service to Linux via NFS and to Windows via Samba.

Computer Science also maintains an OpenStack cluster composed of eight physical servers with 188 GB RAM each, and connects to a NAS for storage. Each student has their own VM, which can be used for programming or system engineering courses.

vi. Electrical and Computer Engineering.

Computers maintained by Electrical and Computer Engineering in support of their undergraduate courses use a number of software packages, including Cadence, Labview, Matlab, B2 Spice, Arduino, and Xilinx, to teach the fundamentals of design, power systems, digital signal processing, and analog, digital, and embedded devices.

vii. Mechanical Engineering.

Mechanical Engineering operates two labs in support of their undergraduate lab courses. These labs use Labview and Matlab to teach students the fundamentals of basic sensors and signal analysis, and to design, perform, and analyze engineering experiments.

viii. Shaver Engineering Library Lab.

Maintained by the College of Engineering's Computing Services group, this is a ten-seat general-purpose lab open to all engineering students. Software installed in this lab includes: Matlab, Maple, Ansys, AutoCAD, Creo, TecPlot, Microsoft Office, Visio, Project, and Visual Studio.

University and College Provided Software:

The College of Engineering participates in Microsoft's DreamSpark program (formally Microsoft Developers Network Academic Alliance - MSDNAA). Through this program, all engineering students and faculty have access to Microsoft's Visual Studio, Visio Professional,

Project Professional, versions of Windows desktop, and various server operating systems and platforms. This software is available in several of the campus and departmental PC lab, and may be downloaded through the College's OnTheHub online software center for use on a student's or faculty member's personal system.

The College of Engineering, and its departments, purchase licenses for a number of engineering and mathematical software packages that are used in the undergraduate programs including; Matlab, Maple, PTC Creo, CATIA, AutoDESK suite, COMSOL, ANSYS, KYPipe, SurvCAD, MiniTab, TecPlot360, MathCAD, ChemCAD, Aspen, and MSC Nastran Bundle. Students may access these software packages from a number of campus and departmental labs.

The University provides faculty and students Thomson Endnote, Adobe CC suite, Google Docs, and Microsoft Office 365. These software packages may be obtained from the campus download server, or the Campus OnTheHub site in the case of students, using their individual Active Directory accounts.

Administration of Computers:

The University computers are administered by the University of Kentucky Analytics and Technologies group and are maintained, upgraded, and enhanced by the University at large through the auspices of the Senior Vice Provost for Analytics and Technology. University facilities are supported by full and part time staff, and consultants are available at major computing sites during the day, evenings, and weekends. Extensive program libraries are maintained for numerical analysis, document preparation, mathematical analysis, engineering analysis, graphics, etc.

College of Engineering computers are administered by the College and/or by the departments within the College. Many of these systems have been acquired within the last four years, and as these systems are superseded by new technologies the College and/or departments will upgrade or replace them as appropriate. College facilities are supported by Engineering Computing Services, which has seven full-time employees and two part-time employees, and provides assistance to students and faculty from 8:00 a.m. to 5:00 p.m., Monday through Friday. Support available includes: hardware installation and upgrades, problem resolution and repair; software installation and upgrades; new system setups; network connectivity and setups; purchasing support; and software support for email, word processing, spreadsheets, graphics and database work.

Accessibility of Computer Facilities:

The University of Kentucky's campus-wide data communications network allows any user to access electronic resources from virtually anywhere on campus. Engineering faculty and staff have wired and wireless network connections in their offices and laboratories which permit access to network resources. Students have wireless network access throughout Engineering, including: all classrooms and labs, the Shaver Engineering Library, and all common spaces.

The University operates 10 microlabs around the campus with approximately of 570 PCs and 160 Macs. Students access these facilities using their Active Directory accounts, which are created when they enroll in the University and remains active for their academic career. These accounts are used to access many University resources including: Canvas, online registration and records, software downloads, Echo360, and all campus microlab computers. As part of UK's Office 365 subscription, students are provided with 1TB of network storage. Students also receive email accounts, though access to these accounts is not tied to a students Active Directory account.

Campus microlabs and computer classrooms located in or near the College of Engineering are:

Civil Engineering lab:

48 seats, Windows, Projection system for instruction
Operating schedule:

- Monday through Thursday, 7:30 a.m. until 2:00 a.m.
- Friday, 7:30 a.m. until 5:00 p.m.
- Saturday, Closed
- Sunday, Closed

Engineering Workstation Lab:

40 seats, Windows, Projection system for instruction
Operating schedule:

- Monday through Thursday, 7:45 a.m. until end of classes that day
- Friday, 7:45 a.m. until end of classes that day
- Saturday, Closed
- Sunday, Closed

Mechanical Engineering Computer Lab:

35 seats, Windows
4 seats, Macintosh
Operating schedule:

- Monday and Thursday, 7:30 a.m. until 12:00 a.m.
- Friday, 7:30 a.m. until 5:00 p.m.
- Saturday, Closed
- Sunday, Closed

CS Teaching Lab:

32 seats, Windows (two classrooms)
Operating schedule:

- Monday and Friday, Open classes and TA office hours
- Saturday, Closed
- Sunday, Closed

King Computer Lab:

24 seats, Windows (microlab)
24 seats, Macintosh (microlab)

16 seats and 22 seats, Windows (two classrooms)
16 seats, Macintosh (MacPros) (classroom)
Operating schedule:

- Monday through Thursday, 8:00 a.m. until 9:00 p.m.
- Friday, 8:00 a.m. until 4:30 p.m.
- Saturday, Closed
- Sunday, 12:00 p.m. until 5:00 p.m.

College of Engineering file, database, and web servers are operated 24 hours a day, seven days a week and are available over the network. Users logins are controlled using campus Active Directory credentials and access control lists, which are created and remain active as follows:

Student: All engineering students receive Active Directory accounts when they enter the University, and these accounts stay active throughout their academic career.

Faculty: Added when entering the College. Active until faculty leaves the College.

Staff: Added when entering the College or by departmental request. Access to resources remains active until the staff member leaves the College or department.

Access to departmental and faculty workstations are determined by the department or the faculty member themselves. Generally, departmental systems are available during the day with some evening and weekend availability. Faculty workstations are available to faculty at all times.

Method of Payment for Instructional Computing Services:

University and College facilities are supported through the unit's operating budget. Departmental and individual machines are supported through departmental resources. No specific payment is required for instructional usage; however students pay a $99/semester technology fee to support University computing facilities. In addition, the students are required to pay a printing charge of $.15/page

The eStudio

The Elbert C Ray eStudio was created specifically to enable students to better meet ABET student outcomes 3g1 an ability to communicate effectively orally, 3g2 an ability to communicate effectively in writing and k an ability to use the techniques, skills and modern engineering tools necessary for engineering practice through the digital media resources it provides. The eStudio reflects the University of Kentucky's 2004 shift to writing in the disciplines, which called for departments throughout Engineering to develop upper level writing intensive courses for their students within their major and the university's 2014 adoption of a graduation composition and communication requirement that expanded the writing in the disciplines requirements to include not just writing, but also oral or visual/digital skills in the writing courses in the disciplines.

The Engineering Dean, Tom Lester, created the eStudio with donor support from Elbert C. Ray and Charlie Scroggins to provide faculty and student support in oral, written, visual and digital communication. The estudio provides free friendly private tutoring by trained Engineering tutors to any student in the College of Engineering from Freshmen to Graduate Student at any stage of their project by appointment and on a drop in basis. The eStudio also offers support for faculty integrating communication assignments into their curriculum through workshops, rubrics, grading assistance and individual consultations on any assignment or activity.

At the time of its creation, no other student support service on campus provided tutors trained in technical and scientific writing assistance. This is still true. Also, at the time there was also no other service that offered oral presentation rehearsal space or digital media tutoring and resources. The eStudio was modeled after similar communication studios at Stanford and Rutgers, but was unique in that it was the very first communication center in the nation targeted exclusively to the needs of engineering students.

Since opening in 2011 the estudio has hosted 4591 appointments in every major of engineering. It has grown on average 40% each semester. On average 60% of the appointments are for writing help, 15% are for oral presentation assistance and 25% are for digital media services. Students come from all majors in engineering.

The estudio provides a variety of workshops and lectures on topics like Conversational English Skills, Computer Safety and How to Write Graduate School Application Essays. We also partner with Career Services to host career related events and activities. To promote a culture of strong communication skills the eStudio also organizes and promotes a large public lecture on the importance of communication skills by a noted Engineer each spring.

Faculty services include:

- Faculty can require your students to visit our tutors with a rubric or for general assistance for mandatory and/or graded appointments in the studio
- Faculty can get recommendations for integrating more diverse or advanced communication skills into your assignments or syllabus
- Faculty can request a customized workshop for your class or choose from on one of our many popular topics like
    - Technical Writing Basics

- Improving Oral Presentations
- Video Production Basics
- Student Professionalism
- Successful Group Meetings
- Avoiding Plagiarism

- Faculty can invite us in to teach or co-teach communication intensive assignments in your courses
- Faculty can get our feedback on your graded assignments and/or work with us to develop style rubrics for your courses
- Faculty can get ideas for team building activities or invite us in to lead a team building workshop

Student services include:

- Students can get encouragement and editing assistance on any writing project, but especially scientific and technical writing, from trained Engineering Tutors
- Students can rehearse oral presentations solo or in groups in private practice rooms and get feedback from trained tutors
- Students can get technical and aesthetic help with
  - PowerPoint
  - Prezi
  - iMovie
  - Moviemaker
  - Adobe Creative Suite

- Students can record audio in our professional sound booth with studio quality recording equipment
- Students can check out HD digital video cameras and tripods
- Students can brainstorm with eDrawing and wall size white boards in our private group project room
- Students can get technical and aesthetic help with flyers, posters, and brochures
- Students can get feedback on scholarship and graduate school applications and essays
- Non-native student speakers can get specialized grammar and sentence level editing assistance from tutors trained and eager to work with international students

C. Guidance

Students are instructed on the use and care of facilities in the appropriate classes. For example, in BAE 102 they are instructed on the use of our BAE computer lab (access, hours, behavior in the lab), and they have a scavenger hunt to familiarize the students with the building. Classes which include a laboratory component begin their laboratory teaching with safety instructions, and safety is reinforced throughout the semester. Signage is posted on the door for each

laboratory space with appropriate contact information and instructions in the event an emergency occurs within that space.

Our building has a Building Emergency Management Plan document, so in the event of severe weather or other threat to the security of the students, the faculty have a procedure to follow to ensure the students' safety. In addition, the University has an early alert system which sends a text message, email and/or telephone calls to cell phones.

D. Maintenance and Upgrading of Facilities

Our building's exterior and major mechanical systems are maintained and upgraded by the University. For example, we are scheduled to have our building chiller replaced in Fall 2016. The building's interior and laboratory/teaching equipment maintenance are the responsibility of the Department. The Department has an overhead budget of approximately $130,000 per year, and approximately 25% of this money is allocated to the maintenance and upgrading of the facility, including equipment. In addition, when the Department has salary release money returned from grants, we use this money to maintain and upgrade laboratory and teaching equipment. Every three years, we replace all of the computers in the student computer lab and transfer the displaced computer lab computers to laboratory equipment needing computer updates.

In Fall 2016, the College of Engineering Dean provided a total of $100,000 to support undergraduate laboratory renovations. The departments submitted proposals describing how they would use the money and agreed to provide a 1:1 match. The Dean plans to provide this support each year. The Biosystems Engineering program received approximately $8,000 of this money, which was matched by the department and used to buy teaching equipment in support of BAE.

E. Library Services

(http://libraries.uky.edu/CampusLibraries#libscroller)

UK Libraries consists of 12 major facilities: William T. Young Library, Agricultural Information Center, Hunter M. Adams College of Design Library, Education Library, Shaver Engineering Library, John A. Morris Equine Library, Lucille Caudill Little Fine Arts Library, Medical Center Library, Science Library, Special Collections, and the Kentucky Transportation Center Library. UK Libraries collections support teaching, learning, and research in agricultural sciences, life sciences, chemistry, geological sciences, mathematics, physics, humanities, history, social sciences, economics, communications, information studies, business, fine arts, medicine, nursing, dentistry, health sciences, engineering, computer science, and veterinary science (specializing in equine). Engineering students have access to all of these libraries and their services. All of the libraries are within a short walking distance from the Engineering Complex. These libraries not only provide library services with full-time staff but also provide a number of study areas for students.

The Shaver Engineering Library is currently located on the 3rd floor of the F. Paul Anderson Building but will be merging with the Science Library to make room for our new Center for Student Success. It houses a collection of more than 120,000 volumes and supports journal subscriptions as well as course reserves for all engineering disciplines. The facility for the

Science and Engineering Library is located within a few hundred feet from the Engineering Complex.

UK Libraries also uses EZproxy which allows access to restricted electronic information purchased or licensed by the University of Kentucky Libraries for current UK students, staff and faculty while they are off campus. A UK EZproxy prefix is added to URLs to licensed electronic resources on the Libraries' web services, which will prompt for authentication when clicked. All current UK personnel need do, is enter their link blue ID and password to gain access. A cookie is then set in the user's browser which ensures continued access to ALL library licensed resources while their browser session is active or times out after a period of non-use.

F. Overall Comments on Facilities

Facilities for the Biosystems Engineering students are well-maintained overall. We have a staff member in the department who is our "facilities manager", and he works with our building operator and the Physical Plant Department (PPD) to ensure all systems are operating as they should. The department is responsible for the costs of maintaining some of the equipment, and the University is responsible for the remainder, based primarily on historical practice.

The department is responsible for the maintenance of tools and equipment used in the program. Instructors maintain the lab equipment used in their classes, and ask the Chair for funds when items need to be replaced or repaired. A portion of our department budget goes towards equipment/tools repair and replacement. We also look for federal excess property items, which come available to offset equipment costs, as well as acquiring used equipment when feasible.

Safety is a prime concern in the department. We have monthly manager's meetings, and staff have the opportunity to assist the Chair in planning for equipment replacement and upkeep. Our computer lab is on a 3-year replacement plan, which we have been able to maintain. This summer (2016) will be the second time the lab computers have been replaced since 2011.

The College of Engineering has created a teaching equipment fund to assist with purchasing teaching equipment. For example, in FY 2016 the COE contributed over $8,000 and the department matched that money to purchase some control systems for our senior machine systems controls class.

Our department participates in yearly safety inspections, and every student working in a lab must undergo yearly mandatory lab safety training. Completion of the training is monitored by our research lab manager.

CRITERION 8. INSTITUTIONAL SUPPORT

A. Leadership

The University of Kentucky is structured with a Provost form of academic administration. The Board of Trustees has overall authority for university direction. The University President, Dr. Eli Capilouto, and his vice presidents report to the board. There are two divisions of the university that are overseen by the UK President: the Medical Center, and the Lexington Campus. The Medical Center contains the allied health professional programs (medical, dental, pharmacy, and nursing) and the health care clinics. The Lexington Campus contains all the non-medical degree granting educational programs. The colleges on the Lexington Campus report to the provost, Dr. Tim Tracy, who is the chief academic officer. The Dean of Engineering, Dr. John Walz, reports to the provost.

The Biosystems and Agricultural Engineering Department is unique at the University of Kentucky in that our academic program is administered through the College of Engineering, and our faculty are assigned to the College of Agriculture, Food, and Environment (CAFE). We are not unique among the profession, however, as the vast majority of our sister departments are also structured in this manner. The BAE faculty members who teach have courtesy appointments in the College of Engineering so that they can participate fully in the decisions made regarding undergraduate engineering education. The BAE director of undergraduate studies (DUS) is appointed through the College of Engineering and attends all DUS meetings in the College of Engineering.

For the purpose of administration of BAE's undergraduate program, the BAE Department Chair reports to the Dean of the College of Engineering, Dr. John Walz, and attends the Dean's meetings (and faculty meetings) in the College of Engineering (For all other administrative duties the BAE Department Chair reports to the Dean of CAFE, Dr. Nancy Cox.). Dean Walz has assigned routine responsibility regarding undergraduates to two Associate Deans, though Dean Walz is directly engaged in budget, personnel, and other matters appropriately managed at the College level. Dr. Kamyar Mahboub, Associate Dean for Outreach and External Partnerships, is charged with oversight of transfer agreements and initiatives involving external domestic and international partners. Dr. Kimberly Anderson, Associate Dean for Academics and Administration, is responsible for oversight for student affairs and the academic programs. Both Associate Deans work with the Department Chairs and Directors of Undergraduate Studies of each program to ensure the quality and continuity of the program. The departments have control over the curricula. Changes in curricula are reviewed and approved by the department faculty, the College of Engineering Undergraduate Committee (i.e. Directors of Undergraduate Studies), the College of Engineering Faculty, followed by the University Undergraduate Council, Senate Council and Senate. BAE curriculum and course changes are approved through the College of Engineering and do not go through CAFE for approval.

B. Program Budget and 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.

The annual budget for the department is developed through CAFE. The teaching budget for FY 2016 was $509,323, which is approximately 10% lower than it was for the previous accreditation visit. The teaching budget essentially pays for the proportion of faculty salaries assigned to resident instruction. Tuition at UK returns to the central administration, and does not return to the Colleges except through faculty salaries. Therefore the BAE teaching budget is funneled through the CAFÉ because that is where the research portion of the faculty salaries originate, which makes up the largest percentage of most teaching faculty members' salaries. Actual expenditures for teaching-related activities (e.g. copier use, telephones) other than salaries are difficult to determine because the department's overhead expenditures are all from one account, whether the expense was related to teaching, research, or extension.

The department does not have an explicit plan for regular replacement of obsolete equipment, partially because our budget model makes it difficult to carry forward budgeted state funds past the fiscal year, so we do not have the flexibility to pre-fund equipment replacement. We do have a commitment to upgrade our undergraduate computer lab every three years, which requires some flexibility and creativity on the part of the faculty to secure these funds. An in-house computer laboratory is seen as a strong benefit for our student programs, and we have been able to maintain high quality computer systems since creation of the laboratory in 1990. The UK College of Agriculture, Food, and Environment supports a full-time computer system administrator in the department which is vital to our program. In addition, the Department Chair asks the faculty each year for a list of their teaching equipment needs. These are prioritized based on the benefit provided from that item back to the department, and any end-of-year funds are used to purchase new equipment. Equipment maintenance is handled out of the money budgeted for overhead and teaching, depending on the item.

Institutional support is adequate for maintenance of our undergraduate program. Table 12 indicates expenditures related to various types of support for the undergraduate program.

Table 13. (ABET Table 8.1) Support expenditures.

Fiscal Year (July 1- June 30)	2014	2015	2016	2017
	(prior to previous year)	(previous year)	(current year)	(year of visit)*
Expenditure Category				
Operations (not including staff)	83,542	86,458	89,856	
Travel	28,000	32,500	40,000	
Equipment				
Institutional Funds	42,000	32,395	16,895	
Grants and Gifts related to Instruction	12,500	8,300	5,400	
Graduate Teaching Assistants	[3 "TA"s + 3 graders]	[3 "TA"s + 3 graders]	[3 "TA"s + 3 graders]	[3 graders]
Part-Time Assistance (teaching BAE)	0	5,400	5,400	5,400

*Common first-year reduces need for TAs

C. Staffing

Faculty are on twelve-month appointments in the College of Agriculture, Food and the Environment (CAFE). The faculty in the College of Engineering are on nine-month appointments; however, the different appointment structure does not present any problems in the administration of the undergraduate program. Students are formally enrolled in the College of Engineering, and also have access to CAFE services, faculty and staff. Students compete for scholarships in both Colleges. 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.

D. Faculty Hiring and Retention

Faculty recruiting is led by the departments.. To date, departments in CAFE have been allowed to retain their faculty positions if someone retires or leave the University. The department chair requests permission from the Dean of CAFE to refill the position. One requirement is that the research area of each approved search be able to show the probability of a positive Return on Investment (ROI). Once permission has been granted to refill a position, the Department Chair takes responsibility for assembling and charging a search committee. If a prospective faculty member will have a teaching appointment, the Dean of Engineering meets with the candidate, in addition to the Dean of CAFE and provides comments to the Department Chair as to the suitability of the candidate. The Dean of CAFE has the ultimate hiring authority.

Retaining outstanding faculty is a major priority for the University, and each Department Chair is encouraged to be pro-active in this area. In addition, the Provost's office provides each College with a retention fund that can be used at the Dean's discretion if a faculty member is being actively recruited by another university.

Retention of Faculty at the University Level:

The Provost Office offers a New Faculty Development (NFD) series. The purpose of the New Faculty Development series is to introduce newly hired faculty members to UK's missions of teaching, research, and engagement, and to facilitate their successful involvement in those missions. The NFD provides an opportunity for new members of our faculty to familiarize themselves with UK's academic environment. Participants will meet at the New Faculty Orientation scheduled the week prior to the opening of the fall semester, and then at various times during the academic year. The development series offers conversational forums where new faculty members can discuss issues ranging from class management and research development, to promotion and tenure.

E. 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 members. A goal of the department is to subsidize this travel to the extent possible. For the previous four years, the department has been able to send everyone to ASABE who was presenting a paper.

Approximately $1,500 per eligible faculty and $880 per eligible graduate student was spent for the ASABE meeting in 2015. 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, Food, and Environment's program for refund of some grant indirect costs.

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, which 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.

Our faculty are all well qualified to teach courses in biosystems engineering, with all having their PhDs in the discipline. In addition, over 70% are registered professional engineers, and all of the faculty teaching design courses are registered engineers. These qualifications were discussed in detail in Criterion 6.

Appendix A – Course Syllabi

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

Credits and contact hours: 1 credit, 1 contact hour

Instructor: Dr. Alicia Modenbach (Fall 2015)

Textbook: None.

Course (Catalog) Description: An introduction to biosystems engineering, emphasizing the influence of biology in engineering design; including the design of sustainable food, energy and fiber production and processing systems. Professionalism and the engineering approach will be emphasized.

Prerequisites: None.

Required course.

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

- Define and discuss engineering in general and biosystems engineering in particular and compare biosystems engineering to the other engineering disciplines.
- Have a better appreciation of yourself and your learning process, including why you are interested in this major, or why another major might be a better choice for you.
- Understand in some depth the area of biosystems engineering in which you want to study.
- Understand the process of engineering design, including the following: what is engineering design, how does one approach a problem using the engineering method, impact of social and technical factors on design, evaluation methods in design, and effective communication in the design process.
- Understand the significance of effective oral and written communication, and how it affects your strength as an engineering student.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 102			1	3	2		3				

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Student Organizations
- Resumes
- Teamwork
- Working the career fair
- Professionalism
- Curriculum/advising
- Reverse engineering
- Engineering design process
- Design report expectations
- Modes of communication

BAE 103: Energy in Biological Systems
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 2 credits, 2 contact hours

Instructor: Dr. Carmen Agouridis (Spring 2016)

Textbooks (suggested):

- *Physics for Scientists and Engineers*, vol 1, 5th edition by R.A. Serway and R.J. Beichner Thomson Learning, Inc.
- *Thermodynamics, an Engineering Approach*, 4th edition by Y.A. Cengel and M.A. Boles McGraw-Hill, New York

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.

Prerequisites: BAE 102, MA 113 (concurrent) or consent of instructor.

Required course.

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

- Apply the engineering problem solving approach to perform energy balances on biological systems.
- Apply the fundamental laws of thermodynamics to solving problems relating to energy transfer and transformations within biological systems.
- Use the psychrometric chart to solve problems relating to air-water vapor mixtures.
- Use direct and indirect bomb calorimetry to estimate the energy content of biological materials.
- Estimate the power and energy requirements for controlling plant and animal environments.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 103	3				3						2

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Unit and dimensional analysis
- Problem solving & defining systems (e.g., biological, mechanical)
- Laws of thermodynamics
- Work, energy, power
- Conservation of energy
- Conversion efficiency (Carnot cycle)
- State change
- Fluid flow in biosystems
- Psychrometrics
- Elementary heat transfer in biosystems
- Heating (energy sources and conversion, thermal resistance)
- Calorimetry

BAE 201: Economic Analysis of Biosystems
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 2 credits, 2 contact hours

Instructor: Dr. Michael Montross (Fall 2015)

Textbook: Park, C.S. 2007. *Contemporary Engineering Economics*. 4th ed. Prentice Hall. Upper Saddle River, New Jersey. ISBN 0-13-187628-7

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 biosystems design analysis in the evaluation of alternatives. Retirement/replacement policies and risk analysis.

Prerequisite: MA 113, BAE 103 or consent of instructor.

Required Course.

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

- 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.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 201	3		2		3	2	2	2	2	2	2

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Nominal and effective interest rates
- Present worth analysis
- Annual equivalent analysis
- Rate of return
- Depreciation and taxes

BAE 202: Probability and Statistics for Biosystems
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Dr. Czarena Crofcheck (Spring 2016)

Textbook: Miller & Freund's Probability and Statistics for Engineers, Richard Johnson, Prentice-Hall, Inc. NY, NY 7th Edition, 2004.

Course (Catalog) Description: Introduction to statistics and statistical inference reasoning. Evaluation of common claims based on statistical constructs, hypothesis tests, margins of error, confidence intervals, and analysis of variation. Identification of possible statistical obstacles, such as confounding, missing data, and inappropriate randomness. Conceptual statistics will be emphasized. Special attention will be given to include biosystems engineering problems.

Prerequisites: MA 113 and sophomore standing.

Required course.

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

- Understand statistics and statistical inferences,
- Understanding of sampling variability and quantifying risk.
- Draw sound conclusions based on null hypothesis testing,
- Evaluate common claims that arise from statistical constructs, and
- Independently identify and use appropriate information resources from a variety of sources.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 202	2	3					1		2		2

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Descriptive statistics
- Histograms
- Probability
- Combinations
- Permutations
- Probability distributions
- Hypothesis testing
- Linear regression
- ANOVA
- Experimental design

BAE 305: DC Circuits and Microelectronics
Biosystems and Agricultural engineering
University of Kentucky

Credits and contact hours: 3 credits, 4 contact hours

Instructor: Dr. Joseph Dvorak (Spring 2015)

Textbook: Alciatore, D.G. and M. B. Histand. 2007. Introduction to Mechatronics and Measurement Systems, 3ed. McGraw Hill, New York, NY.

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.

Prerequisites: EE 305; prereq or concur: CS 221 or equivalent.

Required course.

Outcomes of Instruction: At the completion of the course, the student 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.
- Program and use microcontrollers

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 305	2	3	3	1	3		1		1		2

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Electrical components
- Circuit analysis/measurement
- Op amps
- Signal conditioning
- Transistors, relays, switches
- Electromagnetic interference
- Filters
- Numbering systems/digital logic
- A/D conversion

BAE 400: Senior Seminar
Biosystems and Agricultural engineering
University of Kentucky

Credits and contact hours: 1 credits, 1.5 contact hours

Instructor: Dr. Michael Sama (Fall 2015)

Textbook: None

Course (Catalog) Description: A course for senior students in biosystems engineering with emphasis on oral communications skills. Students will do literature searches on topics related to the biosystems engineering profession and present oral and written reports.

Prerequisites: Prereq or concur with BAE 402

Required course.

