A. General Information

1. Institution: Auburn University

2. Date of Proposal Submission: August 1\textsuperscript{st}, 2008

3. Institutional Contact Person: John G. Heilman, Provost and Vice-President for Academic Affairs
   Telephone: 334-844-5771
   Fax: 334-844-5778
   E-mail: heilmjg@auburn.edu

4. Program Identification--
   Title: Biosystems Engineering
   Degree: Doctor of Philosophy (Ph.D.)
   CIP Code: 14.0301

5. Proposed Program Implementation Date: Fall Semester, 2009

6. Program Administration
   College or School: Graduate School
   Dean: George Flowers
   Department: Biosystems Engineering
   Chairperson: Steven Taylor

B. Program Objectives and Content

1. To facilitate review of the proposal, please classify the degree program (e.g. Post Baccalaureate Masters, Research Doctorate (Ph.D.), Applied/ Professional Doctorate (DPT, Ed.D., or DBA), ...). If desired, please elaborate in a short paragraph.

The degree program is Post Baccalaureate Doctor of Philosophy (Ph.D.) in Biosystems Engineering – a degree program that involves the development and dissemination of engineering knowledge to solve problems in biological systems such as agriculture, food, bioenergy and bioproducts, natural and water resources, forestry, and the environment.

2. List the objectives of the program as precisely as possible. The objectives should address specific needs the program will meet (institutional and societal) and the expected student learning outcomes and achievements. This is an extremely important part of the proposal. The objectives should lend themselves to subsequent review and assessment of program accomplishments.

Program Objectives and Content:
The mission of the Department of Biosystems Engineering is to develop and disseminate engineering knowledge to solve problems in agriculture, food, bioenergy and bioproducts, natural and water resources, forestry and the environment. This mission is crucial to the overall mandate of Auburn University (the 1862 land-grant university for Alabama) that includes service to the citizens of the state of Alabama through instructional, research and outreach programs in agriculture-related problems, and preparing Alabamians to respond successfully to the challenges of a global economy. An example of this challenge is the current effort to reducing nation’s (including the state of Alabama) dependence on fossil fuels. Auburn University Biosystems Engineering Department is the only program in the state of Alabama that is and has conducted research, teaching and outreach activities in engineering, agriculture, forestry and water resources – the areas that are pivotal to the successful development of alternative energy systems from biological materials. A graduate program is therefore needed to strengthen the Biosystems Engineering program mission. The academic and programmatic objectives of the proposed graduate program are as follows:

**Academic objectives:**

a. To provide students with skills necessary to carry out cutting edge research in engineering problems associated with the natural and water resources, bioenergy and bioproducts, the environment, and the production, processing, storage, manufacture, utilization and recycling of biological products;

b. To give students the scientific and engineering background in protecting the environment, utilization and conservation of natural and water resources, and conversion of biological materials to value-added products and to energy;

c. To provide field, laboratory and computational based instruction in Biosystems Engineering, thereby preparing the students for careers in industry and academia; and

d. To produce graduates with the ability to conduct independent scientific experimentation and engineering analysis that leads to development of environmentally and economically feasible design solutions that can be practically implemented.

**Programmatic Objectives:**

a. To recruit high-quality graduate students to Auburn University who will succeed as Biosystems Engineering professionals and who will address the needs of industry, government agencies (federal, state, and local) and academia;

b. To provide high-quality instruction in Biosystems Engineering so that students are successful in finding employment and have the necessary