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

- Prepare a resume
- Conduct a literature search
- Propose a project
- Effectively communicate in oral and written formats

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 400	1	2			2	3	3	3	3	2	1

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Job searches
- Engineering licensure
- Literature searches
- Project proposals
- EndNote
- PowerPoint

BAE 402: Biosystems Engineering Design I
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 2 credits, 3 contact hours

Instructor: Dr. Czarena Crofcheck (Fall 2015)

Textbook: Class notes.

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.

Prerequisites: BIO 150, 152; prereq or concur with BAE 417 or BAE 447.

Required course.

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

- Define and distinguish different approaches to creativity and creative inquiry.
- Begin to exercise creativity and engineering judgment in the design of complete systems.
- Work individually and as a team member in developing project specifications and planning.
- Develop the ability to integrate varied subject knowledge in engineering and apply it to conceptualization and design of systems.
- Understand the basic principles of engineering economics in product design and manufacturing.
- Understand the basic concepts of safety and reliability in the design process.
- Develop and evaluate design concepts in a team environment, with an emphasis on creativity in the design process.
- Consider aspects of environment, safety, quality, cost and contemporary issues in design.
- Articulate the principles of teamwork in achieving creative and workable designs.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 402	1	1	3	3	3		3	1	2		3

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Engineering Design
- The Design Process
- Teamwork
- Modeling and Prototyping
- Economics
- Statistical Analysis
- Defining the Problem
- Objectives & Constraints
- Design Alternatives
- Specifications & Drawings
- Oral and Written Communication

BAE 403: Biosystems Engineering Design II
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 1 credit, 1.5 contact hours

Instructor: Dr. Czarena Crofcheck (Fall 2015)

Textbook: Class notes.

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.

Prerequisites: BAE 402.

Required course.

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

- Define and distinguish different approaches to creativity and creative inquiry.
- Begin to exercise creativity and engineering judgment in the design of complete systems.
- Work individually and as a team member in developing project specifications and planning.
- Develop the ability to integrate varied subject knowledge in engineering and apply it to conceptualization and design of systems.
- Understand the basic principles of engineering economics in product design and manufacturing.
- Understand the basic concepts of safety and reliability in the design process.
- Develop and evaluate design concepts in a team environment, with an emphasis on creativity in the design process.
- Consider aspects of environment, safety, quality, cost and contemporary issues in design.
- Articulate the principles of teamwork in achieving creative and workable designs.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 403	1	2	3	3	3	3	3	1	2	2	3

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Engineering Design
- The Design Process
- Teamwork
- Modeling and Prototyping
- Economics
- Statistical Analysis
- Environmental and Social Factors
- Ethics, Health & Safety
- Multidisciplinary Issues
- Oral and Written Communication

BAE 417: Design of Machine Systems
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours per week; Laboratory: 2 hours biweekly, six laboratories scheduled

Instructor: Dr. Timothy Stombaugh (Fall 2015)

Textbook: Engineering Principles of Agricultural Machines, 2nd edition by A.K. Srivistava, C.E. Goering, R.P. Rohrbach, D.R. Buckmaster ASABE, St. Joseph, MI.

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.

Prerequisites: ME 330 or CE 341, EM 302; prereq or concur: EM 313.

Required course.

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

- Identify foundational machines used in food and fiber production.
- Identify functional process performed by agricultural machinery
- Quantify the performance of internal combustion engines
- Design basic power transmission systems
- Design basic agricultural machines.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 417	3	2	2	1	3	2	2	2	2	2	3

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Engine power
- Mechanical power transmission
- Fluid power
- Precision Agriculture
- Hitching, Traction, Testing
- Crop planting and chemical application
- Biomass harvesting
- Grain harvesting
- Conveying of agricultural materials
- Machinery selection
- Human factors in machinery design

BAE 427: Structures and Environment Engineering
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Dr. Christian Tabor

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

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.

Prerequisites: CE 341 or ME 330; BIO 148 and 152; prereq or concur: EM 313.

Required course.

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

- 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.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 427	2		3		3		1				

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Psychrometric chart
- Steady state energy and mass balances
- Ventilation rates
- Concrete floors and footings
- Post design
- Load analysis
- Fasteners

BAE 435G: Waste Management for Biosystems
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Joseph L. Taraba, Extension Professor of Biosystems and Agricultural Engineering.

Textbook: Natural Resources Conservation Service, USDA. Agricultural Waste Management Field Handbook, Publ. No. 210, Part 651. (http://www.nal.usda.gov/wqic/manure.html). Copies of relevant research publications will be handed out on various topics.

Course Description: A study of the characteristics; treatments and utilization principles; and analysis and design of systems for managing waste from the production and processing of food and fiber.

Prerequisites: MA 214 and BIO 108.

Elective course.

Outcomes of Instruction: At the completion of the course, the student should be able to:
- To have a background in ecology, environmental law, microbial kinetics and waste characteristics as applied to specific waste management system that maximizes returns while maintaining environmental quality.
- The student will have the ability to design a waste management system for an animal production farm upon completion of the course.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 435G	3	1	3	2	1	3	2	3	3	3	1

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:
- Environmental Pollution and Agriculture
- Pollution Law - State and Federal
- Carbon Balance of a Farm
- Water Quality Standards
- Overview of Microbiology - Handouts
- Enzyme Kinetics and Microbial Kinetics
- Waste Management
- Animal Waste Characteristics
- Role of Soils & Plants
- Geology and Groundwater
- Waste Collection Systems
- Farm Composting System
- Storage Systems
- Solids Liquid Separation
- Land Application and Non-Point Source Pollution
- EPIC and OPUS Models (and others)
- Composting
- Economics of Waste Management

BAE 437: Land and Water Resources Engineering
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Dr. Dwayne Edwards

Text: Soil and Water Conservation Engineering, Seventh Edition. Huffman, R.L., D.D. Fangmeier, W.J. Elliot and S.R. Workman. 2013. American Society of Agricultural Engineers. ISBN-10: 1892769867

Course (Catalog) Description: Introductory course in hydrology, erosion and water quality. Topics include characterization and probabilistic analysis of rainfall and floods, runoff and flood estimation, erosion estimation, water use assessment, basic design and analysis of hydrologic structures as well as both non-erodible and erodible channels.

Prerequisites: CE 341 or ME 330.

Required course.

Outcomes of Instruction: At the completion of the course, the student should be able to:
- 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 or design hydrologic structures or structural components to control excess water.
- Developed an understanding of the methods to alleviate excess and deficit soil water conditions.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 437	3	2	2	1	3	1	1	1	1	2	1

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:
- Introduction and Water Quality
- Precipitation
- Evapotranspiration
- Runoff
- Open Channel Hydraulics
- Soil Erosion
- Vegetated Waterways
- Water and Sediment Control Structures
- Channel Stabilization and Restoration
- Water Supply
- Drainage Principles and Surface Drainage
- Water Table Management

BAE 447: Bioprocess Engineering Fundamentals
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Dr. Michael Montross (Fall 2015)

Text: Henderson, S.M., R.L. Perry, and J.H. Young. 1997. Principles of Process Engineering. ASAE Press. ISBN 0-929355-85-7

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.

Prerequisite: ME 325 and engineering standing.

Required course.

Outcomes of Instruction: 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.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 447	3		3	1	3	2	2	1	1	2	3

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

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

BAE 502: Modeling of Biological Systems
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Dr. Michael Montross (Spring 2016)

Textbook: None.

Course (Catalog) Description: The course will focus on the mathematical description and computer simulation of the complex interactions involved in biological systems. Computer simulation will be used as a tool to analyze and suggest design changes to optimize performance.

Prerequisites: BAE 402

Elective course.

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

- Evaluate mathematical equations describing a biological system.
- Analyze the procedure for developing a computer simulation model.
- Create computer simulation models for biological systems.
- Examine existing computer simulation models of biological systems and modify them to evaluate alternative scenarios.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 502	3	1	3		3			1	1	2	3

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Introduction to MATLAB, debugger, modeling basics, roots of equations
- Programming psychrometric chart
- Optimization
- ODE and systems of ODEs
- Modeling of biological processes, specifically the compost model

BAE 504: Biofuels Production and Properties
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 2.5 contact hours

Instructor: Dr. Jian Shi (Fall 2015)

Textbook: Robert C. Brown and Tristan R. Brown. 2012. "Why are we producing biofuels? Shifting to the ultimate source of energy." Brownia Publishing.

Course (Catalog) Description: This course introduces students to the science and engineering of liquid biofuels for transportation. Topics include: physical and chemical properties; engine performance; processing technologies; and environmental impact of biofuels.

Prerequisites: BAE 503 or consent of instructor

Elective course.

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

- Describe the production of biofuels via biochemical or thermochemical conversion
- Explain the fuel properties and standards associated with each biofuel
- Solve related engineering problems in biofuels production
- Describe the complications and challenges associated with current biofuels technologies
- Describe current policies and incentive considerations in the context of first and second generation biofuels
- Identify the major players in the biofuels industry and be able to analyze their underlying base technology.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 504	2	1	2	3	3	1	2	1			1

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Petroleum chemistry
- Engine and combustion
- Alcohols and carbohydrates
- Alternative energy sources, types of biofuels, and production platforms
- Enzyme kinetics & microbiology
- Cellulosic biomass logistics
- Bio-butanol
- Corn ethanol
- Anaerobic digestion
- Biodiesel
- Gasification & pyrolysis
- Syngas fermentation & biomass liquefaction
- Microbial fuel cells
- Environmental and economic impacts of biofuels

BAE 515: Fluid Power Systems
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Dr. Joseph Dvorak (Fall 2015)

Textbook: Esposito, Anthony. 2009. Fluid power with applications—7th Edition, Pearson Prentice Hall. Upper Saddle River, New Jersey.

Course Description: Analysis and design of fluid power systems used in agricultural, industrial and processing equipment. Selected topics to include: positive displacement components, control devices, actuators, fluid transmission and system dynamics.

Prerequisites: ME 330, ME 340 and engineering standing

Elective course.

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

- Identify the basic fluid power components used in agricultural, industrial and processing equipment.
- Analyze and classify different fluid power systems according to operating characteristics.
- Design fluid power systems using basic components.
- Determine efficiency of fluid power systems

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 515	2	2	3		3		2		2		2

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Properties of Hydraulic Fluids
- Energy and Power in Hydraulic Systems
- Frictional Losses
- Hydraulic Pumps
- Hydraulic Cylinders and Cushioning
- Hydraulic Motors
- Hydraulic Circuit Design and Analysis
- Hydraulic Conductors and Fittings
- Maintenance of Hydraulic Systems
- Basics of Pneumatics
- Basic Electrical, PLC and Relay Control
- Servo and Advanced Computer Control

BAE 532: Introduction to Stream Restoration
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Dr. Carmen Agouridis (Spring 2016)

Textbook:
- United States Department of Agriculture Natural Resource Conservation Service (USDA-NRCS). 2008. National Engineering Handbook - Part 654 Stream Restoration Design. The text is available online at http://policy.nrcs.usda.gov/viewerFS.aspx?id=3491.

Course (Catalog) Description: Introduction to principles of fluvial geomorphology for application in restoring impaired streams. Topics include channel formation processes (hydrology/hydraulics), stream assessment, sediment transport, in-stream structures, erosion control, habitat, and monitoring. (Same as CE 542.)

Prerequisites: CE 341 (or equivalent) and engineering standing or consent of instructor.

Elective course.

Outcomes of Instruction: At the completion of the course, the student should be able to:
- Understand stream processes (hydrology/hydraulics) related to channel formation.
- Identify bankfull in the field, measure and compute bankfull dimensions, and apply the Rosgen method of stream classification.
- Assess the current hydraulic state of a stream, determine its stream evolutionary stage, and evaluate the level of restoration required.
- Understand and employ strategies for developing a multi-disciplinary team for stream restoration planning.
- Develop a conceptual restoration plan with the goal of restoring the stream's hydraulic and habitat functions.
- Design a monitoring program to evaluate the success of a restoration project.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 532	2		3	2	3		2	1			2

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:
- Channel formation processes (hydraulics/hydrology)
- Aquatic macroinvertebrates
- Stream assessment and survey procedures
- Stream classification systems
- Channel evolution

- Reference reaches
- Regional curve development
- Sediment transport
- In-stream structures
- Restoration options for incised channels
- Vegetation stabilization and riparian buffer development
- Natural channel design methodology
- Construction and project management techniques
- Evaluation and monitoring techniques
- Permitting

BAE 536: Fluvial Hydraulics
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Dr. Dwayne Edwards

Textbook: Haan, C.T., B.J. Barfield and J.C. Hayes. 1994. Design hydrology and sedimentology for small catchments. Academic Press.

Course (Catalog) Description: Rainfall physics, principles of erosion on upland areas and construction sites, stable channel design in alluvial material, mechanics of sediment transport, river mechanics, reservoir sedimentation.(Same as CE 546.)

Prerequisites: CE 341 or ME 330 and engineering standing.

Elective course.

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

- Perform frequency analysis for hydrologic variables (flows, rainfall depths, etc.).
- Calculate runoff hydrographs and peak flows.
- Assess and design erodible and non-erodible channels.
- Assess performance of selected hydraulic structures (e.g., spillways and culverts).
- Perform channel and reservoir routing.
- Estimate erosion and sediment yield.
- Analyze and design sediment/flood control systems.
- Evaluate performance of sediment control structures and practices.
- Characterize and design stable fluvial channels.
- Understand basic monitoring principles.
- Understand basic modeling principles.
- Develop a pollution prevention plan.
- Be able to correctly operate selected hydrologic/hydraulic modeling software packages.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 536	3	2	3	3	3	1	2	1	1	2	3

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Statistical Concepts
- Precipitation/Runoff Relationships
- Open Channel Hydraulics
- Hydraulics of Structures
- Channel Routing and Reservoir Hydraulics
- Sedimentation principles
- Erosion and Sediment Yield
- Flood detention basins

BAE 549: Bioprocess Engineering
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Drs. Czarena Crofcheck and Akinbode Adedeji (Fall 2015)

Textbooks:

- Bioprocess Engineering, 1992 Michael L. Shuler and Fikret Kargi, Prentice Hall, Englewood Cliffs, NJ 07632;
- R. P. Singh and Heldman, D. R. 2004. Introduction to Food Engineering, Fifth Edition, Hardbound, 864 pages.

Course (Catalog) Description: An analysis of processing operations for the conversion or generation of biological materials. The course material applies thermodynamics, heat transfer, mass and energy balances, and reaction kinetics to biological process operations such as sterilization, fermentation, product recovery, freezing, drying, evaporation, and refrigeration. Applications include biomedical, food processing, and biochemical and biofuel production from biomass.

Prerequisites: BAE 447 or consent of instructor

Elective course.

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

- Determine the effect of a thermal process on the generation or decay of constituents using thermal reaction rate kinetics.
- Perform energy balances around fermentation, food, and biological process operations.
- Apply heat and mass transfer principles to fermentation operations.
- Calculate: heat removal rates for fermentation processes, microbial sterilization times, freezing times, COP for refrigeration processes.
- Be able to conduct basic mass and energy balances around evaporators, food freezers and refrigeration systems.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	G	h	i	j	k
BAE 549	3				3						

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Food and Biochemistry Review
- Microbiological Basics
- Thermodynamics Review
- Enzyme Kinetics
- Microbial Kinetics
- Stoichiometry
- Refrigeration & Freezing
- Evaporation
- Reactor Mass and Energy Balances

BAE 580: Heating, Ventilating and Air Conditioning
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Dr. Donald G. Colliver

Textbook: McQuiston, Faye, Jerald Parker and Jeffrey Spitler. 2005. Heating, Ventilating and Air Conditioning Analysis and Design. 6th ed. John Wiley & Sons.

Course Description: A course emphasizing the use of thermodynamics, fluid mechanics, and heat transfer principles in thermal environmental design. Building energy requirements will be computed and thermal comfort criteria will be studied. (Same as ME 580.)

Prerequisites: BAE 427 or ME 321 (Thermo II) or consent of instructor.

Elective course.

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

- Understand basic HVAC terminology, systems and design processes.
- Compute basic heating and cooling loads and component energy consumption using fundamental heat and mass balances on buildings and system components.
- Utilize engineering industry standard methodologies for calculating building heating/cooling loads, and ventilation and building energy design requirements
- Write a concise summary of a specific area of HVAC systems and present the findings to peers.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 580	3		3		3	2	1	2	1	3	3

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Psychrometrics and Psychrometric Properties, Moist air processes
- Indoor Design Conditions – Thermal Comfort
- IAQ / Ventilation
- Heat Transfer for Buildings - Building Materials, Heat Transmission, Outdoor Design Conditions
- Solar Radiation and Windows
- Load Estimating, Heating Load
- Solar System Design/Alternative Energy
- Transient Conduction Modeling / Conduction Transfer Functions
- Cooling Principles / Opaque Surfaces / Residential Cooling Loads
- Energy Estimating Methods, Building Energy Estimating, eQUEST
- Hour-by-Hour simulations DOE2/EnergyPlus) Energy Design Standard 90.1
- Pumps / Piping
- Ducts / Fans

BAE 599: Topics in Biosystems Engineering: Industrial Energy Assessment
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Dr. Donald Colliver, Dr. Larry Holloway, Dr Dusan Sekulic, Dr Tom Henninger

Textbook: None

Course (Catalog) Description: This course considers energy use in industrial settings, including energy flows and energy transformations. Students will learn methodologies for assessing, analyzing, and reducing energy use in industries. This course is associated with the University of Kentucky's Industrial Assessment Center (IAC) supported by the US Department of Energy. The content presented in this course is intended to be consistent with the IAC program methods. (Same as EGR 599, ME 599, MFS 599)

Prerequisites: Engineering Junior standing

Elective course.

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

- Evaluate energy bills for potential cost savings due to changes in tariff structures and penalty reductions such as power factor correction
- Analyze the energy flows in a number of industrial processes
- Interpret data from equipment commonly use in energy auditing
- Evaluate the energy savings potentials due to changing processes and equipment
- Estimate economics of energy savings recommendations
- Write concise report of analysis of energy flows and recommendations for changes

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 599	3	2	3	3	2	1	3	2	2	1	3

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Energy Basic Concepts / Systems / Properties / Available Energy
- Electricity Basics / Motors and Drives
- Applied Fluids / Thermodynamics / Psychrometrics/ AC Processes
- Energy Procurement / Bill Analysis / PF Correction / Inverse Modeling
- Lighting
- Pumps and Hydronic Systems
- Compressed Air Systems
- Boilers and Fired Systems / Process Heating / Steam and Condensate
- Heat Containment, Waste heat recovery, Heat exchangers
- Process Cooling / Space Conditioning

BAE 599: Topics in Biosystems Engineering:
Solar Cell Devices and Systems for Electrical Generation
Biosystems and Agricultural Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Dr Donald Colliver, Dr Vijay Singh

Textbook: Roger Messenger and Jerry Ventre, *Photovoltaic Systems Engineering, 3rd Ed.*, (CRC Press Taylor & Francis Group, 2010)

Course (Catalog) Description: Physics of photovoltaic (PV) devices, emerging technologies, design of PV cells and systems, electronic components for signal conditioning, integration, installation, performance evaluation and economic issues related to PV systems. (Same as EE 599)

Prerequisites: Engineering Standing and EE 211 or EE 305, or consent of instructor

Elective course.

Outcomes of Instruction: At the completion of the course, the student should be able to:
- Explain the device physics underlying the operation of photovoltaic (PV) devices.
- Design and model a photovoltaic cell.
- Describe the operation of electronic components used in the maximization of PV system output.
- Describe and analyze the integration, installation, performance evaluation and economic issues related to PV systems
- Design and model a practical photovoltaic system.
- Explain basic measurement techniques for device characterization and module performance evaluation of photovoltaic systems.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 599	2		3	2	3		1	2	1	1	3

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:
- Characteristics of Solar Radiation / What Impacts the Amount of Radiation Available at the Surface
- Calculation of Energy Received, Energy Production Estimation
- Design of Grid Connected System
- Solar System Modeling / Economics
- Mechanical Design (Racking/anchoring)
- Design of Grid Connected, Battery Backup System
- Electrons and Waves; Silicon Crystal; Holes; Effective Mass; Drift and Diffusion Currents

- Electron-Hole Recombination; Continuity Equation; p-n Junction in Equilibrium; Junction Capacitance;
- p-n Junction Diode in the Dark; p-n Junction Diode under Sunlight Illumination;
- Photocurrent, Quantum Efficiency; Energy Band Diagrams; Equivalent Circuit; Silicon Solar Cell
- Power Output; Maximum Power Point; Design Issues
- Cell Fabrication; From Cells to Modules; Automatic Series Connection
- Quantum Confinement; Nanotechnology and Photovoltaics
- Buck and Boost Converters, Maximum Power Point Trackers (MPPT), Batteries and Charge Controllers

BAE 599: Topics in Biosystems Engineering: Component Design
Biosystems and Agricultural engineering
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Dr. Michael Sama (Spring 2016)

Textbook: None

Course (Catalog) Description: A detailed investigation of a topic of current significance in biosystems engineering such as: design of small earth dams, vacuum dehydration systems, small particle mechanics, biofuels, environmental control in green houses, sprinkler irrigation, energy conversion in agriculture, bio-simulation. May be repeated to a maximum of six credits, but only three credits can be earned under the same title. A particular topic may be offered at most twice under the BAE 599 number.

Prerequisites: Variable; given when topic identified.

Elective course.

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

- Conduct basic load an stress analysis
- Understand how materials bend and fail
- Design, analyze, simulate, construct, and test common mechanical elements

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 599	3	2	3	1	3		2			2	3

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Absolute tolerances
- Statistical tolerances
- Equilibrium and free-body diagrams
- Shear-force and bending moments
- Deflection due to bending
- Stress and Mohr's Circle
- Torsion
- Static failure theories
- Gear design
- Gear Trains and force analysis
- Power transmission
- Computer numeric control
- Belts and roller chain
- Stepper and Servo Motors
- Sensors
- MATLAB
- Computer aided design

BAE 599: Topics in Biosystems Engineering: Control of Off-Road Vehicles
Biosystems and Agricultural engineering
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Dr. Michael Sama (Spring 2015)

Textbook: None

Course (Catalog) Description: A detailed investigation of a topic of current significance in biosystems engineering such as: design of small earth dams, vacuum dehydration systems, small particle mechanics, biofuels, environmental control in green houses, sprinkler irrigation, energy conversion in agriculture, bio-simulation. May be repeated to a maximum of six credits, but only three credits can be earned under the same title. A particular topic may be offered at most twice under the BAE 599 number.

Prerequisites: Variable; given when topic identified.

Elective course.

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

- Understand the fundamental principles of control systems theory
- Understand digital communication protocols commonly used in off-road vehicles
- Implement basic digital feedback control using a digital signal processor
- Design a simple off-road vehicle control and data acquisition system

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
BAE 599	3	2	3	1	3		2			2	3

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Differential equations of physical systems
- Laplace transforms
- Transfer functions
- Linear system models
- Block diagrams
- Root-locus and stability
- Transient response
- Steady-state error
- Lead control
- Lag control
- PID control
- Digital control
- Microcontrollers
- Microcontroller programming
- RS-232
- Controller Area Network
- Analog inputs
- Frequency inputs
- MATLAB

BIO 148: Introductory Biology I
Department of Biology
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Dr. Jennifer Osterhage (Spring 2016)

Textbook: Biological Science with MasteringBiology®, 5th edition, Freeman ©2013, Benjamin Cummings ISBN 10: 032174361X ISBN 13: 978-0321743619

Course (Catalog) Description: This course is designed to develop an understanding and appreciation of the cell membrane, metabolic processes, and the complex relationships between structure and function in animals and land plants at many different levels of organization: molecule, cell, tissue, organ, and organism.

Prerequisites:

Required course.

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

- Build an appreciation and understanding of the diversity of life on Earth.
- Build an appreciation and understanding of the fundamental principles (with emphasis on molecular, cellular, and evolutionary principles) which unify all life.
- Develop an understanding of the methods and processes of scientific inquiry.
- Gain preparation for advanced courses in evolution and genetics.
- Develop skills of critical thinking, reasoning, and problem---solving; appreciate scientific attitudes and values.

List of Topics Covered:

- Evolution
- Phylogenies
- DNA structure and replication
- Chromosomes Cell Cycle
- Mitosis
- Proteins
- Central Dogma
- Mutations
- Meiosis
- Genetics
- Natural Selection
- Evolutionary mechanisms
- Speciation
- Archaea and Bacteria
- Prokaryotes and Protists
- Green Algae and Plants
- Fungi and Animals

BIO 152: Introductory Biology II
Department of Biology
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Dr. Claire O'Quin (Spring 2016)

Textbook: Biological Science with MasteringBiology®, 5th edition, Freeman ©2013, Benjamin Cummings ISBN 10: 032174361X ISBN 13: 978-0321743619

Course (Catalog) Description: This course introduces students to the biological mechanisms operating at the molecular, cellular, and population level that contribute to the origin, maintenance, and evolution of biodiversity including the origins and history of the evolutionary process. Course material is presented within a phylogenetic context, emphasizing the shared history of all living organisms on earth through common ancestry.

Prerequisites: Successful completion of BIO 148 and CHE with grade C or higher.

Required course.

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

- Build an appreciation and understanding of the cell membrane and metabolic processes, such as glycolysis and photosynthesis.
- Demonstrate an understanding of the relationships between environmental conditions and adaptations of animals and land plants.
- Describe how diversity of animal and plant physiological systems allows different solutions to similar problems.

List of Topics Covered:

- Lipids and Phospholipid Bilayers
- Membrane Transport
- Osmosis and Diffusion
- Enzymes
- Cellular Respiration
- Glucose Oxidation
- Electron Transport Chain and Fermentation
- Photosynthesis
- Plant Form and Tissues
- Plant Growth
- Water Transport
- Sugar Transport
- Plant Nutrition
- Plant Responses
- Animal Physiology
- Homeostasis
- Osmoregulation
- Osmotic Systems
- Animal Nutrition
- Digestive Systems
- Digestive Homeostasis
- Respiration
- Respiratory Organs
- Blood Gasses and Circulatory Systems

BIO 208: Principles of Microbiology
Department of Biology
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Dr. Erin Richard (Spring 2016)

Textbook: Totora, Funke, Case, Microbiology: An Introduction 12th Edition with MasteringMicrobiology Publisher: Pearson. ISBN: 978---0321928924

Course (Catalog) Description: The course introduces fundamental microbiological principles and techniques. Emphasis is placed on structural, functional, ecological and evolutionary relationships among microorganisms, principally viruses, bacteria, fungi and algae.

Prerequisites: High school chemistry recommended.

Selected Elective course.

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

- Have an appreciation for the history of microbiology.
- Understand the structure and function of cells, both prokaryotic and eukaryotic, and their processes.
- Define microbial metabolism, oxidation, and reduction, and relate these reactions to energy loss or gain.
- Describe the structure and chemical composition of DNA with the ability to transcribe and translate it.
- Discuss the classification of bacteria into groups based on their chemical and physical requirements for growth (temperature, pH, osmotic pressure, oxygen, carbon source, etc).
- Describe the basic environmental and physiological parameters which affect the growth of microorganisms.
- Demonstrate an understanding of the effects of antibiotics on bacterial growth.
- Characterize and Classify Viruses, Viroids and Prions, with an understanding of Infection, Infectious Diseases and Epidemiology.

List of Topics Covered:

- Cell structure
- Microbial metabolism
- Microbial genetics
- Microbial growth and control
- Anti-microbial drugs
- Infectious disease and epidemiology
- Innate immunology
- Adaptive immunity
- Grain positive infections
- Grain negative infections
- DNA and RNA viruses

CE 106: Computer Graphics and Communication
Civil Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Samantha J. Wright

Textbook:
Introduction to AutoCAD 2104 for Civil Engineering Applications, Nighat Yasim, ISBN: 978-1-58503-789-6
Developing Spatial Thinking, *Sheryl Sorby*, ISBN: 978-1-111-13906-3

Course Description: Introduction to visualization, orthographic projection, and basic computer-aided drawing. Graphical solution of spatial problems. Integrated use of computer graphics to create civil engineering drawings. Lecture, two hours; laboratory, three hours per week.

Prerequisites: MA 113 or consent of instructor.

Required course.

Outcomes of Instruction: At the completion of the course, the student should be able to:
Visualization and Hand-drawing:

- Visualize spatial relationships among objects in three dimensions.
- Use problem solving techniques and conventions of the graphics language.
- Draw with a reasonable amount of skill and accuracy.
- Identify the shape, axis and degree of rotation for a surface of revolution and for a solid of revolution.
- Visualize and draw the combination of solid objects by the joining, cutting and intersecting operations; identify the volume of interference.
- Visualize and draw the isometric view of an object based on a coded plan and on a given viewpoint; construct a coded plan for a given isometric object.
- Visualize a solid object given the orthographic views of top, front and right side.
- Draw the front, top, and right side views of a given object with normal surfaces and of a given object with inclined surfaces. Understand the usage of visible lines, hidden lines and centerlines in orthographic views.
- Identify true and foreshortened dimensions for surfaces in orthographic views.
- Visualize flat patterns folded into open and closed objects.
- Identify a flat pattern given the front, top and right side views of a folded object.
- Visualize and draw the positive and negative rotation of an object about a single axis and about two or more axes; apply the right-hand rule.
- Visualize and draw an object reflected across an indicated plane. Identify the planes of symmetry for a given object.
- Visualize a cross section given a solid object and a cutting plane. Understand the different results of normal and inclined cutting planes.

AutoCAD Skills and Drawing:

- Create, file, revise and maintain data using AutoCAD 2014.
- Draw with a reasonable amount of skill and accuracy.
- Understand technical drawing standards, graphics terminology and scale.
- Learn the features of the AutoCAD interface, including the ribbon, command line, file settings, grid and snap settings, and plotting.
- Apply two-dimensional drawing methods, including dynamic input, coordinate systems, basic shapes (point, line, polygon, arc, etc…), object properties and text.
- Apply two-dimensional editing techniques, including grips, zoom, object snap, copy, array, rotate, scale, extend, and others.
- Create and label layers in a drawing, define layer characteristics, and move objects between layers.
- Apply dimensioning techniques to a drawing, including new dimensions (linear, angular, radii, etc…) and modifying dimension style.
- Use AutoCAD to draw basic Civil Engineering systems (identified in Lab Topics below) and to take measurements to solve simple engineering problems (length, area, unit conversion, curve fitting, etc…).

Contributions to Student Outcomes from Criterion 3

Outcome:	a	b	c	d	e	f	g	h	i	j	k
CS 106:	I						I, R		I	I	I, R

Key: I- Introduction R - Reinforcement A - Application ☐ *- outcome assessed*

List of Topics Covered:

Lecture Topics (Hand-drawings):

- Surfaces and Solids of Revolution (Module 1)
- Combining Solids (Module 2)
- Isometric Drawings & Coded Plans (Module 3)
- Orthographic Drawings (Module 4)
- Orthographic Projection of Inclined and Curved Surfaces (Module 5)
- Flat Patterns (Module 6)
- Rotation of Objects about a Single Axis (Module 7)
- Rotation of Objects about Two or More Axes (Module 8)
- Object Reflections and Symmetry (Module 9)
- Cutting Planes and Cross Sections (Module 10)

Lab Topics (AutoCAD drawings):

- Introduction to Engineering Graphics (Chapter 1), Getting Started with AutoCAD 2014 (Chapter 2), Basics of 2-Dimentional Drawings (Chapter 3)
- Basics of 2-Dimentional Editing (Chapter 4)
- Layers (Chapter 5), Blocks (Chapter 6), Layout and Template Files (Chapter 7)
- Dimensioning Techniques (Chapter 8), Land Survey (Chapter 9)
- Contours (Chapter 10)
- Drainage Basin (Chapter 11)
- Floodplains (Chapter 12)
- Road Design (Chapter 13)
- Earthwork (Chapter 14)
- Floor Plan (Chapter 15)
- Elevation (Chapter 16)
- Site Plan (Chapter 17)

CE 341: Introduction to Fluid Mechanics
Civil Engineering
University of Kentucky

Credits and contact hours: 4 credit, 4 contact hours

Instructor: Jimmy Fox

Textbook: *Fundamentals of Fluid Mechanics* (Seventh Edition) by Munson, Young, and Okiishi, John Wiley & Sons, Inc. (Required)

Course Description: Fundamentals principles of fluid flow and thermodynamics. Includes properties of fluids, fluids at rest, and fluids in motion. Conservation of Mass, Conservation of Momentum, and First Law of Thermodynamics for ideal and real fluids. Dimensional Analysis and Similitude.

Prerequisites: PHY 231, MA214 and Registration in College of Engineering

Required course.

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

- Know the fundamental properties of fluids and their importance in fluid mechanics
- Apply Newton's Law of Viscosity to fluid flow problems
- Understand surface tension, capillarity, compressibility, and vapor pressure
- Understand the principles governing fluids at rest
- Compute pressure forces on submerged surfaces
- Apply the principle of static equilibrium to analysis of hydraulic structures and manometers
- Apply Archimedes' principle to fully and partially submerged bodies
- Understand elementary fluid dynamics principles for ideal fluids
- Apply Bernoulli's equation to ideal flow problems
- Apply the simplified elementary fluids laws for flow measurement
- Apply the conservation laws to fluid dynamics for real and ideal fluids
- Apply the conservation of mass for steady and unsteady flows
- Apply the conservation of momentum to compute forces at flow constrictions and bends
- Apply the first law of thermodynamics to budget energy for fluid applications
- Understand the principles that govern physical model studies
- Perform dimensional analysis using the Buckingham Pi theorem
- Understand the importance of the Reynolds Number and Froude Number in model studies

Contributions to Student Outcomes from Criterion 3

Outcome:	a	b	c	d	e	f	g	h	i	j	k
CE 341:	A		R	R	R,A	I,R	R	R	R	R,A	A

Key: I- Introduction R - Reinforcement A - Application ☐ *- outcome assessed*

List of Topics Covered:

- Introduction: conservation laws and their importance within civil engineering
- Basic Concepts: dimensions and units, conservation of mass, conservation of momentum and the first law of thermodynamics
- Fluid Properties: basic properties of matter and introduction to viscosity, surface tension, capillarity, compressibility, and vapor pressure
- Fluid Statics: equations of fluid statics for incompressible and compressible fluids, forces and moments on submerged bodies, manometers, buoyancy
- Elementary Fluid Dynamics: Bernoulli's equation and its applications and limitations, flow measurement for ideal fluids
- Conservation of Mass: steady and unsteady forms of the conservation of mass for a control volume and applications
- Conservation of Momentum: steady form of the conservation of momentum for a control volume and its application to nozzles, bends, water jets and vanes
- First Law of Thermodynamics: conservation of energy for a control volume and applications to incompressible and compressible fluids, head losses in laminar and turbulent pipeflow
- Dimensional Analysis and Similitude: dimensional homogeneity, dimensionless parameters, π theorem, similitude and modeling

CE 555: Microbial Aspects of Environmental Engineering
Civil Engineering
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Gail M. Brion

Textbook: *Brock Biology of Microorganisms,* 12th edition, ISBN 0-13-144329-1

Course Description: Environmental microbiology for engineering students with emphasis on microbially mediated chemical cycles, microbial ecology, and industrial microbiology.

Prerequisites: CE 351, engineering standing, graduate status or consent of instructor.

Selected Elective course.

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

- Identify the basic organic macromolecules and cellular structures formed from them.
- Explain the function of cellular structures.
- Describe/diagram cellular metabolism with its component parts; oxidation/reduction of key enzymes, glycolysis, the citric acid cycle, oxidative phosphorylation, and photosynthesis.
- Apply mathematical models to the process of growth in batch and continuous systems with respects to exponential growth, decay.
- Apply statistics to microbial data to determine Poisson distribution and calculate the true mean for regulatory purposes.
- Describe/diagram the diverse ways cells make energy utilizing different electron donors, terminal electron acceptors, and different sources of carbon.
- Describe/diagram the ways which cellular metabolism drives the geochemical cycles on earth: carbon cycle, nitrogen cycle, sulfur cycle, mercury cycle, and iron cycle.
- Apply cellular metabolism and biogeochemical cycling concepts to engineer systems for biological treatment of wastes (WWTPs, bioremediation petrochemicals), or industrial processes (bio-mining of copper), or transformation of hazardous metals in the environment (arsenic cycling in water).

Contributions to Student Outcomes from Criterion 3

Outcome:	a	b	c	d	e	f	g	h	i	j	k
CE 555	I,R,A	A						R,A		I,R	R,A

Key: I- Introduction R - Reinforcement A - Application ▭ *- outcome assessed*

List of Topics Covered:

- Microorganisms and Microbiology
- Chemistry of Cellular Components
- Cell Structure and Function

- Nutrition, Culture, and Metabolism
- Microbial growth
- Metabolic diversity
- Microbial Ecology
- Wastewater treatment, water purification, and waterborne microbial diseases
- Industrial Microbiology

CHE 105: General College Chemistry
Department of Chemistry
University of Kentucky

Credits and contact hours: 4 credits, 4 contact hours

Instructor: Dr. Allison Soult (Spring 2016)

Textbook: Nivaldo J. Tro, *Chemistry: A Molecular Approach, 3rd Edition*, Pearson, 2014.

Course (Catalog) Description: A study of the principles of chemistry and their application to the more important elements and their compounds.

Prerequisites: Math ACT of 23 or above (or Math placement test), or MA 109, or MA 110, or the KCTCS course CHE 102R or CHM 100.

Required course.

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

- Describe methods of inquiry that lead to chemical knowledge, and distinguish scientific fact from pseudoscience.
- Explain fundamental principles of chemistry.
- Apply chemical principles to interpret and make predictions.
- Demonstrate an understanding of discoveries that changed our understanding of the world.
- Give examples of how chemistry interacts with society.
- Conduct a hands-on project. The student taking the accompanying General Chemistry Lab (CHE 111) will fulfill this learning outcome.
- Recognize when information is needed and demonstrate the ability to find, evaluate, and use sources of chemical information.

List of Topics Covered:

- Matter, Measurement, and Problem Solving
- Atoms and Elements
- Molecules, Compounds, and Chemical Equations
- Chemical Quantities and Aqueous Reactions
- Gases
- Thermochemistry
- The Quantum Mechanical Model of the Atom
- Periodic Properties of the Elements
- Chemical Bonding I: Lewis Theory
- Chemical Bonding II: Molecular Shapes, Valence Bond Theory, and Molecular Orbital Theory
- Liquids, Solids, and Intermolecular Forces

CHE 107: General Chemistry II
Department of Chemistry
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Dr. Lisa Blue (Spring 2016)

Textbook: Nivaldo J. Tro, *Chemistry: A Molecular Approach*, *3rd Edition*, Pearson, 2014.

Course (Catalog) Description: A continuation of CHE 105. A study of the principles of chemistry and their application to the more important elements and compounds.

Prerequisites: CHE 105 or CHE 108 or CHE 110 (with a **C** or better in any one of these prereqs).

Required course.

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

- Describe methods of inquiry that lead to chemical knowledge, and distinguish scientific fact from pseudoscience.
- Explain fundamental principles of chemistry.
- Apply chemical principles to interpret and make predictions.
- Demonstrate an understanding of discoveries that changed our understanding of the world.
- Give examples of how chemistry interacts with society.
- Conduct a hands-on project. The student taking the accompanying General Chemistry Lab (CHE 113) will fulfill this learning outcome.
- Recognize when information is needed and demonstrate the ability to find, evaluate, and use sources of chemical information.

List of Topics Covered:

- Liquids, Solids, and Intermolecular Forces
- Metals and Band Theory
- Solutions
- Chemical Kinetics
- Chemical Equilibrium and Coordination Compounds
- Acids and Bases
- Aqueous Ionic Equilibrium
- Free Energy and Thermodynamics
- Electrochemistry
- Radioactivity and Nuclear Chemistry

CS 221: First Course in Computer Science for Engineers
Department of Computer Science
University of Kentucky

Credits and contact hours: 2 credit, 2 contact hours

Instructor: Paul Piwowarski (Spring 2016)

Textbook: *Engineering Computations: An Introduction using MATLAB and EXCEL* by Musto, Howard, Williams, McGraw-Hill, ISBN Number: 978-0-07-338016-2

Course Description: Characteristics of a procedure-oriented language; description of a computer as to internal structure and the representation of information; introduction to algorithms. Emphasis will be placed on the solution of characteristic problems arising in engineering.

Prerequisites: Not open to students who have received credit for CS 115.

Required course.

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

- Use modern computing software to solve problems in engineering
- Apply basic control and data structures to construct simple programs
- Apply testing and debugging techniques to identify and correct errors in programs
- Implement some basic algorithms, including numerical methods

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
CS 221	3		3								

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Computing tools
- Excel for engineers
- Matlab fundamentals
- Matlab programming
- Plotting data
- Matrix mathematics
- Basic numerical methods

EE 305: Electrical Circuits and Electronics
Department of Electrical and Computer Engineering
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Regina Hannemann (Fall 2015**)**

Textbook: Notes provided by the instructor; the following books are recommended as additional reading: Giorgio Rizzoni, *Principles and Applications of Electrical Engineering, 4th revised Edition,* McGraw-Hill, 2004; Allan R. Hambley, *Electrical Engineering, Principles and Applications, 4th Edition,* Prentice Hall, 2008.

Course (Catalog) Description: A service course covering electrical engineering principles for engineering or science students with majors outside of electrical engineering. Topics include: circuits analysis, power, electronics, digital logic and instrumentation.

Prerequisites: PHY 232 and MA 114.

Required course for Biosystems Engineering Program.

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

- Apply node voltage analysis and mesh current analysis.
- Perform ac circuit analysis with phasors.
- Perform power analysis in AC and DC circuit
- Understand transistor fundamentals in amplifier and signal processing circuits.
- Analyze and design signal-conditioning circuits, active filters, integrator, and differentiator circuits containing operational amplifiers.
- Perform operations with binary numbers, design combinational logic circuits using logic gates, and use Karnaugh maps to reduce logical expressions.
- Perform power analysis on AC and DC machines.
- Understand the principal classes of sensors, concepts of shielding and grounding, ground-referenced and differential inputs, noise, and signal conditioning.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
EE 305											

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Circuit Laws and Elements (Ohm's Law; Kirchhoff's Laws; Superposition; Nodal and Mesh Analysis; Maximum Power Transfer)
- Energy Storage
- AC Circuits; Phasors; Complex Power; Filters
- Diodes

- Bipolar Junction Transistors; Amplifiers
- Field Effect Transistors; Amplifiers
- OP Amps
- Electric Machines
- Digital Logic Circuits
- Electronic Instrumentation and Measurements

EM 221: Statics
Department of Mechanical Engineering
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Christine Goble (Fall 2015)

Textbook: WileyPlus for *Statics*, 8th ed., Meriam, Kraige, Bolten, John Wiley & Sons, 2015.

Course (Catalog) Description: Vector algebra; study of the forces on bodies at rest; study of force systems; equivalent force systems; distributed forces; internal forces; principles of equilibrium; application to trusses, frames and beams; friction.

Prerequisites: MA 213 prereq or concur.

Required course for Biosystems Engineering Program.

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

- Perform necessary vector operations.
- Determine moment of a force in both 2D and 3D systems.
- Determine resultants of force-couple systems and distributed loadings.
- Identify and draw appropriate free-body diagrams.
- Solve equilibrium problems in both 2D and 3D.
- Analyze trusses, frames, and simple machines.
- Draw shear and bending moment diagrams.
- Solve problems involving dry friction.
- Locate center of gravity and centroid of a body.
- Determine moment of inertia of an area.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
EM 313	3				2						

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- 2D Force Systems
- 3D Force Systems
- 2D Equilibrium
- 3D Equilibrium
- Trusses
- Frames and Machines
- Centroids
- Distributed Loads
- Shear and Bending Moment Diagrams
- Friction
- Moment of Inertia

EM 302: Mechanics of Deformable Solids
Department of Mechanical Engineering
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Christine Goble (Fall 2015)

Textbook: *Mechanics of Materials*, 7th ed., Beer, Johnston, DeWolf and Mazurek, McGraw Hill, 2014.

Course (Catalog) Description: A study of stress and strain in deformable solids with application primarily to linear elastic materials; stress and strain transformations; simple tension and compression of axial members; torsion of shafts; bending of beams; combined loading of members; buckling of columns.

Prerequisites: EM221; MA 214 prereq or concur.

Required course for Biosystems Engineering Program.

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

- Use standard sign conventions.
- Solve statically determinate and statically indeterminate problems.
- Understand/apply stress-strain relations.
- Solve problems of uniaxial loading and deformation.
- Solve problems of torsion for circular shafts.
- Compute stresses and deflections in beams.
- Compute stresses in problems with combined loading.
- Analyze situations of plane stress and plane strain.
- Solve problems involving buckling of columns.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
EM 313	3				2						

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Concept of Stress
- Axial Loading
- Torsion
- Pure Bending
- Beams - Bending
- Beams – Shear Stress
- Transformation of Stress and Strain
- Combined Loading
- Beam Deflection
- Columns

EM 313: Dynamics
Department of Mechanical Engineering
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: T. W. Wu (Fall 2015)

Textbook: *Engineering Mechanics Dynamics*, 8th Ed., J. L. Meriam, L. G. Kraige, J. N. Bolten, Wiley 2015

Course (Catalog) Description: Study of the motion of bodies. Kinematics: Cartesian and polar coordinate systems; normal and tangential components; translating and rotating reference frames. Kinetics of particles and rigid bodies: laws of motion; work and energy; impulse and momentum

Prerequisites: Registration in College of Engineering, EM 221; prereq or concur: MA 214.

Required course for Biosystems Engineering Program.

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

- Derive, understand, and convert expressions for position, velocity, and acceleration in appropriate coordinate systems, using graphical and vector methods.
- Find velocities and accelerations using translating and rotating reference frames.
- Solve particle motion problems using Newton's Second Law, work-energy, and impulse momentum.
- Express kinematic relations between translational and angular quantities for rigid bodies.
- Analyze the motion of translating and rotating rigid bodies using Euler's equations and work-energy.
- Analyze situations of particle and rigid body free and damped vibration.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
EM 313	3				2						

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- 1D Kinematics of Particles
- 2D Kinematics of Particles: x-y, n-t, and Polar Coordinates.
- Relative Motion and Constrained Motion
- Kinetics of Particles
- Work-Energy Principle for Particles and Rigid Bodies
- Impulse-Momentum Principle for Particles and Rigid Bodies
- Impact
- 3D Fixed-Axis Rotation
- Absolute and Relative-Motion Analyses for Rigid Bodies
- Instantaneous Center
- Rotating Axes
- Vibrations

MA 113: Calculus I
Department of Mathematics
University of Kentucky

Credits and contact hours: 5 credits (with MA 193) 6 contact hours

Instructor: David Royster (Spring 2016)

Textbook: *Calculus: Early Transcendentals, 2nd edition*, by Jon Rogawski ISBN 978-1-4641-3302-2

Course (Catalog) Description: A course in one-variable calculus, including topics from analytic geometry. Derivatives and integrals of elementary functions (including the trigonometric functions) with applications. Lecture, three hours; recitation, two hours per week. Students may not receive credit for MA 113 and MA 137.

Prerequisites: Math ACT of 27 or above, or Math SAT of 620 or above, or MA 109 and MA 112, or MA 110, or consent of the department. Students who enroll in MA 113 based on their test scores should have completed a year of pre-calculus study in high school that includes the study of trigonometric functions. NOTE: Math placement test recommended.

Required course.

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

- Understand the notion of limits in relation to the definition of derivatives and integrals
- Define continuity, the derivative, and the integral
- Understand the fundamental theorem of calculus in relation to the derivative and the integral
- Illustrate the methods and ideas of calculus by applying them to solve several physical and geometric problems

List of Topics Covered:

- Functions and inverse functions
- Trigonometric and inverse trigonometric functions
- Exponential and logarithm functions
- Tangent and velocity
- Basic limit laws
- Limits and continuity
- Evaluating limits
- Trigonometric limits
- Intermediate value theorem
- The derivative
- The derivative as a function
- Product and quotient rules
- Rates of change
- Higher derivatives
- Derivatives of trig functions
- Chain rule
- Derivatives of inverse functions
- Exponential and logarithms
- Implicit differentiation
- Related rates
- Linear approximation
- Extreme values
- Mean value theorem and monotonicity
- The shape of a graph

- Limits at infinity
- Lhopital rule
- Optimization
- Newton’s method
- Anti-derivatives
- Approximating and computing area
- The definite integral
- The fundamental theorem of calculus
- Substitution method
- Further transcendental functions
- Exponential growth and decay
- Area of regions in the plane

MA 114: Calculus II
Department of Mathematics
University of Kentucky

Credits and contact hours: 5 credits (with MA 194), 6 contact hours

Instructor: (Spring 2016)

Textbook: *Calculus: Early Transcendentals, 2nd edition*, by Jon Rogawski ISBN 978-1-4641-3302-2

Course (Catalog) Description: A second course in Calculus. Applications of the integral, techniques of integration, convergence of sequence and series, Taylor series, polar coordinates.

Prerequisites: A grade of C or better in Calculus I (MA 113, MA 137, MA 132 or equivalent) and high school trigonometry or MA 112.

Required course.

Outcomes of Instruction: At the completion of the course, the student should be able to address the following questions:

- How can we add infinitely many items together?
- When and how can polynomials be used to approximate functions?
- What kinds of applied problems can we solve using integration?
- What techniques can we use to evaluate integrals?
- What can we say about the motion of objects moving in more than one dimension?
- How can we model phenomena if we know their rates of change?

List of Topics Covered:

- Sequences
- Series
- Comparison tests, p –series
- Absolute convergence, alternating series
- Ratio and root tests
- Power series
- Taylor series – not binomial series
- Taylor series
- Volumes (review area between curves, density and average value)
- Volumes of revolution
- Volumes by cylindrical shells
- Integration by parts
- Trigonometric integrals
- Trigonometric substitution
- Partial fractions
- Improper integrals
- Arc length
- Surface area
- Center of mass
- Parametric equations (sinh and cosh)
- Calculus with parametric curves
- Polar coordinates and graphs
- Areas and arc length in polar coordinates
- Solving differential equations
- Models involving $y' = k(y-b)$
- Graphical and numerical methods (not Euler's method)
- Logistic equation
- Euler's method and review

MA 213: Calculus III
Department of Mathematics
University of Kentucky

Credits and contact hours: 4 credits, 5 contact hours

Instructor: Peter Perry (Fall 2014)

Textbook: *Calculus: Early Transcendentals, 2nd edition*, by Jon Rogawski ISBN 978-1-4641-3302-2

Course (Catalog) Description: A course in multi-variable calculus. Topics include vectors and geometry of space, three dimensional vector calculus, partial derivatives, double and triple integrals, integration on surfaces, Green's theorem. Optional topics include Stokes' theorem and the Gauss' divergence theorem.

Prerequisites: MA 114 or 138 or equivalent.

Required course.

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

- Manipulate and analyze functions of several independent variables using the differential calculus of several independent variables.
- Interpret geometrical properties of functions of several variables in terms of algebraic properties of their defining formulae in Cartesian and other coordinates.
- Use the calculus of several variables to set up and solve optimization problems involving functions of several variables, including interpretation of the critical points of the problem and the method of Lagrange multipliers for constrained problems.
- Use the integral calculus of functions of two and three variables to solve physical and geometrical problems in Cartesian, cylindrical, spherical or other coordinate systems.
- Analyze situations from physics and mechanics involving the differential and integral calculus of vector fields, including determination of scalar potentials for conservative vector fields and interpretation of integrals of vector fields over surfaces.

List of Topics Covered:

- Unit I: *Geometry and Motion in Space*: Vectors, lines and planes in three dimensions, quadric surfaces, polar and cylindrical coordinates, vector-valued functions, curvature, motion in space, (sections 12.1-12.7 and 13.1-5)
- Unit II: *Differential Calculus of Several Variables*: Functions of several variables, limits and continuity, partial derivatives and their geometric meaning, the gradient, directional derivatives, chain rule, optimization in several variables (sections 14.1-14.7)
- Unit III: *Integral Calculus of Several Variables*: Integration in two and three variables over general regions, integrations in polar, cylindrical, and spherical coordinates, applications of multiple integrals, change of variables theorem (sections 15.1-15.6)
- Unit IV: *Vector Field Theory*: Vector fields, line integrals, conservative vector fields, Green's theorem, divergence and curl (sections 16.1-16.3, 17.1-17.3)

MA 214: Calculus IV
Department of Mathematics
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Dr. Yue Chen (Spring 2015)

Textbook: *Elementary Differential Equations (10th Edition),* by William E. Boyce and Richard C. DiPrima

Course (Catalog) Description: MA 214 is a course in ordinary differential equations. Emphasis is on first and second order equations and applications. The course includes series solutions of second order equations and Laplace transform methods.

Prerequisites: MA 213 or equivalent

Required course.

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

- Model phenomena from physical, biological and social science.
- Solve or characterize solutions of simple types of Ordinary Differential Equations (ODEs)
- Use a variety of techniques to solve second order linear ODEs
- Use Laplace Transform techniques to solve ODEs
- Use linear algebra techniques to solve systems of linear ODEs
- Use numerical methods to find approximate solutions to ODEs

List of Topics Covered:
We'll study basic equations for which the unknown function-the solution-depends on one real variable only, like time or position. This is the meaning of the adjective ordinary. We will study first- and second-order ordinary differential equations extensively, especially linear differential equations. We will discuss applications to other natural sciences, like physics and biology. Approximate course material to be covered includes most of Chapter 1 (Introduction), Chapter 2 (First-order differential equations), Chapter 3 (Second-order linear equations), Chapter 5 (Series solution) and Chapter 6 (The Laplace transform).

ME 220: Engineering Thermodynamics I
Department of Mechanical Engineering
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Kaveh A Tagavi (Fall 2015)

Textbook: *Thermodynamics: An Engineering Approach*, 8th ed., Yunus A. Cengel, McGraw-Hill, 2014

Course (Catalog) Description: Fundamental principles of thermodynamics.

Prerequisites: Prereq: PHY 231. Prereq or concur: MA 214.

Required course for Biosystems Engineering Program.

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

- Understand and apply basic concepts of mass and energy conservation, and increase in entropy principle.
- Understand the ideal gas law, its applicability, and shortcomings. Develop a clear understanding of the difference between the ideal gas law and real gases and mixtures.
- Use tables for finding the steam and refrigerant properties.
- Be able to write the first law of thermodynamics for closed and open systems, for steady and unsteady processes. Show the ability to analyze piston-cylinder assemblies, turbines, pumps, compressors, heat exchangers, boilers and condensers and throttling valves, and charging and discharging from containers. Perform necessary analyses to make the first- and second law analyses of these processes.
- Understand and effectively use the exergy principles.
- Extend the analyses to simple gas power cycles, including to Otto, diesel and dual cycles.
- Extend the analyses to analyze simple steam power cycle and simple refrigeration cycles.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
ME 220	3				2						

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Introduction and Basic Concepts
- Energy, Energy Transfer, and General Energy Analysis
- Properties of Pure Substances
- Energy Analysis of Closed Systems
- Mass and Energy Analysis of Control Volumes
- The Second Law of Thermodynamics
- Entropy (abbreviated version)
- Exergy
- Gas Power Cycles (time permitting

ME 325: Elements of Heat Transfer
Department of Mechanical Engineering
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Michael Winter (Spring 2016)

Textbook: *Introduction to Heat Transfer* by Bergman, Levine, Incropera and Dewitt, 6th edition, John Wiley & Sons, 2011.

Course (Catalog) Description: A course in material and energy balances, units, conversions, tie elements, recycle, bypass, equations of state, heat effects, phase transitions, and the first and second laws of thermodynamics applications in separation processes involving equilibrium reactions and energy exchange.

Prerequisites: ME 330, MA 214, CS 221 and engineering standing.

Required course for Biosystems Engineering Program.

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

- Understand principles of conductive, convective, and radiation heat transfer
- Apply the heat transfer principles to solve practical engineering problems.
- Integrate knowledge on mass, momentum, heat transfer, and thermodynamics.
- Apply the above integrated knowledge to solve practical engineering problems.
- Apply the basics of heat transfer to engineering design.

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
ME 325	3				3						

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- 1D, 2D and transient conduction heat transfer (system's/mechanism's identification, modeling)
- Convection – external and internal flows, free convection (modeling)
- Heat exchangers (modeling, design approach, critical analysis of operation)
- Radiation processes and properties (fundamentals)

ME 340: Introduction to Mechanical Systems
Department of Mechanical Engineering
University of Kentucky

Credits and contact hours: 3 credits, 3 contact hours

Instructor: Jesse B. Hoagg (Fall 2015)

Textbook: C. M. Close, D. K. Frederick, and J. C. Newell, *Modeling and Analysis of Dynamic Systems*, 3rd edition, Wiley, 2002.

Course (Catalog) Description: Modeling of mechanical, thermal, hydraulic, and electrical systems, and other phenomena from a system viewpoint. Analysis of continuous-time models for free and forced response. Laplace transforms and transfer functions. Introduction to numerical simulation. Analysis of higher-order systems.

Prerequisites: Prerequisite: MA214; Co-requisite: EM313.

Required course for Biosystems Engineering Program (BAE 502 can be taken to fulfill this requirement as well).

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

- Construct mathematical models of translational and rotational mechanical systems, passive electrical systems, and thermal systems, using idealized elements. Arrange equations in input/output form.
- Formulate models in state-space, put equations into matrix form, and solve matrix equations using numerical integration methods from MATLAB or other engineering software to determine system response.
- Use analytical methods of solve first-and second-order ordinary differential equations to determine free, step, and impulse responses.
- Show how the system response is affected by the choice of time constant, damping ratio, and natural frequency.
- Apply Lapace transform principles to find the complete time response of a system to a given input. Determine the zero-input and zero-state responses.
- Determine the transfer function and the frequency response of a system.
- Derive the transfer function from a block diagram of a system
- Be familiar with linear algebra
- Determine information needs when solving real-world problems
- System Modeling or Numerical Manipulation package such as MATLAB

Contributions to Student Outcomes from Criterion 3

Outcome	a	b	c	d	e	f	g	h	i	j	k
EM 313	3										2

Key: 3 − Strongly supported; 2 – Supported; 1 – Minimally supported; Blank − Unsupported

List of Topics Covered:

- Modeling of translational mechanical systems
- Input-output and state-variable models
- Modeling rotational mechanical systems
- Modeling electrical systems
- Simulating dynamic systems in MATLAB and Simulink
- Laplace transforms
- Solving linear time-invariant differential equations with Laplace transforms
- Transfer functions
- Stability and response characteristics
- Linearization techniques for nonlinear systems
- Linear state-space equations in matrix form
- Modeling thermal systems
- Modeling fluid systems

PHY 231: General University Physics
Department of Physics and Astronomy
University of Kentucky

Credits and contact hours: 4 credits, 4 contact hours

Instructor: Joseph P. Straley (Spring 2016)

Textbook: *Physics for Scientists and Engineers*, Serway & Jewett, 9th Edition.

Course (Catalog) Description: This course is about classical mechanics. It is the first part of a two-semester survey of introductory physics for science and engineering students. We will see how a few general principles and concepts of mechanics suffice to understand a broad range of physical phenomena. Our goal is to sharpen your analytical thinking skills and problem solving skills by applying these principles and concepts to wide-ranging situations.

Prerequisites: MA 113

Required course.

Outcomes of Instruction: This course is about classical mechanics. It is the first part of a two-semester survey of introductory physics for science and engineering students. We will see how a few general principles and concepts of mechanics suffice to understand a broad range of physical phenomena. Our goal is to sharpen your analytical thinking skills and problem solving skills by applying these principles and concepts to wide-ranging situations.

List of Topics Covered:

- Measurement
- 1D motion
- Constant acceleration
- Vectors
- Projectile motion
- Relative motion N I
- Newton's II Law
- Newton's III law; weight
- Applications of Newton's laws
- Friction
- Circular motion
- Work
- Potential energy
- Force and PE
- Conservation of Mech En
- Nonconservative forces
- Conservation of momentum
- Impulse and momentum
- Collisions
- Center of mass
- Kinematics of rotation
- Kinetic energy, mom. Int.
- Mechanical energy, rolling torque
- Static equilibrium
- Angular momentum
- Conservation of AM
- Gravitation
- Kepler's laws
- Gravity: field and energy
- Conservation of energy
- Oscillatory motion
- Oscillations II
- Waves
- Sinusoidal waves
- Superposition; interference
- Standing waves

PHY 232: General University Physics
Department of Physics and Astronomy
University of Kentucky

Credits and contact hours: 4 credits, 4 contact hours

Instructor: Dr. Francisco Guzman Fulgencio

Textbook: *Physics for Scientists and Engineers*, Serway & Jewett, 9th Edition.

Course (Catalog) Description: A general course covering electricity, magnetism, electromagnetic waves and physical optics.

Prerequisites: PHY 231 + (co-requisite = MA 213)

Required course.

Outcomes of Instruction: Electricity and magnetism are present in our everyday life. Understanding the basic concepts of electric and magnetic forces is crucial for the good developing of technical activities. After this course, you should be able to understand for example the principles behind how a defibrillator charges, why power is transferred in high voltage lines, superconductors, electromagnets or electric guitars. This course will provide the basic of electric and magnetic fields and forces and end on the explanation of the nature of light as a combination of both types of field to create electromagnetic waves.

List of Topics Covered:

- Review vector calculus
- Electric fields
- Gauss Law
- Electric potential
- Capacitance and dielectrics
- Current and resistance
- Direct current circuits
- Magnetic fields
- Sources of the magnetic field
- Faraday's Law
- Inductance
- Electromagnetic waves and wave optics

PHY 241: General University Physics Laboratory I
Department of Physics and Astronomy
University of Kentucky

Credits and contact hours: 1 credit, 2 contact hours

Instructor: Dr. Max Brown (Spring 2016)

Textbook: Lab manuals, templates, and all other instructions can be found on Canvas under "Modules."

Course (Catalog) Description: A laboratory course offering experiments in mechanics and heat, framed in a small group environment that requires coordination and team work in the development of a well-written lab report.

Prerequisites: PHY 231

Required course.

Outcomes of Instruction: Each class group members will be assigned one of three roles which will rotate with each new lab:

a. Researcher – During class time, the researcher is primarily responsible for operating the laboratory equipment and taking measurements. In writing the report, the researcher is responsible for writing the "Procedure" section and explaining the major steps of how raw data is analyzed to produce a final result.

b. Data Analyst (DA) – During class time, the Data Analyst is primarily responsible for recording data into Excel and typing formulae in Excel. In writing the report, the DA is responsible for the "Analysis" section, editing the data tables and graphs to ensure that all data is legible, has appropriate units, and is properly labeled.

c. Principal Investigator (PI) – During class time, the PI assists the other two roles and attempts to maintain the "big picture" to keep the group moving in a productive direction. In writing the report, the PI composes the "Introduction" and "Conclusion" sections, summarizing the entire experiment into simple, clear, and objective statements.

List of Topics Covered:

- Measuring paper
- Incline track
- Friction
- Springs
- Energy
- Gravity
- Rotation
- Pendulum period

PHY 242: General University Physics Laboratory II
Department of Physics and Astronomy
University of Kentucky

Credits and contact hours: 1 credit, 2 contact hours

Instructor: Dr. Max Brown (Spring 2016)

Textbook: Lab manuals, templates, and all other instructions can be found on Canvas under "Modules."

Course (Catalog) Description: A laboratory course offering experiments in electricity, magnetism, and light, framed in a small group environment that requires coordination and team work in the development of a well written lab report.

Prerequisites: PHY 241 and PHY 232

Required course.

Outcomes of Instruction: Each class group members will be assigned one of three roles which will rotate with each new lab:

a. Researcher – During class time, the researcher is primarily responsible for operating the laboratory equipment and taking measurements. In writing the report, the researcher is responsible for writing the "Procedure" section and explaining the major steps of how raw data is analyzed to produce a final result.

b. Data Analyst (DA) – During class time, the Data Analyst is primarily responsible for recording data into Excel and typing formulae in Excel. In writing the report, the DA is responsible for the "Analysis" section, editing the data tables and graphs to ensure that all data is legible, has appropriate units, and is properly labeled.

c. Principal Investigator (PI) – During class time, the PI assists the other two roles and attempts to maintain the "big picture" to keep the group moving in a productive direction. In writing the report, the PI composes the "Introduction" and "Conclusion" sections, summarizing the entire experiment into simple, clear, and objective statements.

List of Topics Covered:

- Resistor vs Lightbulb
- Function Generator and Oscilloscope
- Capacitance
- Series and Parallel
- Wheatstone Bridge
- Magnetic Field
- Current Balance
- Magnetic Induction
- Inductance
- Malus Law

PLS 366: Fundamentals of Soil Science
Plant and Soil Sciences
University of Kentucky

Credits and contact hours: 4 credits, 5 contact hours

Instructor: Dr. David McNear (Fall 2015)

Textbook: *The Nature and Properties of Soils*, 14th Edition, by Nyle C. Brady and Ray R. Weil, Prentice Hall, Upper Saddle River, New Jersey 07458. ISBN 0-13-016763-0

Course (Catalog) Description: Development of concepts and understanding of the properties and processes which are basic to the use and management of soils.

Prerequisites: CHE 105

Selected Elective course.

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

- Identify soil orders by carefully examining soil profiles in natural settings.
- Assess the differences among soils in physical, chemical, and biological properties.
- Evaluate the suitability of soils for agricultural, urban, and ecological uses.
- Grasp the principles of soil management for food production and environmental protection.
- Collect, analyze, and interpret data and then write effective technical reports on soils-related topics.
- Solve mathematical problems related to soil properties and soil management.

WRD 110: Composition and Communication I
Department of Writing, Rhetoric and Digital Media
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Staff

Textbook:

Lunsford, Andrea A. The *St. Martin's Handbook: University of Kentucky.* Boston: Bedford/St. Martin's, 2009.

O'Hair, Dan, Rob Stewart and Hannah Rubenstein. *A Speaker's Guidebook: Text and Reference*, 4th ed. Boston: Bedford/St. Martin's, 2010.

The Engaged Citizen: A Reader for First-Year Writing, 4th ed. University of Kentucky, Division of Writing, Rhetoric, and Digital Media, 2010-11. Boston: Bedord/St. Martin's, 2011.

Course (Catalog) Description: Composition and Communication I is a course in speaking and writing emphasizing *critical inquiry* and *research.* Throughout the course, I will encourage you to explore your place in the broader community and take a stance on issues of public concern – that is, to begin to view yourself as an engaged citizen. You will engage in reflective thinking and analysis, conduct primary research in the community and secondary research using library resources, and learn how to write and speak effectively about a local issue not only for your classmates but also for audiences beyond the classroom. A significant component of the class will be learning to use visuals and online resources to enhance writing and oral presentations. Over the course of the semester, class members can expect to work independently, with a partner, or with a small group of classmates to investigate, share findings, and compose presentations of their research, as well as to practice and evaluate interpersonal and team dynamics in action.

Prerequisites: None.

Required course.

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

- Compose written texts and deliver oral presentations that represent a relevant and informed point of view appropriate for its audience, purpose, and occasion in an environment that reinforces the recursive and generative nature of the composition and delivery rehearsal processes.
- Demonstrate an awareness of strategies that speakers and writers use in different communicative situations and media, and in large and small groups; learn to analyze and use visual effectively to augment their oral presentations; to employ invention techniques for analyzing and developing arguments; to recognize and address differing genre and discourse conventions; and to document their sources appropriately.
- Find, analyze, evaluate, and properly cite pertinent primary and secondary sources, using relevant discovery tools, as part of the process of speech preparation and writing process.

- Develop flexible and effective strategies for organizing, revising editing, proofreading, and practicing/rehearsing to improve the development of their ideas and the appropriateness of their expression.
- Collaborate with peers, the instructor, and librarians to define revision strategies for their essays and speeches, to set goals for improving them, and to devise effective plans for achieving those goals.
- Engage in a range of small group activities that allow them to explore and express their experiences and perspectives on issues under discussion.

List of Topics Covered:

- Comp and Comm Perspectives
- In-class Diagnostic Essay
- Analyzing Visuals Perceptions
- Planning and Drafting Essays
- Verbal and Nonverbal Communication
- Listening and Responding
- Writing Effective Sentences
- Effective Punctuation
- Effective Community Research
- Effective Secondary Research
- Rhetorical Devices
- Conducting Effective Interviews
- Document Design and Organization
- Writing about People and Places
- Interpersonal Communication
- Communicating Across Cultures
- Polishing PowerPoints

WRD 111: Composition and Communication II
Department of Writing, Rhetoric and Digital Media
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Allison Palumbo, MA

Textbook:
Lunsford, Andrea A. and John J. Ruszkiewicz. *Everything's an Argument.* 5th ed. Boston: Bedford/St. Martin's, 2010.
The Engaged Citizen: A Reader for Composition and Communication. 4th ed. UK, Composition and Communication Program, 2011-12. Cincinnati: Van-Griner, 2011.
University of Kentucky Guide to Oral, Written, and Visual Communication. Division of Writing, Rhetoric, and Digital Media. Boston: Bedford/St. Martin's, 2011.

Course (Catalog) Description: Composition and Communication II is the second of two general education courses focused on integrated oral, written, and visual communication skill development emphasizing *critical inquiry* and *research*. In this course, students will explore issues of public concern using rhetorical analysis, engage in deliberation over those issues, and ultimately propose solutions based on well-developed arguments. Students will sharpen their ability to conduct research; compose and communicate in written, oral, and visual modalities; and work effectively in groups (dyads and small groups).

Prerequisites: WRD 110 or CIS 110

Required course.

Outcomes of Instruction: At the completion of the course, the student should be able to:
- Compose in writing and deliver orally with visuals (in a face-to-face or digital environment) at least one major project grounded in scholarly research in a manner that is appropriate and effective for the audience, purpose, and occasion. (The development of one or more major research projects is the course's primary educational focus.)
- Conduct significant research on a subject using the resources of the UK Libraries.
- Employ advanced strategies for developing ideas and analyzing arguments, with greater emphasis on addressing and mediating issues of public interest, and with evidence of critical thinking in both the conception and the development of the thesis.
- Refine their speaking, writing, and visual communication skills, focusing on matters of construction, design, and delivery style.
- Critique the work of peers and professionals.
- Revise their written and oral presentations, in collaboration with peers, instructor, librarians, and pertinent members of the public.
- Employ and evaluate interpersonal and small group communication skills.

List of Topics Covered: To learn to analyze a public issue using rhetorical analysis, the entire class will explore together one contemporary social issue and related texts about it. Students will

then be grouped in teams, each of which will explore a different public controversy with a local face (e.g., the use of renewable energy vs. fossil fuels—local angle: coal mining practices in Eastern Kentucky). For the first two-thirds of the class, students will decide on their team focus and conduct significant primary and secondary research on the issue, culminating in a series of reports and a group symposium. In the last third of the class, teams will develop digital projects to communicate their well-argued solutions to audiences beyond the classroom.

A significant component of the class will consist of learning to use visual and digital resources, first to enhance written and oral presentations and later to communicate mass mediated messages to various public audiences. Over the course of the semester, class members can expect to work independently, with a partner, and in a small group (team) to investigate, share findings, and compose and deliver presentations, as well as to practice and evaluate interpersonal and team dynamics in action.

WRD 204: Technical Writing
Department of Writing, Rhetoric and Digital Media
University of Kentucky

Credits and contact hours: 3 credit, 3 contact hours

Instructor: Dr. Bill Endres

Textbook: None.

Course (Catalog) Description: Instruction and experience in writing for science and technology. Emphasis on clarity, conciseness, and effectiveness in preparing letters, memos, and reports for specific audiences.

Prerequisites: Completion of university writing requirement

Selected Elective course.

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

- Write a paper that is essentially free of mechanical errors (grammar, punctuation, spelling, and syntax) and awkwardness, using a style that is appropriate to the purpose and audience.
- Demonstrate an ability to discover, evaluate, and clearly present evidence in support of an argument in the subject area and utilize documentation that conforms to the formats and the citation conventions of the subject area.
- Be aware that composing a successful text frequently takes multiple drafts, with varying degrees of focus on generating, revising, editing, and proofreading.
- Write a capable, interesting essay about a complex issue (discipline-specific) for a general university audience.

List of Topics Covered:

- Know your writing process, its roots in your experiences, and learn practices used by professional writers to aid you in its development and refinement.
- Learn to read for writing strategies (not just content) and to put those strategies to use.
- Understand the writing required of an engineer, both in the classroom and on the job.
- Learn to write writer-centered drafts for discovery and how to revise those drafts for reader-centered prose.
- Analyze for and adapt to the constraints of specific rhetorical situations, including audience and purpose.
- Learn strategies for making documents accessible and reader-centered (analyzing for needed context, background information, and flow of claims, evidence, and commentary).
- Design and integrate tables, figures and images into documents in a ready-friendly way.
- Refine writing style for clarity, conciseness, coherence, cohesion, and emphasis.
- Learn the punctuation marks most helpful to engineers and how to proofread carefully.

- Develop abilities to perform peer reviews that are insightful, critical, encouraging, and constructive.
- Learn to strategically orchestrate elements of document design, including font, spacing, images, graphs, and color.
- Learn to assess one's own strengths and weaknesses as a writer and develop strategies for continued growth in your writing.

Appendix B – Faculty Vitae

AKINBODE A. ADEDEJI, Ph.D.
80% Research, 20% Instruction

Education

Ladoke Akinbode University of Technology, Nigeria — Food Engineering B.Tech. 1990–1997
University of Ibadan, Nigeria — Food Technology M.Sc. 1999–2000
McGill University, Canada — Bioresource (Food Process) Engineering Ph.D. 2005–2010

Academic Experience

- Lecturer, Food Sci. & Engr. Dept., Ladoke Akintola University of Tech., Nigeria, 1998 – 2012.
- Assistant Prof., Biosystems & Agric. Engineering Dept., University of Kentucky, July 2014 to present.

Non-academic Experience

None.

Certification or professional registrations

- Certified Quality Engineer, 2012, Certification # 59722
- Professional Engineer Nigeria, since July 2005, License # R11, 709

Current membership in professional organizations

- American Society of Agricultural and Biological Engineers (ASABE), member since 2006.
- Canadian Institute of Biological Engineers (CSBE), member since 2006.
- Institute of Food Technology (IFT), member since 2008
- Nigerian Institute of Food Technology (NIFST) , member since 1995

Honors and awards

- Evangelina Villegas Excellence in Research Award for a Post-Doctoral Research Associate, Grain Science & Industry Dept. Kansas State University April 2013
- Hugh Baily Award, Best Graduating Student in my faculty McGill Uni. 2009/2010
- Runner up, Food Engineering Division paper competition IFT 2009

Service Activities

- Member, Advisory Committee of Biosystems & Agricultural Engineering program at Florida A&M University, 2015 to present.
- Secretary, BAE Faculty Meeting, 2015-2016.
- Member, University of Kentucky TSM program curriculum committee, 2015 to present.
- Secretary, ASABE PRS 701 Committee, 2015-2016.
- IFT Research and Development Awards Jury, 2015-2016.

Select publications and presentations (last five years)

- Adedeji, A. A., Zhou, Y., Fang, X., Davis, D. A., Fahrenholz, A. and Alavi, S. (2015), Utilization of sorghum distillers dried grains in extruded and steam pelleted shrimp diets. *Aquaculture Research*. doi: 10.1111/are.12932
- Adedeji, A. A., Alakali, J., and Ngadi, M. O. (2014). Characterization of thermophysical properties of Afzelia (*Afzelia africana*) seed. *American Journal of Nutrition and Food Science* 1(3), 57- 63.
- Abioye, A. O., Abioye, V. F., Ade-Omowaye, B.I.O. and Adedeji, A. A. (2013). Kinetic modeling of ascorbic acid loss in baobab drink at pasteurization and storage temperatures. *Journal of Environmental Science, Toxicology and Food Technology* 7(2), 17-23.
- Rahimi, J., Singh, A., Adewale, P. O., Adedeji, A. A., Ngadi, M.O., and Raghavan, V. (2013). Effect of carboxylmethyl cellulose coating and osmotic dehydration on freeze drying kinetics of apple slices. *Journal of Foods* 2, 170-182.
- Adedeji, A. A., Alakali, J., Adewale, P. O., and Ngadi, M. O. (2012). Thermophysical properties of *Deterium microcapun* seed flour. *LWT* 47(2), 233 - 237.
- Adedeji A. A., Alavi, S., and Matthew, F. (2014). Micronutrient fortified extruded rice kernels: impact of processing and formulation on physico-chemical attributes. American Association of Cereal Chemists International (AACCI). Holding at Providence, Rhode Island USA October 5 – 8, 2014. Paper No. P-147. (Poster).
- Adedeji, A.A., Padmanabhan, N., Zhu, L., and Alavi, S. (2013). Digestibility and micronutrient retention of fortified extruded sorghum-soy blends. Inst. of Food Techn. (IFT), Food Engr. Division Poster Session. Held at Chicago, IL USA. July 13 – 16, 2013. Poster No. 135-06.
- Zhou, Y, Fan, X., Davis, D.A., Adedeji, A.A., and Alavi, S. (2013). Growth of juvenile pacific white shrimp *litopenaeus vannamei* fed diets containing different level of sorghum co-product (ddgs) using extrusion and pelleting methods. World Aquaculture Society, Nashville Tennessee, USA. February 21 – 25. Paper Number 114. Oral.
- Alavi, S, A. Adedeji, A. A., Joseph, M., and Plattner, B. (2012). Innovations in extrusion—Configuring a multi-operation, low-shear, semicold process for novel and nutritious products. American Association of Cereal Chemists International (AACCI). Held at Hollywood Florida USA September 30 - October 3. Paper No. - 48-S, CFW 57:A15. Oral.

Professional Development

- Imaging Symposia. Biomedical Informatics. By Dr. Zhang, a Professor Internal Medicine, Director for Medical Informatics and Director for Biomedical Informatics Core, at University of Kentucky. Pavilion H Rm HX303, 2015.
- eLII (eLearning) Cohort 2 Workshop. “The Good, the Bad, and the Ugly: Teacher and Course Evaluations”. Wednesday, November 18th, 2015 from 3:30 - 4:30 p.m. Held in Niles Gallery, Lucille Little Fine Arts Building, UK, Lexington KY.
- "Working with Distressed and Distressing Students". A presentation made by Mary Chandler Bolin, PhD, Director-University of Kentucky Counseling Center and Therese Smith, Students of Concern Case Manager, both of University of Kentucky. November 17, 2015 at 2 – 3:30 pm in C.E. Barnhart Building Room 249.
- NSF Career Proposal Writing Workshop. Held at Northeastern University, Boston MA from April 27 – 28, 2015.

CARMEN T. AGOURIDIS, Ph.D., P.E.
37.75% Research, 53.75% Instruction, 8.5% Extension

Education

University of Tennessee	Agricultural Engineering	B.S., 1998
University of Tennessee	Agricultural and Biosystems Engineering	M.S., 2000
University of Kentucky	Biosystems and Agricultural Engineering	Ph.D., 2004
University of Kentucky	Public Policy and Administration	M.P.P., 2012

Academic Experience

- Associate Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, Lexington, KY, 2014-present.
- Director, Stream and Watershed Science Graduate Certificate, University of Kentucky, Lexington, KY, 2012-present.
- Co-Director, Greenhouse: Environment & Sustainability Residential College, University of Kentucky, Lexington, KY, 2013-present.
- Assistant Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, Lexington, KY, January 2010-2014.
- 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.

Certification or professional registrations

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

Current membership in professional organizations

- Alpha Epsilon Kentucky Omega Chapter
- American Society of Biological and Agricultural Engineers
- American Society of Civil Engineers
- American Society of Engineering Education
- American Society of Mining and Reclamation
- American Society of Water Resources
- Appalachian Regional Reforestation Initiative
- Association for Women Geoscientists

Honors and Awards

- University of Kentucky Gamma Sigma Delta 2015 Master Teacher Award.
- American Society of Biosystems and Agricultural Engineers 2014 A.W. Farrall Young Educator Award.
- American Society of Biosystems and Agricultural Engineers 2014 Educational Aids Blue Ribbon Award, Publications-Short Category, Managing Stormwater Using Low Impact Development (LID) Techniques.
- American Society of Biosystems and Agricultural Engineers Outstanding Reviewer for 2012

Publication Year, Biological Engineering Division.
- Association of Public Land-Grant Universities (APLU) C. Peter Magrath/W.K. Kellogg 2011 Engagement Award for Reclamation of Surface-Mined Lands.

Service Activities
- Advisory council member, University of Tennessee Biosystems Engineering (BsE) program.
- University of Kentucky, Department of Forestry Program Review (Bachelor's Degree in Forestry, Master's Degree in Forestry, Forestry Research, and Forestry Extension), 2015
- University of Kentucky, Biosystems and Agricultural Engineering Department, chair of the research and graduate studies committee.
- American Society of Agricultural and Biological Engineers, chair of E-07 Issues Management and Social Action, M-115 Young Educator, and NRES-25 Streams, Reservoirs, and Wetlands

Select publications and presentations (last five years)
- Agouridis, C.T. 2016. Reconnecting through Stream Restoration. Eds. Lee, B.D., A. Jones, D. Carey, and J. Burch. In Shaped by Water: Kentucky's Watersheds, Landscapes, and People. University Press of Kentucky, Lexington, KY. In Press. (Invited).
- Agouridis, C.T. and T.M. Sanderson. 2016. Understanding Ecosystems and Their Services through Apollo 13 and Bottle Models. Ed. L.B. Byrne. In Learner-Centered Teaching Activities for Environmental and Sustainability Studies. In Press.
- Agouridis, C.T. 2015. Rotational vs. Continuous Stocking Comparisons: Environmental and Wildlife Responses. Technical Note for the USDA-NRCS Conservation Assessment Project, CEAP Conservation Insight. (Invited).
- Williamson, T.J., C.T. Agouridis, C.D. Barton, J.A. Villines, and J.G. Lant. 2015. Delineating Ephemeral, Intermittent, and Perennial Streams in the Eastern Kentucky Coalfield Using a TOPMODEL Based Approach. Journal of the American Water Resources Association 51(60: 1739-1759.
- Villines, J.A., C.T. Agouridis, R.C. Warner, and C.D. Barton. 2015. Using GIS to Delineate Headwater Stream Origins in the Appalachian Coalfields of Kentucky. Journal of the American Water Resources Association 51(6): 1667-1687. doi: 10.1111/1752-1688.12350 (jif: 1.782).

Professional Development
- Stream Restoration Training – In-Channel Structure Design and Placement. 2015. American Society of Civil Engineers Webinar, December 28. (1 PDH)
- University of Kentucky eLearning Innovation Initiative (eLII) Faculty Skill Development: Community 1 (Online Learning), Cohort 1.5, September 2014-August 2015.
- 2014 ASABE Annual International Meeting, Montreal, Quebec Canada, July 13-16.
- 2013 ASABE International Meeting, Kansas City, Missouri, July 20-25.
- College of Agriculture 2012-2013 Faculty Learning Community focused on Student Engagement Techniques.
- Stream Restoration in the Southeast: Innovations for Ecology. 2012. Wilmington, NC, October 15-18.
- College of Agriculture 2011 Spring Teaching Seminar on Distance Learning, May 11

DONALD G. COLLIVER, Ph.D., P.E.
60% Instruction, 20% Administration, 15% Research, 5% Service

Education

University of Kentucky	Agricultural Engineering	B.S., 1974
University of Kentucky	Agricultural Engineering	M.S., 1977
Purdue University	Agricultural Engineering	Ph.D., 1979

Academic Experience

- Director of Graduate Studies, Biosystems and Agricultural Engineering, University of Kentucky, Lexington, Kentucky, June 2014 to present
- 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.
- Visiting Specialist; Air Infiltration and Ventilation Centre, Annex V, International Energy Agency; Coventry, Great Britain, March 1994 to August 1994.
- Assistant Professor; Department of Agricultural Engineering, University of Kentucky, Lexington, Kentucky, June 1979 to June 1985.

Non-academic Experience

- 07/14-Present, Director, Kentucky Industrial Assessment Center, University of KY
- 06/10-Present, Assistant Director, Power and Energy Institute of Kentucky, Univ of KY
- 2007-2009, PI / Advisor, University of KY entry in the US-DOE Solar Decathlon
- July 2004-2014. Chairman. Advanced Energy Design Guide Steering Committee.
- 2005-2006 – Consultant. Setty Associates/U.S. Department of State.
- 5/02-5/03 President, American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 2002-2003
- Chairman, 2003 National Engineers Week

Certification or professional registrations

- Professional Engineer (P.E.), Kentucky License #12228

Current Membership in Professional Organizations

- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), President (2002-2003); ASHRAE Foundation (2006-Present); Society Vice President - Chair Technology Council & 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; College of Fellows (2015-Present)

Honors and Awards

- Center of Excellence Award (Outstanding IAC Center), US-DOE, 2016
- Green Initiative Award. Ball State University. 2013
- Outstanding Service Award. UK College of Engineering. 2013
- Fellow, ASHRAE, 1995

Service Activities

- National Academy of Science. 2012. Analysis of the Cost Effectiveness of Energy and Green Building Codes Relating to the National Defense Authorization Act of 2012.
- DiscoverE (National Engineers Week) National Steering Committee. 2002-Present. (National Chairman 2003). Sponsoring Society Representative.
- KY Center for Renewable Energy Research and Environmental Stewardship (CRERES), 05/09-Present, Board Member, Governor's Appointment
- President, American Society of Heating, Refrigerating and Air Conditioning Engineers, 2002-2003.

Select publications and presentations (last five years)

- *Colliver, DG.* 2015. New and Recent Energy Saving Technologies for Manufacturing Facilities. Corning International Energy Managers Conference. Harrodsburg. KY 11/3/15
- *Colliver, DG*. 2015. The Intersection of Energy, Carbon and You – What Can One Person Do? Western KY Sierra Club Energy Conference. Murray, KY. 10/13/15.
- *Colliver, DG.* 2015. Industrial Assessment Centers: A Project to Teach Students Energy and Resource Auditing and Help Manufacturing Companies. Seminar 41. ASHRAE Annual Conference. Atlanta. 6/30/15.
- *Colliver, DG*. 2014. Addressing the Challenges of Leadership. ASHRAE Chapters Regional Conference Pre-Session. Rogersville, AL. 6/6/14
- *Colliver, DG.* 2013. Energy Auditing in Grain Facilities – With a Case Study from a Large MidWest Grain Elevator. Presentation to the GEAPS (Grain Elevator and Processing Society) Annual Meeting 2013. Louisville. 2/26/13.
- Roberts, A and *D.G. Colliver*. 2013. Time Coincidence of Energy Demand from a Residence and Electrical PV Production. American Solar Energy Society Annual Meeting. Baltimore.
- *Colliver, DG* and S. McNeill. 2013. Results and Recommendations from an Assessment of a Midwest Grain Facility, Part 2. *Grain Journal*, M/J 97-102.
- *Colliver, DG* and S. McNeill. 2013. Results and Recommendations from an Assessment of a Midwest Grain Facility, Part 2. *Grain Journal*, M/A 74-77.
- *Colliver, DG* and C Ramspeck. 2012. An Analysis of the Cost Effectiveness of Energy and Green Building Codes Relating to the National Defense Authorization Act of 2012 – Section 2830(a). National Academy of Science / National Research Council. 9/17/2012.
- *Colliver, DG* and LE Holloway. 2012. An Industrial-Academic Partnership for an Eyes-On Electrical Energy Experiences Class. ASEE 2012 Conference Paper AC 2012-4963.
- Holloway, LE, YT Cheng, *DG Colliver*, A Cramer, P Dolloff, B Gregory, JG Groppo, Y Liao, SLipka, J Neathery, J Parker, V Singh. 2012. A Multidisciplinary Power and Energy Engineering Program. ASEE 2012 Conference Paper AC 2012-4071.

Professional Development:

- Industrial Assessment Center Directors Annual Meeting: Jul 2013 (Niagara Falls), Jul 2014 (Rutgers), Jul 2015 (Washington), May 2016 (New Orleans)
- ASHRAE Winter and Annual Conferences: Jan 2013 (Dallas), Jun 2013 (Denver), Jan 2014 (NYC), Jun (Seattle), Jan 2015 (Chicago), Jun (Atlanta), Jan 2016 (Orlando). Served on Foundation Board of Trustees, Building Performance Task Group, AEDG Steering Comm.

CZARENA CROFCHECK, Ph.D., P.E.
49% Research, 51% Instruction

Education

Michigan State University	Chemical Engineering	B.S., 1994
University of Kentucky	Chemical Engineering	M.S., 1997
University of Kentucky	Biosystems & Agricultural Engineering	Ph.D., 2001

Academic Experience

- Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 2015 to present.
- Associate Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 2007-June 2015.
- Assistant Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, April 2001-June 2007.

Non-academic Experience

None.

Certification or professional registrations

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

Current membership in professional organizations

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

Honors and awards

- University of Kentucky College of Engineering's Dean's Award for Excellence in Service, 2014.
- University of Kentucky Outstanding Biosystems and Agricultural Engineering Teacher, 2005, 2006, 2012, 2013, 2014, 2015, 3026.
- ASABE AW Farrall Young Educator Award, 2009.
- ASABE Honorable Mention Paper Award, 2006, 2007.
- University of Kentucky College of Agriculture Student Council Early Career Outstanding Teaching Award, 2007.
- Henry Mason Lutes Award for Outstanding Engineering Education, 2006.
- University of Kentucky Provost's Award for Outstanding Teaching Award, 2006.
- Gamma Sigma Delta Master Teacher Award, 2006.

Service Activities

- Departmental: Student Recruitment Committee 2001-2005, chair 2004-2006, Undergraduate Teaching and Curriculum Committee 2002-2006, chair 2006-2009.
- College: Graduate Student Awards Committee, Gamma Sigma Delta, 2005, C.E. Barnhart.
- University: Instructional Computing Subcommittee, 2004-2010.

Select publications and presentations (last five years)

- E, X., C. Crofcheck, and M. Crocker. 2016. Application of recycled media and algae-based anaerobic digestate in Scenedesmus cultivation. Journal of Renewable & Sustainable Energy, 8(1):p013116-1-013116-14.
- Crofcheck, C., X. E, S. Nokes, M. Montross. 2015. Modeling Mass and Heat Transfer in Baled Lignocellulosic Feedstock During Solid-state Aerobic Fungi Pretreatment and Anaerobic Bacteria Fermentation. Podium presentation at the Annual Institute of Biological Engineering Meeting, Clayton, MO, March 2015.
- C. Crofcheck, C., A. Shea, M. Crocker, M. Wilson, J. Groppo, M. Montross. Life cycle assessment on a large scale algae CO_2 mitigation system for a coal-fired power plant. Poster presentation at the ASABE Annual International Meeting, New Orleans, LA, July 2015.
- E, X., and C. Crofcheck. 2014. Pretreatment of *Scenedesmus* biomass as a potential anaerobic substrate. 2014. Biological Engineering Transactions, 7(1): 41-52.
- Shin, H.-Y., J.-H. Ryu, S.-Y. Bae, C. Crofcheck, and M. Crocker. 2014. Lipid extraction from *Scenedesmus sp*. microalgae for biodiesel production using hot compressed hexane. Fuel, 130:66-69.
- Crocker, M., M. H. Wilson, J. Groppo, A. Placido, S. Graham, E. Santillan-Jimenez, T. Morgan, J. Shoup, D. Kim, L. Mills, H. Y. Shin, and C. Crofcheck. 2014. CO_2 Recycling using Microalgae for the Production of Fuels. Applied Petrochemical Research, 246.
- Crofcheck, C. 2014. Utilization of a feedback loop in the evaluation of design reports. Podium presentation at the Annual Institute of Biological Engineering Meeting, Lexington, KY, March 2014.
- Amos, K., J. Stork, S. DeBolt, and C. Crofcheck. 2014. Up regulation of Heat Shock Protein 70A (HSP70A) in *Chlamydomonas reinhardtii* via internal promoter and SSA transformation, Podium presentation at the Annual Institute of Biological Engineering Meeting, Lexington, KY, March 2014.
- Rhea, N., C. Crofcheck, and J. Groppo. 2014. Evaluation of sedimentation and vacuum assisted filtration on microalgae with polymeric flocculant addition. Podium presentation at the Annual Institute of Biological Engineering Meeting, Lexington, KY, March 2014.
- Crofcheck, C. 2014. Utilization of Microalgae for CO_2 Mitigation and the Production of Value-Added Products. Invited podium presentation at the ASABE Annual International Meeting, Montreal, Canada, July 2014.
- Crofcheck, C., A. Shea, M. Montross, M. Crocker, and R. Andrews. 2013. Influence of flue gas components on the growth rate of Chlorella vulgaris and *Scenedesmus acutus* utilized for CO_2 mitigation. Transactions of the ASABE, 56(6):1421-1429.
- Frederick, J., C. Crofcheck, S.P. Walker, M.C. Newman, and F. Payne. 2013. Evaluation of Chemical Additives for the Separation and Recovery of Bacteria from Food Matrices. Biological Engineering Transactions, 6(2):105-115.

Professional Development

- Attended ASABE Annual International Meeting (2011-2015)
- Attended Institute of Biological Engineers (2011-2015)
- Attended University of Kentucky workshop: using Canvas. 2015.

JOSEPH DVORAK, Ph.D.
68% Research, 32% Instruction

Education

Oklahoma State University	Biosystems Engineering	B.S., 2005
Oklahoma State University	Biosystems Engineering	M.S., 2007
Kansas State University	Biological & Agricultural Engineering	Ph.D., 2012

Academic Experience

- Assistant Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 2012 to present.

Non-academic Experience

- Systems Design Engineer, The Charles Machine Works, Inc. (Ditch Witch), Perry, Oklahoma. January 2008-August 2009.

Certification or professional registrations

- Professional Engineer (P.E.), since 2015, Kentucky License # 31262

Current membership in professional organizations

- American Society of Agricultural and Biological Engineers (ASABE), member since 2003.

Honors and awards

- ASABE Superior Paper Award (2016) for "An Optical Sprayer Nozzle Flow Rate Sensor"

Service Activities

- Departmental: Computer Committee 2013-2016, Undergraduate Curriculum Committee 2013-2016, chair 2015-2016, and BAE Student Branch Advisor. 2013-2016.
- University: Kentucky 4-H Teen Conference Workshop, "There's an App for That." 2015
- National: ITSC Technical Community Vice Chair. Officer on 4 other technical committees.

Select publications and presentations (last five years)

- Dvorak, Joseph, Stone, Marvin, and Self, Kelvin. Object Detection for Agricultural and Construction Environments using an Ultrasonic Sensor. Journal of Agricultural Safety and Health. In Press.
- Dvorak, J. and Dvorak, T. Utilizing Wii technology to teach acceleration to middle school students. Transactions of the ASABE. In Press.
- Dvorak, Joseph, McNeill, Sam and Hardy, Clint. 2015. Wet Grain Delivery Advice: A Previously Impossible Extension Challenge Solved Through Apps. Journal of Extension [On-line]. In Press.
- Dvorak, J.S. and Bryant, L.E. 2015. An optical sprayer nozzle flow rate sensor. Transactions of the ASABE. 58(2): 251-259. (doi: 10.13031/trans.58.10765)
- Zhang, N., Dvorak, J. S., and Zhang, Y. 2013. A Correlation-Based Optical Flowmeter for Enclosed Flows. Transactions of the ASABE. 56(6): 1511-1522.

- Dvorak, Joseph S., Tanya C. Franke-Dvorak, and Randy R. Price. 2012. "" Apps"—An Innovative Way to Share Extension Knowledge." *Journal of Extension* 50, no. 6: 6IAW2.
- Dvorak, J.S. Electrical Energy for Agricultural Machinery. Oral Presentation. 2015 Electric and Hybrid Vehicle Technology Conference. Novi, Michigan. September 15-17, 2015
- Dvorak, J.S., Rounsaville, J. RAFiE - The 30HP Autonomous Tractor. Oral Presentation. 2015 ASABE Annual International Meeting, New Orleans, LA. July 26-29, 2015.
- Dvorak, J.S. Application testing of an optical individual sprayer nozzle agent concentration sensor. Oral Presentation. 2015 ASABE Annual International Meeting, New Orleans, LA. July 26-29, 2015.
- Seyyedhasani, H., Dvorak, J.S. Optimal Path Planning Using NSGA II. Oral Presentation. 2015 ASABE Annual International Meeting, New Orleans, LA. July 26-29, 2015.
- Dvorak, J.S., Seyyedhasani, H. Testing of Tablet-Based GPS Systems. Oral Presentation. 2014 ASABE Annual International Meeting, Montreal, QC, Canada. July 12-17, 2014.
- Dvorak, J.S., Dvorak, T.C., Neel, S. Utilizing Wii Technology to Teach Acceleration. Oral presentation. 2013 ASABE Annual International Meeting, Kansas City, MO. July 21- July 24, 2013.
- Dvorak, J.S., Byrant, L. Optical Sprayer Nozzle Discharge Sensor. Poster presentation. 2013 ASABE Annual International Meeting, Kansas City, MO. July 21- July 24, 2013.
- Jackson, J., Dvorak, J. Testing the efficiency of a series hybrid drivetrain for use in agricultural equipment. Oral presentation. 2013 ASABE Annual International Meeting, Kansas City, MO. July 21- July 24, 2013.
- Dvorak, J.S., Byrant, L. Optical Sprayer Nozzle Discharge Sensor. Poster Presentation. 2013 Kentucky Innovations and Entrepreneurship Conference, Lexington, KY. August 29, 2013.
- 2014 Kentucky Cooperative Extension Professional Development Conference. February 26, 2014. Creating an Android App. Presentation on basics of app development and how to make simple apps. 140 attendees.
- Precision in Practice. Successful Farming. April 2015.
- 2016 Kentucky Fruit and Vegetable Conference. The Future: Autonomous Tractors. Invited presentation.

Professional Development

- Attended a technology fair sponsored by the College of Agriculture, “College of Agriculture Teaching and Technology Fair.” August 2012.
- Attended a seminar sponsored by the College of Agriculture, “Using iPads for instruction and extension.” August 2012.
- Member of eLII Faculty cohort 1.5, “Blended,” Faculty Learning Community to advance the blended learning style especially in BAE 305.
    - Monthly discussion meetings with other faculty implementing hybrid learning styles.
    - Presentations to larger eLII faculty groups at the end of each semester
    - Attended at least 30 hours of faculty training workshops (mostly CELT workshops) in areas relating to blended online and classroom instruction
- Attended ASABE Annual International Meeting (2012, 2013, 2014, and 2015)
- Attended Multi-State Meetings (2013 and 2014) to discuss opportunities in vegetable production automation.

DWAYNE R. EDWARDS, Ph.D., P.E.
50% Research, 50% Instruction

Education

University of Arkansas	Agricultural Engineering	B.S., 1984
University of Arkansas	Agricultural Engineering	M.S., 1986
Oklahoma State University	Agricultural Engineering	Ph.D., 1988
U.S. Army War College	Strategic Studies	M.S., 2005

Academic 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.

Certification or professional registrations

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

Current membership in professional organizations

- 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)

Honors and Awards

- ASAE New Holland Young Researcher Award, 2000.
- Honorable Mention, ASAE Paper Competition, 1999.
- Environmental Excellence Award, U.S. Environmental Protection Agency, 1995.
- 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.
- USDA National Needs Fellowship, Oklahoma State University, 1986-1988.

Service Activities

- Director of Graduate Studies, Biosystems and Agricultural Engineering Department, University of Kentucky, 2003-2013.
- University of Kentucky, Kentucky Water Resources Institute Oversight Committee, 1997-present.
- Publications Council, ASAE, 2002-present. Vice Chair, 2002-2004. Chair, 2004-2006.
- Regional Research Project S-1063, 2014-present.

Select publications and presentations (last five years)

- Edwards, D.R. 2016. Spatio-temporal variation of runoff curve number for grassed plots in central Kentucky. *Hydrological Processes* (in review).
- Bullock, E.L., D.R. Edwards, P.A. Moore, Jr. and R.S. Gates. 2016. Effects of chemical amendments to swine manure on runoff quality. *Transactions of the ASABE* (in review).
- Williams, R.E. and D.R. Edwards. 2016. Effects of biochar treatment of municipal biosolids and horse manure on quality of runoff from fescue plots. *Transactions of the ASABE* (in review).
- Lidong, H., P.A. Moore, Jr., P.J.A. Kleinman, K.R. Elkin, M.C. Savin, D.H. Pote and D.R. Edwards. 2016. Reducing phosphorus runoff and leaching from poultry litter with alum: twenty-year small plot and paired-watershed studies. *Journal of Environmental Quality* (in press).
- Chattopadhyay, S. and D.R. Edwards. 2016. Long-Term Trend Analysis of Precipitation and Air Temperature for Kentucky, United States. *Climate* 4(1): 10-24. doi: 10.3390/cli4010010
- Maupin, T.P., C.T. Agouridis, D.R. Edwards, C.D. Barton, R.C. Warner, and M.P. Sama. 2013. Specific Conductivity Sensor Performance: II. Field Evaluation. 2013. *International Journal of Mining, Reclamation and Environment*: 1-21. Published online March 22, 2013. doi: 10.1080/17480930.2013.764702 (jif: 0.392)

Professional Development

- Nuclear Instrument Safety and Hazardous Materials, 2016
- Kentucky Water Resources Research Institute Symposium, 2016
- Canvas Learning Management System, 2015
- International meeting of ASABE, Kansas City, 2013.
- Senior Leader Development Program, University of Notre Dame, 2012

SAMUEL GAITHER MCNEILL, Ph.D., P.E.
20% Research, 80% Extension

Education

University of Kentucky	Agricultural Engineering	B.S., 1974
University of Kentucky	Agricultural Engineering	M.S., 1979
University of Tennessee	Agricultural Engineering	Ph.D., 1996

Academic Experience

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

Current membership in professional organizations

- American Society of Agricultural and Biological Engineers (ASABE), 1979-present.
- Kentucky Association of State Extension Professionals (KASEP), 1979-present.

Honors and awards

- ASABE Blue Ribbon Award for Innovative Extension Methods, 2015.
- Outstanding Specialist Award. Kentucky Association of County Agricultural Agents. 2014.
- Wethington Award. University of Kentucky. 2010, 2011, 2012, 2013, 2014, 2015.
- Service Award (35 years). UK Cooperative Extension Service. 2014.

Select publications and presentations (last five years)

- McNeill, S.G. and M.D. Montross. 2015. Harvesting, drying and storing organic corn *In:* Organic corn production in Kentucky. Cooperative Extension Publication ID-225.
- Boac, J.M., R. Bhadra, M.E. Casada, S.A. Thompson, A.P. Turner, M.D. Montross, S.G. McNeill and R.G. Maghirang. 2015. Stored grain pack factors for wheat: comparison of three methods to field measurements. Transactions of the ASABE 58(4): 1089-1101.
- Bhadra, R., A.P. Turner, M.E. Casada, S.A. Thompson, J.M. Boac, M.D. Montross, S.G. McNeill, and R.G. Maghirang. 2015. Pack factors for corn in grain storage bins. Transactions of the ASABE 58(3): 879-890.
- McNeill, S.G., P.A. Armstrong and E. Osekre. 2015. Assessment of moisture measurement and maize dryers in Ghana. Proceedings: 1st International Congress on Postharvest Loss Prevention. Rome, Italy. Oct. 4-7.
- Bhadra, R., J.M. Boac, M.E. Casada, S. Thompson M.D. Montross, S.G. McNeill and R. Maghirang, 2014. Field measurements for grain compaction in commercial storage in the U.S. ASABE Paper No. 141899383 presented at ASABE AIM, Jul. 13-16. Montreal, CN.
- McNeill, S. 2014. How energy costs impact corn harvest decisions. Family Farms Conference. San Antonio, TX. Jan. 23.
- McNeill, S. 2014. Costs of drying corn vs harvest losses. UT No-till Field Day, Milan, TN. Jul 24.

- McNeill, S. 2013. Why Dry Grain? A cost comparison of corn harvest losses and drying costs. Farm Progress Show (Ten 20 min lectures in three days). Aug. 27-29.
- McNeill, S.G., M.E. Casada, M.D. Montross, S.A. Thompson, R.G. Maghirang, J.M. Boac and R. Bhadra. 2013. New models for describing grain packing. ASABE Paper No. 1620757 presented at ASABE AIM, Jul. 21-24. Kansas City, MO.
- Overhults, D.G., M.A. Hagan, S.G. McNeill and M.D. Montross. 2013. A summary of farm energy audits in Kentucky. ASABE Paper No. 1620937 presented at ASABE AIM, Jul. 21-24. Kansas City, MO.
- Colliver, D. and S. McNeill. 2013. Energy audit for a commercial grain elevator. Grain Elevators and Processors Society. Louisville, KY. Feb 26.
- McNeill, S. and P. Vincelli. 2012. Harvesting and storing Kentucky's 2012 corn crop. UK CES Kentucky Pest News. No. 1214. <http://www.uky.edu/Agriculture/kpn/kpnhome.htm>
- Vincelli, P. and S. McNeill. 2012. Aflatoxin in stored corn. UK-CES Kentucky Pest News Alert. 24(5). <http://www.uky.edu/Agriculture/kpn/kpnhome.htm>
- C. Walters, S. McNeill and D. Johnson. 2012. Benefits and costs associated with the wheat storage hedge. UK Extension Pub. ID-198.
- McNeill, S.G. 2011. Drying the 2011 corn and soybean crops. UK-PPS Grain Crops Update. <http://graincrops.blogspot.com/2011/09/drying-2011-corn-and-soybean-crops.html>
- Opit, G., S. McNeill and K. Ileleji. 2011. Protecting stored grain with IPM to reduce post-harvest grain losses. OKSU Extension Publication L-352.
- Opit, G., S. McNeill and K. Ileleji. 2011. Protecting stored grain with proper fumigation. OKSU Extension Publication L-350.
- Ileleji, K., S. McNeill and G. Opit. 2011. Protecting stored grain with D.I.C.E. Purdue Extension Publication ABE-131.

Professional Development

- First International Congress on Postharvest Loss Prevention. Rome, Italy. Oct. 4-8, 2015.
- Annual International Meeting of ASABE. New Orleans, LA. Jul. 26-29, 2015.
- Global Food Security Symposium. Washington, D.C. Apr. 15, 2015.
- NC-213 Annual Meeting. Feb. 18-19, 2015. Kansas City, MO.
- Annual International Meeting of ASABE. Montreal, CN. Jul. 13-16, 2014.
- NC-213 Annual Meeting. Feb. 24-26, 2014. Omaha, NB.
- UK Winter Wheat Seminar. Hopkinsville, KY. Jan. 7, 2014.
- Tennessee Renewable Energy Seminar, Clarksville, TN. Jul. 9, 2013.
- KY Association of State Extension Profs. Spring meeting. Frankfort, KY. Apr. 11. 2013.
- Annual International Meeting of ASABE. Kansas City, MO. Jul. 21-24, 2013.
- Grain Elevators and Processors Society Annual Meeting. Louisville, KY. Feb. 26, 2013.
- Workshop to reduce global post-harvest losses, Washington, D.C. Jan. 13, 2013.

ALICIA MODENBACH, Ph.D., EIT
Instructor

Education

Louisiana State University	Biological and Agricultural Engineering	B.S., 2006
University of Kentucky	Biosystems and Agricultural Engineering	M.S., 2008
University of Kentucky	Biosystems and Agricultural Engineering	Ph.D., 2013

Academic Experience

- Engineer Associate for Academics, Biosystems and Agricultural Engineering Department, University of Kentucky, February 2014-Present
- Post-Doctoral Scholar, Biosystems and Agricultural Engineering Department, University of Kentucky, August 2013-January 2014

Non-academic Experience

None.

Certification or professional registrations

- Engineer in Training (EIT), since 2007

Current membership in professional organizations

- American Society of Agricultural and Biological Engineers (ASABE), member since 2005.
- American Society of Engineering Education (ASEE), member since 2014.

Honors and awards

- Gale A. Holloway Professional Development Award, 2016.
- Order of the Engineer, 2011
- New Faces of ASABE, 2011
- 2010 Chancellor's Sesquicentennial Service Award, 2010
- National Science Foundation Fellowship, 2008-2011

Service Activities

- Departmental: Undergraduate Curriculum Committee 2014-Present; Student Recruitment and Outreach Committee 2014-Present; Alumni and Development Committee 2014-Present; Research and Graduate Studies Committee 2011-2012, 2014-Present; Departmental Seminar Committee 2007-2011, 2013-Present.
- College: BAE Periodic Program Review Committee 2011-2012.
- Professional Society (ASABE): Membership Development Council, Young Professional Community (YPC) representative 2013-2015, vice chair 2014-2015, chair 2015-present; YPC Executive Committee, Membership Development representative 2013-2015, Member-at-large 2010-2013; Bioconversion and Bioprocesses Technical Committee 2013-2014; Marketing and External Communication Committee 2012-Present; National Engineers' Week Subcommittee, chair 2012-Present; Alpha Epsilon Honor Society, National Secretary and Treasurer 2009-2014; Student Organizations Committee 2008-Present.

Select publications and presentations (last five years)

- Engineering Girl Day Faculty Q&A Panel. Presented during the University of Kentucky College of Engineering E-Week activities to prospective female students and their families (approximately 60 people), Lexington, KY. 2016.
- Modenbach, A., Nokes, S., Day, G., Adams, W. An alternative approach to introducing the engineering design process to freshmen engineering students. ASABE Annual International Meeting, Montreal, Quebec, Canada. 2014.
- Modenbach, A.A., Nokes, S.E. 2014. Effects of sodium hydroxide pretreatment on structural components of biomass. Transactions of the ASABE. 57(4): 1187-1198.
- Modenbach, A., Nokes, S. Effects of solids loadings in sodium hydroxide pretreatment and enzymatic hydrolysis of corn stover. IBE Annual Meeting, Lexington, KY. 2014.
- Modenbach, A., Nokes, S. Example of freshmen biological engineering design projects. IBE Annual Meeting, Lexington, KY. 2014.
- Modenbach, A., Nokes, S. Towards improving hydrolysis of sodium hydroxide pretreated corn stover at high-solids loadings. ASABE Annual International Meeting, Kansas City, MO. 2013.
- Gray, K., Nokes, S., Montross, M., Modenbach, A., Jackson, J. Investigation of alkaline hydrogen peroxide pretreatment for its use in an on-farm butanol bioprocessing facility. Poster presented at the ASABE Annual International Meeting, Kansas City, MO. 2013.
- Modenbach, A.A., Nokes, S.E. 2013. Enzymatic hydrolysis of biomass at high-solids loadings – A review. Biomass and Bioenergy. 56: 526-544.
- Modenbach, A., Nokes, S., Montross, M., Knutson, B. 2012. Characterization of soluble and insoluble inhibitor effects on enzymatic hydrolysis at high solids using pretreated corn stover. ASABE Annual International Meeting, Dallas, TX, 2012.
- Modenbach, A.A., Nokes, S.E. 2012. The use of high-solids loadings in biomass pretreatment – A review. Biotechnology and Bioengineering. 109(6): 1430-1442.
- Modenbach, A., Nokes, S., Knutson, B., Rankin, S. 2011. Recovery of a Purified Stream of C5 Sugars from Lignocellulosic Hydrolyzate Using Microphase-Directed Imprinted Materials. ASABE Annual International Meeting, Louisville, KY, 2011.
- Modenbach, A., Nokes, S., Knutson, B., Rankin, S. 2011. Recovery of a Purified Stream of C5 Sugars from Lignocellulosic Hydrolyzate Using Microphase-Directed Imprinted Materials. Poster presented at the S-1041 Annual Symposium, Stillwater, OK, 2011.

Professional Development

- Accommodating Accommodations: How to Work with Students with Disabilities or Emotional Concerns. College of Agriculture, Food and Environment Lunch-and-Learn Series presented by Dr. Leisa Pickering and Dr. Matt Ashton, April 13, 2016.
- Panel Discussion with Underrepresented Students in STEM. Facilitated by CELT and Dr. Renee Fatemi, April 7, 2016.
- SafeZone Workshop. University of Kentucky Office of LGBTQ* Resources presented by Lance Poston, March 2, 2016.
- Teaching the Millennials with the Net Generation on the Way (Advice from a Boomer). Graduate Student Workshop presented by Bill Burke, November 10, 2011.
- Preparing for the Professoriate: What You Can Do Now to Optimize Your Success. Graduate Student Workshop presented by Morris Grubbs and Linda Worley, April 13, 2011.

MICHAEL D. MONTROSS, Ph.D., P.E.
65% Research, 30% Instruction, 5% Extension

Education

Michigan State University	Agricultural Engineering	B.S., 1994
Michigan State University	Agricultural Engineering	M.S., 1995
Purdue University	Agricultural Engineering	Ph.D., 1999

Academic Experience

- Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 2012 to present
- Associate Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 2005 to June 2012.
- Assistant Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, November 1999-June 2005.

Certification or professional registrations

- Professional Engineer (P.E.), since 2003, Kentucky License #23403

Current membership in professional organizations

- American Society of Agricultural and Biological Engineers, member since 1994.

Honors and Awards

- Outstanding Teacher in Biosystems and Agricultural Engineering 2008, 2009.
- Loys Mather Teaching Award 2007.

Service Activities

- 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, SE-202 Bulk Solids Storage Systems (2001 to present), Vice-Committee chair (2003), program chair (2006).
- ASAE, PM-23/7/2 Forage and Biomass Engineering (2004 to present).
- ASAE, FPE-709 Biomass Energy and Industrial Products (2006 to present).

Select publications and presentations (last five years)

- A.P. Turner, M.D. Montross, J.J. Jackson, S.G. McNeill, M.E. Casada, J.M. Boac, R. Bhadra, R.G. Maghirang, S.A. Thompson. 2016. Error analysis of stored grain inventory determination. Trans. ASABE. In press.
- A.P. Turner, M.D. Montross, J.J. Jackson, S.G. McNeill, M.E. Casada, J.M. Boac, R. Bhadra, R.G. Maghirang, S.A. Thompson. 2016. Modeling the Compressibility Behavior of Hard Red Wheat Varieties. Trans. ASABE. In press.

- Jackson, J.J., A.P. Turner, T. Mark, M.D. Montross. 2016. Densification of biomass using a pilot scale flat ring roller pellet mill. Jrnl of Fuel Proc. Tech. 148: 43-49.
- Bhadra, R., A. P. Turner, M. E. Casada, M. D. Montross, S. A. Thompson, J. M. Boac, S. G. McNeill and R. G. Maghirang (2015). "Pack factor measurements for corn in grain storage bins." Transactions of the Asabe **58**(3): 879-890.
- Boac, J. M., R. Bhadra, M. E. Casada, S. A. Thompson, A. P. Turner, M. D. Montross, S. G. McNeill and R. G. Maghirang (2015). "Stored grain pack factors for wheat: Comparison of three methods to field measurements." Transactions of the Asabe **58**(4): 1089-1101.
- Crofcheck, C., A. Shea, M. Montross, M. Crocker and R. Andrews (2013). "Influence of flue gas components on the growth rate of chlorella vulgaris and Scenedesmus acutus." Transactions of the Asabe **56**(6): 1421-1429.
- do Nascimento, J. W. B., J. P. L. Neto and M. D. Montross (2013). "Horizontal pressures in cylindrical metal silos and comparison with different international standards." Engenharia Agricola **33**(4): 601-611.
- Martinez-Martinez, V., J. Gomez-Gil, T. S. Stombaugh, M. D. Montross and J. M. Aguiar (2015). "Moisture content prediction in the switchgrass (Panicum virgatum) drying process using artificial neural networks." Drying Technology **33**(14): 1708-1719.
- Montross, M. D., S. De Bolt and W. C. Adams (2013). "Interplay between yield, nitrogen application, and logistics on the potential energetic and greenhouse gas emissions from biomass crops." Global Change Biology Bioenergy **5**(6): 664-673.

Professional Development

- Attended ASABE Annual International Meetings (2010, 2011, 2012, 2013, 2014, and 2015)

SUE E. NOKES, Ph.D., P.E.
55% Research, 25% Instruction, 20% Administration

Education

The Ohio State University	Agricultural Engineering	B.S., June 1982
The Ohio State University	Agricultural Engineering	M.S., December 1983
North Carolina State University	Biological and Agricultural Engineering, Biomathematics (minor)	Ph.D., May 1990

Academic Experience

- Chair, Biosystems and Agricultural Engineering, University of Kentucky, 7/1/2011 - present.
- 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.

Non-Academic Experience

- Mechanical Engineer, Directorate of Engineering and Housing, Fort Benjamin Harrison, Indianapolis, Indiana. July, 1984 - July, 1985.
- Product Engineer, Ford Motor Company, Climate Control Division, Dearborn, Michigan. September, 1983 - June, 1984.

Certification or professional registrations

- Professional Engineer (P.E.), since 1995, State of Ohio

Current membership in professional organizations

- American Society of Agricultural and Biological Engineers (ASABE)
- American Society for Engineering Education (ASEE)
- American Institute for Medical and Biological Engineers (AIMBE)

Honors and Awards

- ASABE, Inducted as Fellow, 2016
- American Institute for Medical and Biological Engineers, Inducted as Fellow, 2014
- Provost's Outstanding Teacher Award, University of Kentucky, 2012.
- Outstanding Teacher Award, BAE, College of Engineering University of Kentucky, 2011.
- Wethington Award (Award for obtaining extramural funding), 2006-2015.
- Recognized at half-time at the UK men's basketball game for receiving the Excellence in Teaching Award, January 28, 2004.
- USDA-NASULGC Excellence in Teaching Award, Southern Region. November 2003.
- Superior ASAE Paper Award. 2002. (2.5% of the papers published in 2002 were selected as Superior.)

Service Activities

- ASABE Treasurer, July, 2013 – Present
- ABET Program Evaluator, 2007 – Present
- Institutional Diversity Advisory Council; Senate Council Liaison. September 2010-July, 2011. (resigned to become Department Chair)
- Senate Council member, January, 2010-July, 2011. (resigned to become Department Chair)
- ASABE Nominating Committee, July, 2010-June, 2011
- Senate Council 2009-May, 2012
- Faculty Senate, 2009-May, 2012
- Academic Area Advisory Committee for the Physical and Engineering Sciences; 2009-2011

Select publications and presentations (last five years)

- Flythe, M.D., Elia, N.M., Schmal, M.B., and S.E. Nokes. 2015. Switchgrass (*Panicum virgatum*) Fermentation by *Clostridium thermocellum* and *Clostridium beijerinckii* Sequential Culture: Effect of Feedstock Particle Size on Gas Production. Advances in Microbiology. 5:311-316.
- Modenbach, A.A., and S.E. Nokes. 2014. Effects of sodium hydroxide pretreatment on structural components of biomass. Transactions of the American Society of Agricultural and Biological Engineers 57(4):1187-1198.
- Yao, W., and S.E. Nokes. 2014. First proof of concept of sustainable metabolite production from high solids fermentation of lignocellulosic biomass using a bacterial co-culture and cycling flush system. Bioresource Technology 173(Dec):216-223.
- Yao, W. and S.E. Nokes. 2014. *Phanerochaeta chrysosporium* Pretreatment of Biomass to Enhance Solvent Production in Subsequent Bacterial Solid-substrate Cultivation. Biomass & Bioenergy. 62(Mar): 100-107.
- Yao, W., and S.E. Nokes. 2013. The use of co-culturing in solid substrate cultivation and possible solutions to scientific challenges. Biofuels, Bioproducts, & Biorefining-BIOFPR. 7(4):361-372.
- Petti, C., Shearer, A., Tateno, M., Ruwaya, M., Nokes, S.E., Brutnell, T., and S. DeBolt. 2013. Comparative feedstock analysis in *Setaria viridis L*. as a model for C4 bioenergy grasses and Panicoid crop species. Frontiers in Plant Science 19 June 2013. Published online: doi: 10.3389/fpls.2013.00181.
- Modenbach, A.A., and S.E. Nokes. 2013. Enzymatic hydrolysis of biomass at high-solids loadings - a review. Biomass & Bioenergy 56(Sep):526-544.
- Li, H-F., Knutson, B.L., Nokes, S.E., Lynn, B.C., and M.D. Flythe. 2012. Metabolic control of *Clostridium thermocellum* via inhibition of hydrogenase activity and the glucose transport rate. Applied Microbiology & Biotechnology. Feb: 93(4):1777-84. doi 10.1007/s00253-011-3812-3.

Professional Development

- Engineering Research Council Annual Conference, March 7-9, 2016. ASEE.
- ASABE Annual International Meeting, attend yearly 1995-2016.
- Attended 18th World Congress of CIGR, Beijing, China September 16-19, 2014
- American Institute of Medical and Biological Engineers Conference, March 2014

MARK A. PURSCHWITZ, Ph.D.
75% Extension, 15% Research, 10% Instruction

Education

Purdue University	Agricultural Engineering	B.S., 1977
Purdue University	Agricultural Engineering	M.S., 1981
Purdue University	Agricultural Engineering	Ph.D., 1989

Academic 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.
- Research Engineer, Agricultural Safety, National Farm Medicine Center, Marshfield Clinic Research Foundation, Marshfield, WI, 2003-2007.
- 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.
- Director, University of Wisconsin-Madison/Extension Center for Agricultural Safety and Health, 1994-2003.
- Assistant Professor, (100% Extension) and Extension Safety Specialist, Department of Agricultural & Biological Engineering, Clemson University, Clemson, SC, 1990-1993.

Current membership in professional organizations

- American Society of Agricultural and Biological Engineers (ASABE), member since 1979.
- International Society for Agricultural Safety and Health (ISASH), member since 1986, (past president, 1996).

Honors and Awards

- Journal of Agromedicine Peer Reviewer of the Year, 2015.
- ASABE "SMV Technologies Ergonomics, Safety and Health Award" (highest award for agricultural safety work), 2012.
- ASABE Blue Ribbon Award for Educational Aids, 1996 (2x), 1997, 2011
- University of Wisconsin – Madison, College of Agricultural and Life Sciences, John S. Donald Short Course Teaching Award, 1998.

Service Activities

- USDA NCERA-197, North Central Education/Extension and Research Activity Committee on Agricultural Safety and Health Research and Extension, 2008-present.
- American Society of Agricultural and Biological Engineers, ESH-01 (Ergonomics, Safety,

and Health Division Executive Committee), 2006-present.
- 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-present.

Select publications and presentations (last five years)
- Sorensen, J.A., P.L. Jenkins, B. Bayes, M.A. Purschwitz, and J.J. May. 2013. Increases in Rollover Protective Structure Pricing from 2006-2012 and the Impact on ROPS Demand. Journal of Agricultural Safety and Health 19(2): 115-124.
- Myers, M.L. and M.A. Purschwitz. 2012. ROPS Deficiency of Gray Market Tractors. Journal of Agricultural Safety and Health 18(2): 129-140
- Purschwitz, M.A., J. Wilhoit, and R. Pearce. 2012. Introductory Safety Training for Tobacco Workers (bilingual – Spanish). Extension Publication ID-204. UK Cooperative Extension. 16 pages.
- Purschwitz, M.A. 2012. New Kentucky Administrative Regulation for Transporting or Moving Overweight or Overdimensional Farm Equipment. AEU-98. UK Cooperative Extension, Biosystems and Agricultural Engineering Update. Two pages.
- Purschwitz, M.A. 2012. Selecting the Right SMV Emblem and Reflective Materials. AEU-97. UK Cooperative Extension, Biosystems and Agricultural Engineering Update. Two pages
- Purschwitz, M.A. 2012. Tractor Rollover Safety and ROPS. PowerPoint presentation for use by county Extension agents and others. UK Cooperative Extension, Dept. of Biosystems and Agricultural Engineering.
- Purschwitz M.A. and J. Wilhoit. 2011. Safety in Tobacco Production. In 2011-2012 Kentucky & Tennessee Tobacco Production Guide [Ed. K.W. Seebold], UK Extension Publication ID-160, Cooperative Extension Service, University of Kentucky College of Agriculture; pp. 50-52.
- Sorensen, J.A., E.A. McKenzie, Jr., M.A. Purschwitz, T. Fisk, P.L. Jenkins, P. O'Hara, and J.J. May. 2011. Results from Inspections of Farmer-Installed Rollover Protective Structures. Journal of Agromedicine 16(1):19-29.

Professional Development
- National Green Industry and Equipment Expo, October 22, 2015, Louisville.
- Int. Soc. for Agr. Safety and Health Annual Mtg., June 22-25, 2015, Bloomington, IL.
- National Farm Machinery Show, Feb. 11, 2015 and Feb. 12, 2014, Louisville.
- ASABE Agricultural Equipment Technology Conference, Feb. 9-10, 2015, Louisville.
- National Safety in Agriculture for Youth Conference, October 27-28, 2014, Louisville.
- Nordic Mtg. on Agr. Occupational Health and Safety, Aug. 27-29, 2012, Ystad, Sweden
- ASABE Annual International Meeting, July 28-Aug 1, 2012, Dallas, TX.

MICHAEL P. SAMA, Ph.D., P.E.
67.7% Research, 32.3% Instruction

Education

Rensselaer Polytechnic Institute	Computer and Systems Engineering	B.S., 2004
University of Kentucky	Biosystems and Agricultural Engineering	M.S., 2008
University of Kentucky	Biosystems and Agricultural Engineering	Ph.D., 2013

Academic Experience

- Assistant Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 2013-present.
- Adjunct Instructor, Biosystems and Agricultural Engineering Department, University of Kentucky, January 2010-June 2013.

Non-academic Experience

- Electrical Engineering Consultant, August 2013-present.

Certification or professional registrations

- Professional Engineer (P.E.), December 2011-present, Kentucky License # 28355

Current membership in professional organizations

- American Society of Agricultural and Biological Engineers (ASABE), member since 2004.

Honors and awards

- ASABE Superior Paper Award, 2015.
- Outstanding Doctoral Student, Gamma Sigma Delta Kentucky Chapter, 2012.
- New Faces of Engineering, National Engineers Week, 2012.
- New Faces of ASABE, American Society of Agricultural and Biological Engineers, 2012.
- ASABE Sunkist Young Designer Award, 2011.
- Outstanding Masters Student, Gamma Sigma Delta Kentucky Chapter, 2006.
- Gamma Sigma Delta Kentucky Chapter, 2006.
- Alpha Epsilon Kentucky Omega Chapter, 2005.

Service Activities

- Departmental: Faculty Secretary, 2013-2015; Student Recruitment and Outreach Committee, Chair, 2014-2015; Social Committee, 2014-2015; Alumni and Development Committee, Chair, 2015-2016; Building, Maintenance and Safety Committee, Chair, 2013-2014; Undergraduate Curriculum Committee, 2013-2016; Computer Committee, 2005-2011; Wildcat Pulling Team, Faculty Advisor, 2011-2016; Livestock Systems Faculty Position Search Committee, 2015-2016.
- College: Ag Systems Modeling Faculty Position Search Committee, 2014.

Select publications and presentations (selected last five years)

- Kesterson, M.A., J.D. Luck, M.P.Sama. 2015. Development and Preliminary Evaluation of a Spray Deposition Sensing System for Improved Pesticide Application. *Sensors*. Vol. 15(12): 31965-31972.
- Luck, J.D., S.A. Shearer, M.P. Sama, S.K. Pitla. 2015. Control System Development and Response of an Electronically Actuated Variable-Orifice Nozzle for Agricultural Pesticide Application. *Transactions of the ASABE*. Vol 58(4): 997-1008.
- Sama, M.P., J.D. Luck, T.S. Stombaugh. 2015. Scalable Control Architecture for Variable-Rate Turn Compensation. *Applied Engineering in Agriculture*. Vol. 31(3): 425-435.
- Luck, J.D., S.K. Pitla, M.P. Sama, S.A. Shearer. 2015. Flow, Spray Pattern and Droplet Spectra Characteristics of an Electronically Actuated Variable-Orifice Nozzle. *Transactions of the ASABE*. Vol. 58(2): 261-269.
- Sama, M.P., T.S. Stombaugh. 2014. Performance Evaluation of a Tracking Total Station as a Position Reference for Dynamic GNSS Accuracy Testing. *Applied Engineering in Agriculture*. Vol. 30(4): 557-563.
- Sama, M.P., T.S. Stombaugh, J.E. Lumpp. 2013. A Hardware Method for Time-Stamping Asynchronous Serial Data Streams Relative to GNSS Time. *Computers and Electronics in Agriculture*. Vol. 97: 56-60.
- Maupin, T.P., C.T. Agouridis, D.R. Edwards, C.D. Barton, R.C. Warner, M.P. Sama. 2013. Specific Conductivity Sensor Performance: II. Field Evaluation. *International Journal of Mining, Reclamation and Environment*. Vol. 27(5): 345-364.
- Zandonadi, R.S., T.S. Stombaugh, J.D. Luck, M.P. Sama, S.A. Shearer. 2011. A Computational Tool for Estimating Off-Target Application Areas in Agricultural Fields. *Transactions of the ASABE*. Vol. 54(1): 41-49.
- Luck, J.D., S.K. Pitla, R.S. Zandonadi, M.P. Sama, S.A. Shearer. 2011. Estimating Off-Rate Pesticide Application Errors Resulting from Agricultural Sprayer Turning Movements. *Precision Agriculture*. Vol. 12(4): 534-545.

Professional development (selected from the last five years)

- AUTONAVx: Autonomous Navigation for Flying Robots, Technische Universität München, 2015.
- ASABE Agricultural Equipment Technology Conference. Louisville, KY. 2016.
- Kentucky Transportation Cabinet Drone Workshop. Lexington, KY. 2015.
- VDI Wissenforum 73. International Landtechnik. Hannover, Germany. 2015.
- ASABE Annual International Meeting. New Orleans, LA. 2015
- ASABE Agricultural Equipment Technology Conference. Louisville, KY. 2015.
- The InfoAg Conference. St. Louis, MO. 2014.
- ASABE Annual International Meeting. Montreal. Quebec, Canada. 2014.
- Kentucky Corn Growers Association CORE Farmer Program. Louisville, KY. 2014.
- ASABE Agricultural Equipment Technology Conference. Louisville, KY. 2014.
- Kentucky Summit – Unmanned Aerial Systems. Lexington, KY. 2013.
- VDI Wissenforum 71. International Landtechnik. Hannover, Germany. 2013.
- ASABE Annual International Meeting. Kansas City, MO. 2013.
- ASABE Annual International Meeting. Dallas, TX. 2012.
- ASABE Annual International Meeting. Louisville, KY. 2011.

JIAN SHI, Ph.D.
75% Research, 25% Instruction

Education

Chongqing University	Metallurgical Engineering	B.S., 1999
China Agricultural University	Food Science and Engineering	M.S., 2003
North Carolina State University	Biological and Agricultural Engineering	Ph.D., 2007

Academic Experience

- Assistant Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 2015-present.
- Postdoc, Joint BioEnergy Institute, Sandia National Labs, March 2012-Juanuary 2015.
- Research Associate II, OARDC, Ohio State University, March 2011-March 2012.
- Postdoc, University of California Riverside, February 2008-Dec 2010.

Non-academic Experience

- Senior Scientist, Novozymes Biologicals, 2015.

Certification or professional registrations

- Engineer in Training (EIT), A-22277, North Carolina, 2006.

Current membership in professional organizations

- American Society of Agricultural and Biological Engineers (ASABE), member since 2005.
- American Institute of Chemical Engineers (AIChE), member since 2008.
- The Society for Industrial Microbiology (SIM), member since 2008.

Honors and awards

- Joint BioEnergy Institute Most Patent Disclosures Award, 2014.
- Joint BioEnergy Institute Citizenship Contribution Award, 2014.
- OARDC Annual Research Conference First Place Research Award, 2012.
- EPA P3 National Sustainable Design Expo Honorable Mention Award, 2010.
- ASABE Honorable Mention Paper Award, 2008.

Service Activities

- Departmental: Research and Graduate Studies Committee 2015-present, Social Committee 2015-present, Seminar Committee, 2015-present, Facilities Committee, 2015-present.
- External: Judge on Boyd-Scott Graduate Research Award of ASABE, 2016

Select publications and presentations (last five years)

- F Xu, S Konda, J Shi, T Dutta, CD Scown, B Simmons, S Singh (2016) Transforming biomass conversion with ionic liquids: process intensification and the development of a high-gravity, one-pot process for the production of cellulosic ethanol. *Energy & Environmental Science.*

- YF Li, J Shi, MC Nelson, PH Chen, J Graf, Y Li, Z Yu (2016) Impact of different ratios of feedstock to liquid anaerobic digestion effluent on the performance and microbiome of solid-state anaerobic digesters digesting corn stover, *Bioresource Technology*, 200, 744-752.
- Shi J, George K, Sun N, He W, Stavila V, Lee TS, Simmons BA, Singh S (2015) Impact of pretreatment technologies on saccharification and isopentenol fermentation of mixed lignocellulosic feedstocks, *BioEngery Research*, 1-10.
- Konda MNVSN, Shi J, Singh S, Blanch HW, Simmons BA, Klein-Marcuschamer D (2014) Understanding cost drivers and economic potential of two variants of ionic liquid pretreatment for cellulosic biofuel production, *Biotechnology for Biofuels*, 7*:86.*
- Shi J, Balamurugan K, Parthasarathi R, Sathitsuksanoh N, Zhang S, Stavila V, Subramanian V, Simmons BA, Singh S (2014) Understanding the role of water during ionic liquid pretreatment of lignocellulose: co-solvent or anti-solvent, *Green Chemistry*, 16, 3830-3840.
- Socha, AM, Parthasarathi R, Shi J, Pattathil S, Whyte D, Bergeron M, Venkatachalam S, Hahn MG, Simmons BA, and Singh S (2014) Efficient biomass pretreatment using ionic liquids derived from lignin and hemicellulose, *Proceedings of the National Academy of Sciences*, 111, E3587-E3595.
- Shi J, Gladden JM, Sathitsuksanoh N, Kambam P, Sandoval L, Mitra D, Zhang S, George A, Singer SW, Simmons BA, Singh S (2013). One-pot ionic liquid (IL) pretreatment and saccharification of switchgrass, *Green Chemistry,* 15, 2579-2589.
- Shi J, Wang Z, Stiverson JA, Yu ZT, Li Y (2013). Reactor performance and microbial community dynamics during solid-state anaerobic digestion of corn stover at mesophilic and thermophilic conditions, *Bioresource Technology,* 136: 574–581.
- Shi J, Qing Q, Zhang T, Lloyd TA and Wyman CE (2012) Aqueous processing of cellulosic biomass for biological and chemical conversion to ethanol and other fuels. In *Fundamentals of Materials for Energy and Environmental Sustainability*, David Ginley and David Cahen edition, Materials Research Society and Cambridge University Press.
- Shi J, Sharma-Shivappa RS, and Chinn MS (2012) Interactions between fungal growth, substrate utilization and enzyme production during shallow stationary cultivation of *Phanerochaete chrysosporium* on cotton stalks, *Enzyme and Microbial Technology*, 51 (1): 1-8.
- Shi J, Pu Y, Yang B, Ragauskas A, and Wyman CE (2011) Comparison of microwaves to fluidized sand baths for heating tubular reactors for hydrothermal and dilute acid batch pretreatment of corn stover. *Bioresource Technology*, 102(10): 5952-61.
- Shi J, Ebrik MA, Redmond T, et al. (2011) Application of cellulase and hemicellulase to pure xylan, pure cellulose, and switchgrass solids from leading pretreatments. *Bioresource Technology*, 102(24): 11080-88.

Professional development

- Attended University of Kentucky eLii workshops about hybrid teaching technologies and Canvas, 2015.
- Attended NSF Supercommunicator Workshop, 2016

TIMOTHY S. STOMBAUGH, Ph.D., P.E.
56% Extension, 20% Instruction, 24% Research

Education

The Pennsylvania State University	Agricultural Engineering	B.S., 1989
The Pennsylvania State University	Agricultural and Biological Engineering	M.S., 1991
University of Illinois at Urbana-Champaign	Agricultural Engineering	Ph.D., 1998

Academic Experience

- Extension Professor, Biosystems and Agricultural Engineering, University of Kentucky, Lexington, KY, 2013-present.
- Associate Extension Professor, Biosystems and Agricultural Engineering, University of Kentucky, Lexington, KY, 2006-2013.
- 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.

Certification or professional registrations

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

Current membership in professional organizations

- American Society of Agricultural and Biological Engineers, member since 1990.
- International Society of Precision Agriculture
- Gamma Sigma Delta and Alpha Epsilon.

Honors and Awards

- ASABE Blue Ribbon Award for Educational Aids, 2009, 2013, 2014
- ASABE Outstanding Paper Award, 2015

Service Activities

- Convener, ISO TC23/SC19/WG7 - committee to develop standards for GNSS-based equipment.
- Chair, ASABE Power and Machinery Division PM-01, 2012.
- Past Chair, ASABE PM-54 Precision Agriculture Committee, 2006-2008.
- NCERA-180 Regional committee on precision agriculture.

Select publications and presentations (last five years)

- Víctor Martínez-Martíneza, V., J. Gomez-Gila, T.S. Stombaugh, M.D. Montross, J.M. Aguiar. 2015. Moisture content prediction in the switchgrass (Panicum Virgatum) drying process using artificial neural networks. *Drying Technology: An International Journal.* 33(14):1708-1719.
- *Sama, M.P.*, T.S. Stombaugh. 2014. Performance evaluation of a tracking total station as a position reference for dynamic GNSS accuracy testing. *Applied Engineering in Agriculture* 30(4): 557-563.

- *Y. Wan*, N. Wang. T. Stombaugh. 2014. Human-subject tracking and localization for a hand hygiene monitoring system. Accepted with oral presentation at The International Conference and Exhibition of Ubiquitous Positioning, Indoor Navigation and Location-Based Services, Corpus Christi, Texas, November, 2014, IEEE.
- *Zandonadi, R.S.*, J.D. Luck, T.S. Stombaugh, S.A. Shearer. 2013. Evaluating field shape descriptors for estimating off-target application area in agricultural fields. Computers and Electronics in Agriculture 96:217-226.
- *Sama, M.P.*, T.S. Stombaugh, J.E. Lumpp. 2013. A hardware method for time-stamping asynchronous serial data streams relative to GNSS time. *Computers and Electronics in Agriculture* 97:56-60.
- Shockley, J.M., C.R. Dillon, and T.S. Stombaugh. 2012. The Influence of Auto-Steer on Machinery Selection and Land Acquisition. *Journal of the American Society of Farm Managers and Rural Appraisers.* 75(1):1-7.
- Shockley, J., C.R. Dillon, T.S. Stombaugh, S.A. Shearer. 2011. Whole farm analysis of automatic section control for agricultural machinery. *Precision Agriculture*, 7(1):1-10.
- Gomez-Gil, J., S. Alonso-Garcia, F.J. Gómez-Gil 2 and T.S. Stombaugh. 2011. A simple method to improve autonomous GPS positioning for tractors. *Sensors*, 11:5630-5644.
- *Zandonadi, R.S.*, J.D. Luck, T.S. Stombaugh, *M.P. Sama*, S.A. Shearer. 2011. A computational tool for estimating off-target application areas in agricultural fields. *Trans. of ASABE*, 54(1): 41-49.
- Shockley, J., C.R. Dillon, T.S. Stombaugh. 2011. A whole farm analysis of the influence of auto-steer navigation on net returns, risk, and production practices. *Journal of Agricultural & Applied Economics*, 43(1):57-75.
- Stombaugh, T.S., S. Smith, M. Thamann. 2015. The use of unmanned aircraft systems in agriculture. University of Kentucky, Cooperative Extension Service, AEU-102.
- Stombaugh, T.S. 2014. Technology to Improve Sprayer Accuracy. University of Kentucky Cooperative Extension Service, PA-9.
- Wilhoit, J., T.S. Stombaugh. 2013. Mulching with Large Round Bales between Plastic-covered Beds. University of Kentucky Cooperative Extension Service, ID-214 (Received ASABE Blue Ribbon Award).
- Stombaugh, T.S. 2013. GPS in Jeopardy? University of Kentucky Cooperative Extension Service, AEU 95 (updated).
- Stombaugh, T.S., M.D. Montross, S. Nokes, W. Adams. 2012. A new concept in on-farm biofuel production. University of Kentucky Cooperative Extension Service, AEN 112.
- Stombaugh, T.S., M.D. Montross, S. Nokes, M.K. Gray. 2012. Butanol: The new biofuel. University of Kentucky Cooperative Extension Service, AEN 111.

Professional Development Activities

- ASABE Annual International Meeting: 2011, 2012, 2013, 2014, 2015
- Agricultural Equipment Technology Conference: 2011, 2012, 2014, 2015, 2016

JOSEPH L. TARABA, Ph.D.
62% Extension, 18% Teaching, 20% Research

Education

The Ohio State University	Chemical Engineering	B.Ch.E., 1968
The Ohio State University	Chemical Engineering	M.S., 1971
The Ohio State University	Chemical Engineering	Ph.D., 1978

Academic 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 Inst Stromungsforschung, Gottingen, W Germany, summer 1971.

Current membership in professional organizations

- American Society of Agricultural and Biological Engineers, member since 1977
- KY Association of Extension Professionals, member since 1980

Honors and awards

- Outstanding Extension Program. 2005. Master Cattleman, January.
- State Team Award for Excellence. 1999. Sustainable Dairy Systems Training Project. Epsilon Sigma Phi - National Honorary Extension Fraternity, February.

Service Activities

- Certified On-farm Odor/Environmental Assistance Program Assessor. 1999-2012.
- Departmental: Extension Committee 1990-2016, Graduate Student and Research Committee 2006-2015.

Select publications and presentations (last five years)

- JM Bewley, RA Black, FA Damasceno, EA Eckelkamp, GB Day, JL Taraba. 2015. Compost bedded pack barns as a lactating cow housing system. Session 30. Abstract 66th Annual Meeting of the European Federation of Animal Science. Book of Abstracts No 21, Page 318. Warsaw Poland. Aug 31- Sept 4.
- EA Eckelkamp, JL Taraba, RJ Harmon, KA Akers, JM Bewley. 2015. Comparison of mastitis, its indicators, and lameness in composted bedded pack and sand freestall farms. Session 30. Abstract 66th Annual Meeting of the European Federation of Animal Science. Book of Abstracts No 21, Page 322. Warsaw Poland. Aug 31- Sept 4.

- JL Taraba and JM Bewley. 2015. Compost Bedded Loose Housing (CBP) Dairy Barn for Sustainable Dairy Production. Session 30. Abstract 66th Annual Meeting of the European Federation of Animal Science. Abstract No 21, Page 320. Warsaw Poland. Aug 31- Sept 4.
- JM Bewley, RA Black, FA Damasceno, EA Eckelkamp, GB Day, JL Taraba. 2014. Compost bedded pack barns as a lactating cow housing system for the Southeast. Abstract 0100. ADSA-ASAS CSAS Joint Annual Meeting (JAM) in Kansas City, Missouri, July 20–24. J of Dairy Science: Vol 97, E-Supplement 1. Pg 4-5.
- H.A. Mussell, J.L. Taraba, K.L. Jacobsen, and J.M. Bewley. 2014. Assessment of the Potential for Compost Bedded Pack Barns in Sustainable Organic Dairy Farming Systems. Abs #1051.ADSA-ASAS CSAS Joint Ann Mtg (JAM) in Kansas City, MO, July 20–24. J of Dairy Sci: 97, E-Supplement 1. Pg. 522-3.
- Eckelkamp, E.A., J.L. Taraba, R.J. Harmon, K.A. Akers, and J.M. Bewley. 2014. Somatic cell counts, mastitis infection prevalence, and mastitis pathogen distribution in compost bedded pack and sand freestall farms. Abstract No 0557. ADSA-ASAS CSAS Joint Annual Meeting (JAM) in Kansas City, Missouri, July 20–24, J of Dairy Science: 97, E-Supplement 1. Pg 279.
- RA Black, JL Taraba, GB Day, FA Damasceno, MC Newman, KA Akers, CL Wood, KJ McQuerry, JM Bewley. 2014. The relationship between compost bedded pack performance, management, and bacterial counts. Journal of Dairy Science: 97(5):2669-2679.
- Mussell, HA, JL Taraba, JM Bewley. 2013. Potential for compost bedded pack barns in sustainable organic dairy farming systems. ADSA-SAD Undergraduate Poster Competition: Original Research, Abstract T100. J Dairy Sci. 96, E-Suppl.1. Ann Mtg, American Dairy Science Association, Indianapolis IN, July 8-12.
- Eckelkamp, E, JL Taraba, JM Bewley. 2013. A decision support tool for compost bedded pack barn bedding cost analysis. Abstract TH200. J. Anim. Sci. Vol. 91, E-Suppl. 2/J. Dairy Sci: 96, E-Suppl. 1. Annual Meeting, American Dairy Science Association, Indianapolis IN, July 8-12.
- Black, RA, JM Bewley, JL Taraba, GB Day, FA Damasceno. 2013. 2011 Kentucky Compost Bedded Pack Barn Project. Cooperative Ext. Serv. Publ. ID-213, University of Kentucky, College of Agriculture, Lexington KY.
- RA Black, JL Taraba, GB Day, FA Damasceno, JM Bewley. 2013. Compost bedded pack dairy barn management, performance, and producer satisfaction. J Dairy Sci: 96 (12):8060-74.
- JM Bewley, JL Taraba, M Schutz, J Zulovich. 2013. Guidelines for managing compost bedded-pack barns. . Guideline # 110. The Dairy Practices Council, Newtown PA. In: Guidelines for Dairy Industry Relating to Sanitation and Milk Quality. V2013.2. July.

Professional Development

- KY Association of Extension Professionals Annual Meeting, 2012-2016.
- Dairyland Initiative Workshop, Tube ventilation for calf and holding areas. 2/3-6, 4/6, 2016.
- Annual Research Meeting - S 1032 USDA Regional Project, 2015-2016.
- Annual Meeting of European Federation of Animal Science, 8/29-9/5, 2015.
- Symposium in Brazil. Interleite Brasil, Dairy Housing, Urlandia MG, Brazil 8/1-8/10, 2015.
- Waste To Worth Conference, Livestock and Poultry Env. Learning Center, 3/31-4/5 2015.
- Dairy Conference in Lins, S-P, Brazil, 4/22-28, 2014.

Appendix C – Equipment

Specifically used in BAE courses:

- UV-Vis (used in BAE 202 time permitting)
- 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 (used almost exclusively in BAE 305 and BAE 599: Control of Off-Road Vehicles)
- Flumes for hydrology exercises (used often in BAE 402/403)
- Armfield hydraulics training bench (used during BAE 417)
- 8 pneumatic and fluid power trainer benches (used during BAE 417 and BAE 515)
- Various farm equipment including 3 tractors with autosteer, combine, high clearance self-propelled sprayer, planters, tillage tools, and manure handling and application equipment (used often in BAE 402/403)
- Various wood and metal fabrication equipment including a CNC milling machine, computerized plasma cutting table, and state-of-the-art welding equipment. (used often in BAE 402/403)
- Autolevels with tripods and rods; 100 ft and 300 ft tapes, sieves, scales, and rulers (BAE 532)
- 3D printer (BAE 599: Component Design)

Available for special topics courses and possible BAE 402/403 design projects:

- 2 NIST traceable dewpoint hygrometers
- Soil bin for tillage, compaction, and traction testing
- 2 Thermal imaging cameras
- 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
- PTO-driven dynamometer
- Instron universal testing apparatus
- 7 temperature/humidity environmental chambers
- 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

1. The Institution

a. Name and Address of the Institution
University of Kentucky, Lexington, KY 40506

b. Chief Executive Officer
Eli Capilouto, President
Tim Tracy, Provost (Chief Academic and Operating Officer)

c. Person Submitting Self-Study Report
John Y. Walz, Dean of the College of Engineering

d. Accreditation
Southern Association of Colleges and Schools Commission on Colleges (SACSCOS); Existing Accreditation Reaffirmed in 2013; Next Reaffirmation in 2023

2. Type of Control

State.

3. Educational Unit

Organizational charts for the Biosystems and Agricultural Engineering Department (Figure 5), College of Engineering (Figure 6), College of Agriculture, Food, and the Environment, UK Office of the Provost (), and UK Office of the President (**Error! Reference source not found.**) are provided on the following pages.

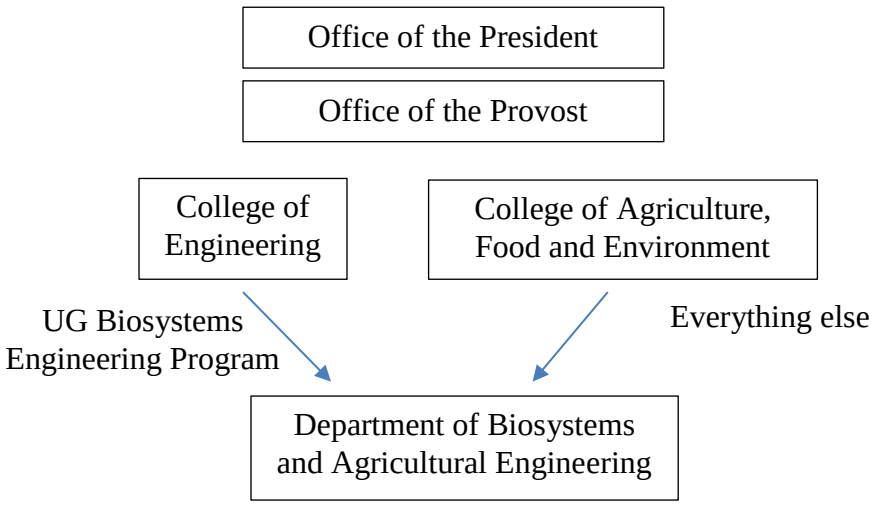

Figure 5. Schematic of how the Biosystems and Agricultural Engineering Department fits into the organizational charts for the College of Engineering, College of Agriculture, Food and Environment, the Office of the Provost, and the Office of the President.

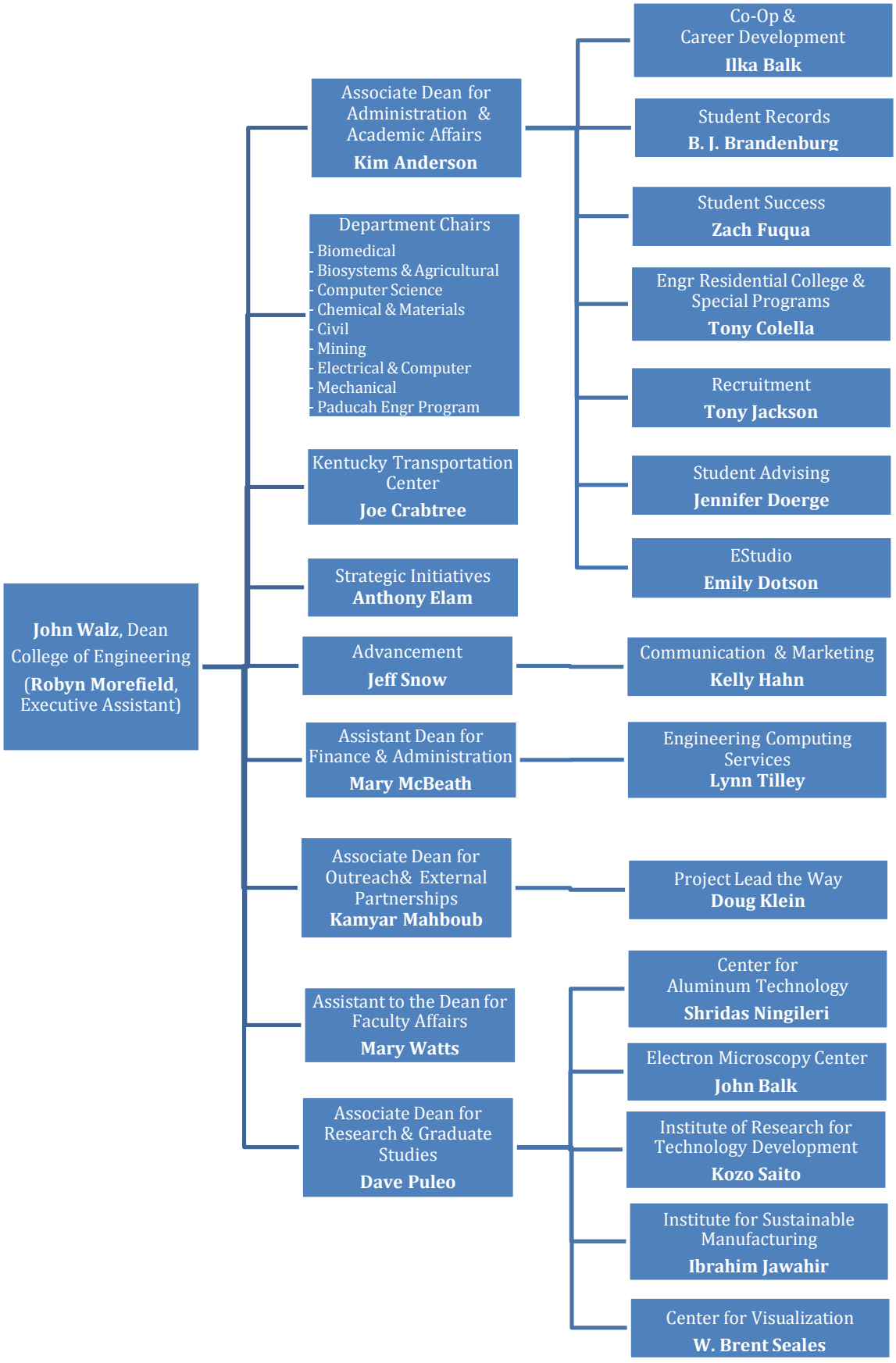

Figure 6. College of Engineering organizational chart FY 2016.

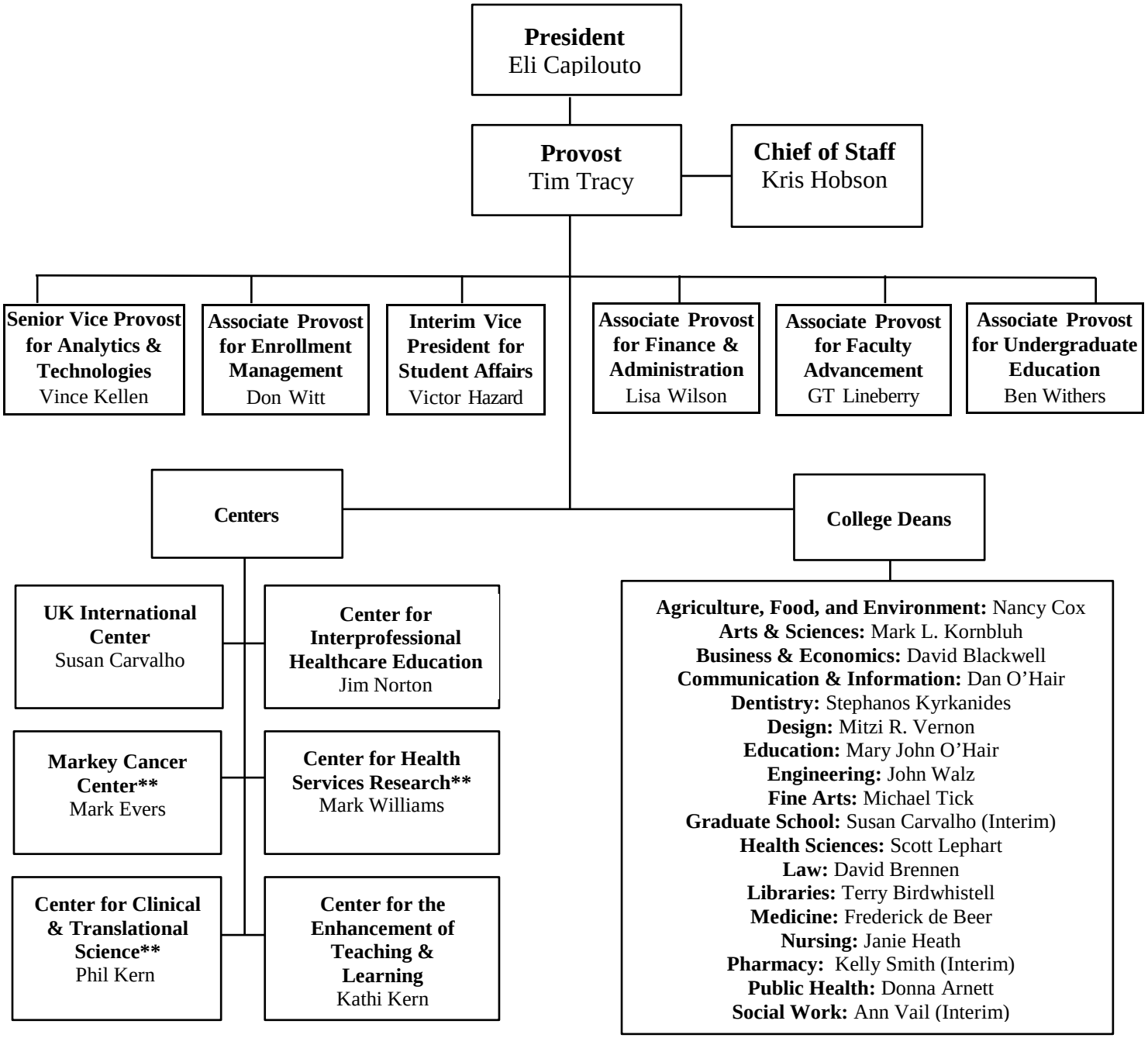

Figure 7. University of Kentucky Office of the Provost, February 2016.

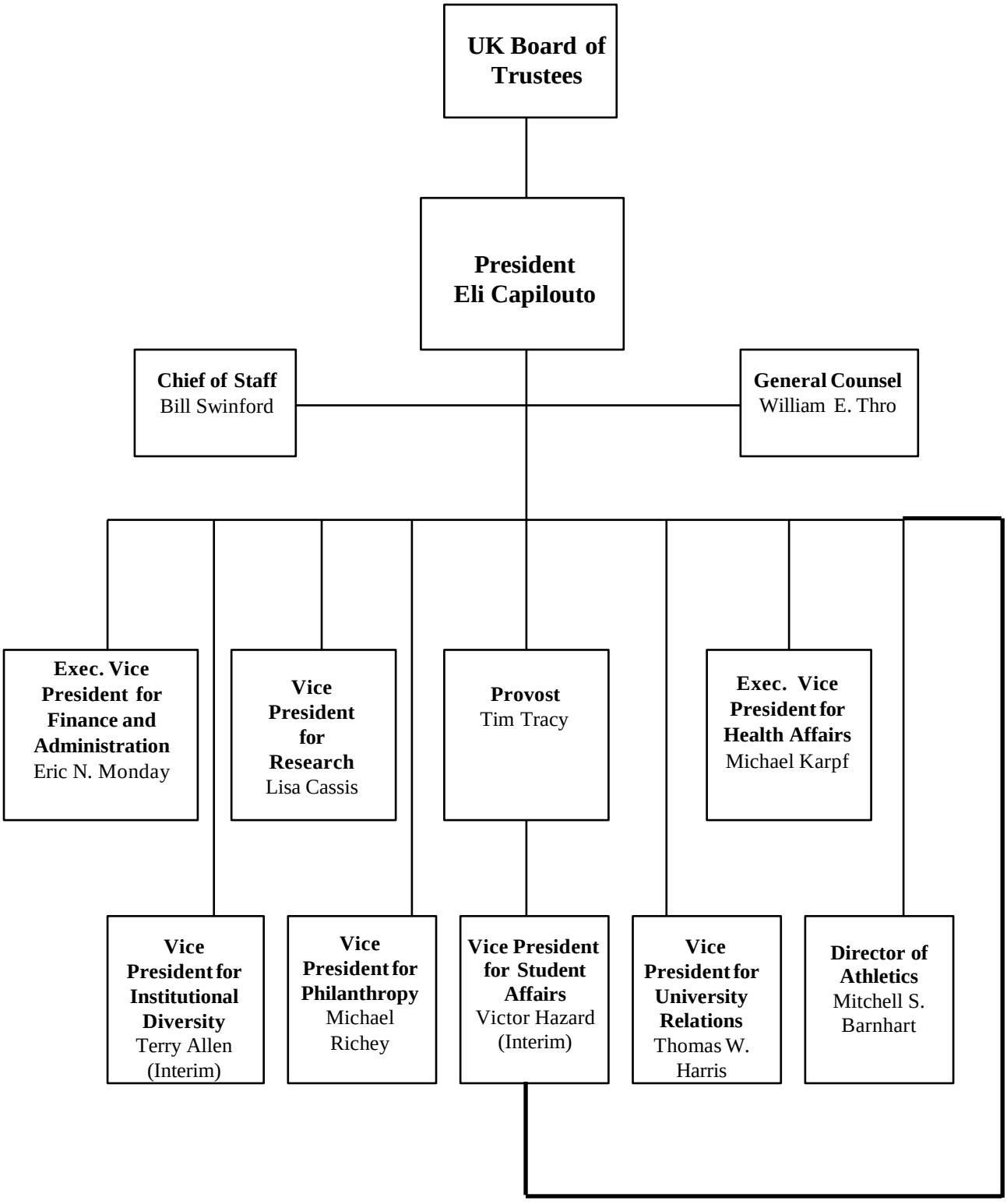

Figure 8. University of Kentucky Administrative Organization, Office of the President, February 2016.

4. Academic Support Units

Chemistry:

Mark Meier, Chair
125 Chemistry Physics Building
859-257-3837
meier@uky.edu

Arthur Cammers, Dir. of Undergraduate Studies
359 Chemistry Physics Building
859-323-8977
a.cammers@uky.edu

Communications:

Elisia Cohen, Chair
228 Enoch Grehan Journalism Building
859-257-3622
elisia.cohoen@uky.edu

Don Helme, Dir. of Undergraduate Studies
226 Enoch Grehan Journalism Building
859-257-8886
don.helme@uky.edu

Mathematics:

Russell Brown, Chair
723 Patterson Office Tower
859-257-3951
russell.brown@uky.edu

Serge Ochanine, Dir. of Undergraduate Studies
837 Patterson Office Tower
859-257-8837
serge.ochanine@uky.edu

Physics:

Sumit R. Das, Chair
177F Chemistry Physics Building
859-257-4686
das@pa.uky.edu

Kwok-Wai Ng, Dir. of Undergraduate Studies
171 Chemistry Physics Building
859-257-1782
kwng@uky.edu

Writing, Rhetoric and Digital Studies:

Jeff Rice, Chair
1353 Patterson Office Tower
859-257-7002
j.rice@uky.edu

Brian McNely, Dir. of Undergraduate Studies
1315 Patterson Office Tower
859-218-0957
brian.mcnely@uky.edu

5. Non-academic Support Units

Library:

Terry Birdwhistell, Dean
1-85 William T. Young Library
859-218-1871
terry.bird@uky.edu

Susan Smith, Engr. Librarian
355 F. Paul Anderson Building
859-257-7176
susan.smith@uky.edu

Computing Facilities:

H. Lynn Tilley, Director, Engr. Computing Services
217 Robotics and Manufacturing Services Building
859-257-3452
lynn.tilley@uky.edu

Placement:

Michelle Nordin, Director, Student Services
100 Funkhouser Building
859-257-2008
mnordin@email.uky.edu

Barbara Brandenburg, Dir, Engr. Student Records
373 Ralph G. Anderson Building
859-257-7978
barbara.brandenburg@uky.edu

Tutoring:

Tourgee Simpson, Dir., Academic Enhancement
306 Complex Commons Building
859-257-1356
tourgee.simpson@uky.edu

Tony Colella, Dir. of Engr. Special Programs
383 Ralph G. Anderson Building
859-257-0552
joseph.colella@uky.edu

6. Credit Unit

One semester hour represents one class hour or three laboratory hours per week.
One academic year represents 28 weeks of classes, exclusive of final exams.

7. Tables

Table 14. (ABET Table D-1.) Program enrollment and degree data for Biosystems Engineering.

Biosystems Engineering

	Academic Year		Enrollment Year					Total Undergrad	Total Grad	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
Current Year	2016	FT	60	37	38	64		199	17		30	5	2
		PT	0	1	1	2		4	5				
1	2015	FT	48	25	36	56		165	24		27	9	1
		PT	0	1	3	1		5	4				
2	2014	FT	36	30	25	50		141	26		22	16	1
		PT	1	0	1	1		3	2				
3	2013	FT	44	24	30	23		121	27		11	8	3
		PT	0	0	0	0		0	3				
4	2012	FT	48	25	14	19		106	26		8	7	4
		PT	1	1	0	0		2	6				

FT--full time
PT--part time
*The August 2016 graduates are not reflected in the 2016 degree numbers.

Table 15. (ABET Table D-2.) Personnel for Biosystems Engineering.

Biosystems Engineering

Year[1]: __2015_____

	HEAD COUNT		FTE[2]
	FT	PT	
Administrative[2]	3	0	0.60
Faculty (tenure-track)[3]	14	0	14
Other Faculty (excluding student Assistants)	0	0	0
Student Teaching Assistants[4]	4	2	5
Technicians/Specialists			
Office/Clerical Employees	3	0	3
Others[5]			

1. Data on this table should be for the fall term immediately preceding the visit. Updated tables for the fall term when the ABET team is visiting are to be prepared and presented to the team when they arrive.

2. Persons holding joint administrative/faculty positions or other combined assignments should be allocated to each category according to the fraction of the appointment assigned to that category.

3. For faculty members, 1 FTE equals what your institution defines as a full-time load

4. For student teaching assistants, 1 FTE equals 20 hours per week of work (or service). For undergraduate and graduate students, 1 FTE equals 15 semester credit-hours (or 24 quarter credit-hours) per term of institutional course work, meaning all courses — science, humanities and social sciences, etc.

5. Specify any other category considered appropriate, or leave blank.

Appendix E - Additional Documentation and Policies

Advising Procedure

Biosystems Engineering

1) College of Engineering advisors advise freshman students for 1st, 2nd and 3rd semesters.
   a. Role of the professional staff advisors in the Freshman Engineering Advising Program is to assist each freshman student in the transition from high school to college.
   b. Freshman advisors will work with the DUSs and department advisors to be aware of the first year curriculum, and more generally, engineering standing, requirements and program course preferences articulated by the faculty.
   c. The DUSs and departmental advisors will ensure that the freshman advisors know the current practices and requirements of the first three semesters of the programs.
   d. After advising for the 3rd semester, the students' files are sent to the departments.
   e. Exceptions are possible. For example if a freshman comes into UK with AP and/or college credit such that the majority of their first year is complete, they are sent directly to the departments for advising. A good example of this are the students who attend the Gatton Academy.

2) Students registering for their 4th semester (sophomore year, Fall registering for Spring) and transfer students are advised by the biosystems engineering advisors. The sophomores will be advised by the Engineering Associate for Academics (currently Dr. Modenbach) and she will serve as their academic and career advisor. Students will receive advising with respect to career development from their "career advisor" and they will receive advising to ensure they are taking the correct courses to graduate from their "academic advisor". Juniors and seniors will be assigned a faculty advisor to serve as their "career advisor", based on matching the faculty member's area of specialization with the student's desired career path. In addition, the juniors and seniors will have the DUS (currently Dr. Crofcheck) serve as their "academic advisor". The students will meet with their "career advisor" and receive advice about choosing technical electives, possible internships and co-ops, and advice about graduate school when appropriate. As their "academic advisor" the DUS is responsible for ensuring that the student is on track to graduate. Either the Engineer Associate for Academics or the DUS will check over the students' schedules for accuracy and notify the student of any issues before the semester starts.

3) The Chair selects who among the faculty members will be involved in advising. Advising will be included in the faculty member's distribution of effort (DOE) and will be evaluated as part of their performance review.

4) All advisors (both our academic coordinator and faculty) will be trained on their advising roles.

5) Students will be surveyed on a yearly basis on their advising experiences and the improvements necessitated based on these assessments will be part of faculty evaluations. These assessments will be conducted at the departmental level.

6) Anyone who advises will be well-trained on Notes in the advising system, and will be encouraged to make notes regarding each advising session so that there is good communication between the academic advisor, the career advisor, and the COE Dean's office.

Student Outcome Rubrics 2015-2016

Math & Science Rubric (ABET Outcome A)

	Exceeds Standards, 4	Meets Standards, 3	Partially Meets Standards, 2	Does Not Meet Standards, 1
Problem Statement	Problem statement clearly shows **full** understanding of the problem. **Clearly and completely** states what information is known and what needs to be determined.	Problem statement shows **some** understanding of the problem. **Most of** what information is known and what needs to be determined.	Problem statement shows **little** understanding of the problem. **Some of** what information is known and what needs to be determined.	No problem statement.
Procedure (Correct use of math, science, and engineering concepts)	**Clear** definition of solution, procedure, and methods. Includes references to outside materials where appropriate.	**Somewhat clear** definition of solution, procedure, and methods.	Outlines a general procedure but does **not clearly** identify methods.	No procedure, tries things out unsystematically.
Final Solution	Final solution is correct and clearly stated.	Final solution is correct, but may not be clearly stated.	Final solution is almost correct.	Final solution is not correct, or not provided.

Statistics Rubric (ABET Outcome B)

	Exceeds Standards, 4	**Meets Standards, 3**	**Partially Meets Standards, 2**	**Does Not Meet Standards, 1**
Purpose	Purpose of project is **very clear**. Hypotheses are **appropriately** identified and **clearly** conveyed.	Purpose of project is **clear**. Hypotheses are **appropriately** identified	Purpose of project is **unclear** Hypotheses are **not appropriately** identified	Purpose of project is **not provided**. Hypotheses were **not identified**
Methods	Sampling procedure is **thoroughly** explained; design of study/experiment and how the data were measured are easy to understand; chosen population is fully discussed	Sampling procedure is **fairly clear**; design of study/experiment and how the data were measured are fairly easy to understand; chosen population is discussed	Sampling procedure is **somewhat** explained; design of study/experiment and how the data were measured are somewhat clear; chosen population is barely discussed	Sampling procedure is **unclear**; design of study/experiment and how the data were measured are unclear; chosen population is not discussed
Statistical Analysis	Statistical analysis procedure is **thoroughly** explained; conditions necessary for inference are shown to be checked.	Statistical analysis procedure is **clearly** explained; conditions necessary for inference are shown to be checked.	Statistical analysis procedure is **somewhat** explained; conditions necessary for inference are shown to be checked.	Statistical analysis procedure is **unclear** explained; conditions necessary for inference are shown to be checked.
Conclusion	Conclusion is **thoroughly stated**; any issues which may affect the validity of the study/experiment are fully discussed; possible biases are fully discussed; changes to be made if experiment/study were to be repeated are discussed; possible causal connection is discussed fully	Conclusion is **clearly stated**; any issues which may affect the validity of the study/experiment are discussed fairly well; possible biases are discussed fairly well; changes to be made if experiment/study were to be repeated are discussed fairly well; possible causal connection is somewhat discussed	Conclusion is **somewhat unclear**; issues which may affect the validity of the study/experiment are barely discussed; possible biases are mentioned; changes to be made if experiment/study were to be repeated are barely discussed; possible causal connection is discussed inappropriately	Conclusion is **unclear**; issues which may affect the validity are not included.
References	**All** necessary citation information is fully provided	Citations are **fairly complete**	Citations are **incomplete**	Citations are **not provided**

Design Rubric (ABET Outcome C)

	Exceeds Standards, 4	Meets Standards, 3	Partially Meets Standards, 2	Does Not Meet Standards, 1
Problem Statement (Identify)	Problem statement clearly shows **full** understanding of the problem. **Clearly and completely** states the objectives, constraints, and given information.	Problem statement shows **some** understanding of the problem. **Somewhat clearly** states the objectives, constraints, and given information.	Problem statement shows **little** understanding of the problem. **Does not clearly** state the objectives, constraints, and given information.	**No** problem statement.
Procedure (Formulate)	**Clear** definition of solution, procedure, and methods. Includes references to outside materials where appropriate.	**Somewhat clear** definition of solution, procedure, and methods.	Outlines a general procedure but does **not clearly** identify methods.	**No** procedure, tries things out unsystematically.
Final Design (Solve)	Final design demonstrates **effective use** of the design process, engineering standards, economics to satisfy design objectives and real-world constraints.	Final design demonstrates **some use** of the design process, engineering standards, and economics to satisfy some of the design objectives and real-world constraints.	Final design demonstrates **little use** of the design process, engineering standards, economics to satisfy few design objectives and real-world constraints.	Final design does **not demonstrate** the use of any design process, engineering standards, economics to satisfy any design objectives and real-world constraints.

Teamwork Rubric (ABET Outcome D)

	Exceeds Standards, 4	Meets Standards, 3	Partially Meets Standards, 2	Does Not Meet Standards, 1
Contributes to Team Meetings	Helps the team move forward by articulating the merits of alternative ideas or proposals **(amazing ideas)**.	Offers alternative solutions or courses of action that build on the ideas of others **(great ideas)**.	Offers new suggestions to advance the work of the group **(good ideas)**.	Shares ideas but does not advance the work of the group **(some ideas)**.
Facilitates the Contributions of Team Members	Respects the contribution from others, encourages input from others, facilitates input from others. Does **greatly** help the group move forward.	Respects the contribution from others and encourages input from others. Does **help** the group move forward.	Respects the contribution from others, but doesn't encourage it. Does **not hinder** the progress of the team.	Does not fully respect the opinions of other and doesn't encourage input from team members. Does **somewhat hinder** the progress of the team.
Individual Contributions Outside of Team Meetings	Completes **all assigned** tasks by deadline; **Proactively** helps other team members complete their assigned tasks.	Completes **all assigned** tasks by deadline; **Helps** others if asked.	Completes **almost all** assigned tasks by deadline;	**Fails** to complete several assigned tasks by deadline.
Responds to Conflict	Addresses destructive conflict directly and **constructively, helping to manage/resolve** it in a way that strengthens overall team cohesiveness and future effectiveness.	Identifies and acknowledges conflict and stays engaged **works to resolve the conflict**.	**Redirecting** focus toward common ground, toward task at hand (away from conflict).	**Passively accepts** alternate viewpoints/ideas/opinions.

Engineering Problems Rubric (ABET Outcome E)

	Exceeds Standards, 4	Meets Standards, 3	Partially Meets Standards, 2	Does Not Meet Standards, 1
Problem Statement (Identify)	Problem statement clearly shows **full** understanding of the problem. **Clearly and completely** states what information is known and what needs to be determined.	Problem statement shows **some** understanding of the problem. **Most of** what information is known and what needs to be determined.	Problem statement shows **little** understanding of the problem. **Some of** what information is known and what needs to be determined.	No problem statement.
Procedure (Formulate)	**Clear** definition of solution, procedure, and methods. Includes references to outside materials where appropriate.	**Somewhat clear** definition of solution, procedure, and methods.	Outlines a general procedure but does not clearly identify methods.	No procedure, tries things out unsystematically.
Final Solution (Solve)	Final solution is correct and clearly stated.	Final solution is correct, but may not be clearly stated.	Final solution is almost correct.	Final solution is not correct, or not provided.

Ethics Rubric (ABET Outcome F)

	Exceeds Standards, 4	Meets Standards, 3	Partially Meets Standards, 2	Does Not Meet Standards, 1
Ethical Issue Recognition	Student can recognize ethical issues when presented in a complex, multilayered (gray) context AND can recognize cross-relationships among the issues.	Student can recognize ethical issues when issues are presented in a complex, multilayered (gray) context OR can grasp cross-relationships among the issues.	Student can recognize basic and obvious ethical issues and grasp (incompletely) the complexities or interrelationships among the issues.	Student can recognize basic and obvious ethical issues but fails to grasp complexity or interrelationships.
Application of Ethical Perspectives/Concepts	Student can independently apply ethical perspectives/concepts to an ethical question and is able to consider full implications of the application.	Student can independently (to a new example) apply ethical perspectives/concepts to an ethical question, but does not consider the specific implications of the application.	Student can apply ethical perspectives/concepts to an ethical question, independently (to a new example) and the application is inaccurate.	Student can apply ethical perspectives/concepts to an ethical question with support but is unable to apply ethical perspectives/concepts independently (to a new example.).

Oral Communications Rubric (ABET Outcome G)

	Exceeds Standards, 4	Meets Standards, 3	Partially Meets Standards, 2	Does Not Meet Standards, 1
Content	Addresses **all** specified content areas. Material **abundantly** supports the topic. Appropriate use of engineering terms and jargon **matches** the audience level.	Addresses **most** content areas. Material **sufficiently** supports the topic. Use of engineering terms and jargon **mostly** matches the audience level.	Addresses **some** of the content areas. Material **minimally** supports the topic. Use of engineering terms and jargon **minimally** matches the audience level.	Addresses **few** of the content areas. Material does **not** support the topic. Use of engineering terms and jargon **do not match** the audience level.
Visuals	Text is **easily** readable. Graphics use **constantly** supports the presentation. Slide composition has a professional look that enhances the presentation.	Text is **readable**. Graphics use **mostly** supports the presentation. Slide composition is not visually appealing, but does not detract from the presentation.	Text is **readable with effort**. Graphics use **rarely** supports the presentation. Slide composition somewhat distracts from the presentation.	Text is **not readable**. Graphics use **does not** support the presentation. Slide composition format is clearly **distracting**.
Presentation Skills	**Clearly** heard and **polished**. Attitude indicates **confidence** and **enthusiasm**. Audience **attention is** maintained.	**Clearly** heard but **not** polished. Attitude indicates confidence, but **not enthusiasm.** Audience attention is **mostly** maintained.	**Difficult to hear** and/or moments of awkwardness. Attitude indicates some **lack** of confidence and/or disinterest. Audience attention **minimally** is maintained.	**Inaudible**; several awkward pauses. Attitude indicates **lack** of confidence and/or disinterest. Audience attention is **not** maintained.
Organization	Information presented in a **logical** and **interesting** sequence that the audience can easily follow.	Information presented in a **logical** sequence that the audience can easily follow.	Information not always presented in a logical sequence; audience has **trouble** following presentation.	Information not presented in a logical sequence; the audience **cannot follow** presentation.
Handling of Questions	Demonstrates **full** knowledge of the material; can explain and elaborate on expected questions.	Demonstrates **sufficient knowledge** to answer expected questions.	Demonstrates **difficulty answering** expected question beyond a rudimentary level.	Demonstrates an **inability** to answer expected questions.
Central Message	Central message is **compelling** (precisely stated, appropriately repeated, memorable and strongly supported.	Central message is **clear** and consistent with supporting material.	Central message can be deduced, but is **not explicitly** stated in the presentation.	Central message is **unclear**.

Written Communication Rubric (ABET Outcome G)

	Exceeds Standards, 4	Meets Standards, 3	Partially Meets Standards, 2	Does Not Meet Standards, 1
Visual Format	Document is **visually appealing** and easily navigated (formatting is used **compellingly** to separate blocks of text and add emphasis).	Document is for the **most part** visually appealing and easily navigated (formatting is used **appropriately** to separate blocks of text and add emphasis).	The document is **somewhat** visually appealing and there **could be more** "cues" to help the reader navigate the document.	The document is **not** visually appealing and there are **few** "cues" to help the reader navigate the document.
Organization	Document flows **very well**, making it easy for the reader to follow.	Document flows **pretty well**, but there are some choppy areas.	Within section, the order in which ideas are presented is **occasionally confusing**.	There is **no apparent ordering** of paragraphs.
Language (Word Choice, Grammar)	Sentences are **consistently** complete and grammatically correct (even eloquent). Repetition is **avoided**. Engineering terms are **always** used correctly. 0 misspelled words.	**For the most part**, sentences are complete and grammatical. Any errors are minor and are **not a distraction** to the reader. Repetition is **mostly avoided**. Engineering terms **mostly** used correctly. **1-2** misspelled words.	**In a few places**, errors in sentence structure and grammar distract the reader and interfere with meaning. Repetition is **distracting**. Engineering terms are **usually** used correctly. **3-4** misspelled words.	Errors in sentence structure and grammar **frequently** distract the reader and interfere with meaning. Repetition is **contradictory**. Engineering terms are **somewhat** used correctly. **5+** misspelled words.
Equations, Tables, and Figures	**All equations** are clear, accurate, and labeled. All variables are defined and units specified. Discussion regarding the equation development and use has been stated. **All** of the figures and tables are accurate, consistent with the text and of good quality.	**Most equations** are clear, accurate, and labeled. Most variables are defined and units specified. With minor exception, discussion regarding the equation development and use has been stated. For the **most part**, the figures and tables are accurate, consistent with the text and of good quality.	Equations are **somewhat** clear. Too many variables not defined. Discussion regarding the equation development and use is unclear. **In some cases**, illustrations are not conveying information clearly.	There may be **inaccuracies** within the equations. Little or no attempt is made to make it easy for the reader to understand the use of an equation or its derivation. Figures, graphs, charts, and drawings are of **poor quality**, have numerous inaccuracies and mislabeling, or are missing.
Use of References	Prior work is **consistently** acknowledged by referring to sources. References are **complete**.	With an **occasional oversight**, prior work is acknowledged by referring to sources. References are **almost** complete.	On **several instances**, references are not stated when appropriate. References are **not complete**.	**Little** attempt is made to acknowledge the work of others. Most references that are included are **inaccurate** or unclear.

Global Context Rubric (ABET Outcome H)

	Exceeds Standards, 4	Meets Standards, 3	Partially Meets Standards, 2	Does Not Meet Standards, 1
Knowledge *Knowledge of cultural worldview frameworks*	Demonstrates **sophisticated** understanding of the complexity of elements important to members of another culture in relation to its history, values, politics, communication styles, economy, or beliefs and practices.	Demonstrates **adequate** understanding of the complexity of elements important to members of another culture in relation to its history, values, politics, communication styles, economy, or beliefs and practices.	Demonstrates **partial** understanding of the complexity of elements important to members of another culture in relation to its history, values, politics, communication styles, economy, or beliefs and practices.	Demonstrates **surface understanding** of the complexity of elements important to members of another culture in relation to its history, values, politics, communication styles, economy, or beliefs and practices.

Life Long Learning Rubric (ABET Outcome I)

	Exceeds Standards, 4	Meets Standards, 3	Partially Meets Standards, 2	Does Not Meet Standards, 1
Knowledge of the importance of lifelong learning	Student has a clear and concise understanding of the importance of lifelong learning. Includes relevant examples and appropriate elaboration.	Student has a clear and concise understanding of the importance of lifelong learning. Includes at least one example, but no elaboration.	Student has a somewhat clear and somewhat concise understanding of the importance of lifelong learning.	Student has a poor understanding of the importance of lifelong learning.

Contemporary Issue Rubric (ABET Outcome J)

	Exceeds Standards, 4	Meets Standards, 3	Partially Meets Standards, 2	Does Not Meet Standards, 1
Explanation of issues	Issue is stated clearly and described comprehensively, delivering all relevant information necessary for full understanding.	Issue is stated, described and clarified so that understanding is not seriously impeded by omissions.	Issue is stated but description leaves some terms undefined, ambiguities unexplored, boundaries undetermined, and/or backgrounds unknown.	Issue is stated without clarification or description.

Computer Skills Rubric (ABET Outcome K)

	Exceeds Standards, 4	Meets Standards, 3	Partially Meets Standards, 2	Does Not Meet Standards, 1
Methods	**Clear** evidence of the ability to correctly apply tools, techniques, & skills effectively	**Some** evidence of the ability to correctly apply tools, techniques, & skills effectively	**Little** evidence of the ability to correctly apply tools, techniques, & skills effectively	**No** evidence of the ability to correctly apply tools, techniques, & skills effectively
Results	**Clear** evidence of correct conclusion of results gained from the tool	**Some** evidence of correct conclusion of results gained from the tool	**Little** evidence of correct conclusion of results gained from the tool	**No** evidence of correct conclusion of results gained from the tool

BAE PROBLEM SOLVING PROCEDURE

Clearly use the following headings with the indicated items. Use engineering paper when solving engineering problems (only writing on one side). NEVER turn in spiral notebook paper. Be sure to staple your multiple page assignments.

Given:

1. Always draw a picture of a physical situation.
2. State any assumptions.
3. Indicate all given properties on the diagram with their units.

Required:

4. Put your problem statement here.

Assumptions (if appropriate):

5. Clearly list your assumptions.

Procedure:

6. Write the *main equation* that contains the desired quantity. (If necessary, you might have to derive the appropriate equation.)
7. Algebraically manipulate the equation to isolate the desired quantity.
8. Write *subordinate equations* for the unknown quantities in the main equation. Indent to indicate that the equation is subordinate. You may need to go through several levels of subordinate equations before all the quantities in the main equation are known.

Solution:

9. After all algebraic manipulations and substitutions are made; insert numerical values **with their units.**
10. Ensure that units cancel appropriately. Check one last time for a sign error.
11. Compute the answer.
12. Clearly mark the final answer (a box is preferred). **Indicate units.**
13. Check that the final answer makes physical sense!
14. Ensure that all questions have been answered.

Technical Writing Checklist

Technical Writing Checklist

Did I remember to…

Formatting

☐ use consistent formatting throughout my report (including headings, fonts, indentations, abbreviations, spacing)?
☐ use headings and make sure that everything is in the proper section?
☐ avoid using bullet points or lists within the main body of the text?
☐ format my tables, figures and captions properly?

Figures and Tables

☐ number my figures and tables?
☐ add a caption below my figures and above my tables?
☐ use the figure or table number when referring to them within the text of my report?
☐ refer to my figure or table in the main body of the report?
☐ place my figure or table immediately after the paragraph in which it was first mentioned?

Symbols, Numbers, and Units

☐ use symbols instead of words (i.e. "α" instead of "alpha")?
☐ use proper and appropriate abbreviations instead of words (i.e. °F, instead of "Fahrenheit" or "degrees")?
☐ use the number 0 (zero) before a decimal as in 0.1?
☐ use appropriate spacing between numbers and units (i.e. 0.5 ft, $5.00, 65°F)?
☐ use sub- and superscripts (i.e. H_2O or 10^5)?
☐ use the appropriate number of significant figures?
☐ use the appropriate units?
☐ be consistent with type of units (SI or US Customary)?

Spelling and Grammar

☐ use the correct verb with the word "data" (i.e. "the data show…" or "the data are…")?
☐ use past tense?
☐ avoid using pronouns (i.e. I, we, you, they, it)?
☐ avoid using ambiguous words (i.e., this, that, there, one)?
☐ check for any spelling and/or grammar mistakes?
☐ avoid using contractions (i.e. don't, can't, won't)?
☐ write my report as concisely as possible but still include all relevant details?
☐ avoid using slang words and phrases (i.e. a lot, kinda, should of)?

References

☐ include all relevant sources of information in my bibliography?
☐ include all relevant citations within the body of the report?
☐ use an appropriate and consistent format for citing my references at the end of my report?
☐ use an appropriate and consistent format for citing my references within the body of report?

I, (Type your name here), have used the above checklist to proofread my report prior to submitting it for evaluation. I understand that an excessive number of mistakes will negatively impact my grade and have edited my report to the best of my ability.

College of Engineering Transfer Policy

The following policy is intended to establish a uniform procedure for an institution to obtain prior approval for the transfer of courses for credit as College of Engineering Courses. This policy applies to regionally-accredited institutions in the U.S. that do not offer engineering programs accredited by the Engineering Accreditation Commission of ABET and to foreign accredited colleges and universities with which the UK College of Engineering has a credit-transfer, twinning, or other similar program or arrangement.

The engineering courses eligible for transfer credit are lower-division (100- and 200-level) courses (e.g., EE 221, Circuits I; EM 221, Statics; ME 220, Engineering Thermodynamics I) and the following two 300-level courses: EM 313, Dynamics, and EM 302, Mechanics of Deformable Solids. Other engineering courses may be approved on a case-by-case basis.

If an institution wishes prior approval of a course to be accepted for transfer credit, it is requested that the following information be provided for evaluation:

1. Name and number of course proposed, plus name and number of corresponding UK College of Engineering course.
2. Title, author, and publisher of required textbooks(s).
3. Syllabus of the course, showing subject content and textbook assignments. (It is highly recommended that the syllabus contain a list of student learning outcomes appropriate for the course.)
4. Sample tests and examinations.
5. List of homework problems required.
6. Examples of graded student papers, ranging from poor to good for homework, tests, and examinations.

The requested information is identical to that which is made available by the College of Engineering to the ABET review team during accreditation inspections.

If it can be demonstrated that a course which is under consideration by the UK-COE for credit transfer has already been granted equivalency by an ABET accredited program, the UK-COE would grant an appropriate equivalency commensurate with its curriculum.

This policy becomes effective at the start of the 2006 spring semester. After approval for a particular course is given, the approval will remain in force for a period of six (6) years. For renewal of the equivalency, documentation that there has been no significant change in learning outcomes, course coverage, textbook (except for new editions), grading standards, and types of graded assignments must be submitted to the Dean of the College of Engineering or his/her designate. (Note: In a November 2006 interpretation of the transfer policy by the College's Directors of Undergraduate Studies, it was stipulated that a syllabus must also be submitted to show that there are no changes in course content.) Any time there are changes in the course for which equivalency has been granted (even within the 6-year cycle), the institution should submit new materials for consideration by the appropriate UK department.

At this time, all correspondence and materials should be directed to: Dr.
Kamyar Cyrus (K.C.) Mahboub, P.E., FASCE
Associate Dean of Outreach and External Partnerships Lawson
Professor of Civil Engineering
Lexington, KY 40506-0503
Phone: 859-257-4279
Fax: 859-257-5727
e-mail: kc.mahboub@uky.edu

Institutions are encouraged to contact the appropriate department chairperson if there are questions about specific courses.

Revised: April 3, 2015

Signature Attesting to Compliance

By signing below, I attest to the following:

That _____ (*Name of the program(s)*) has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET's *Criteria for Accrediting Engineering Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual.*

_____

Dean's Name (As indicated on the RFE)

_____ _____

Signature **Date**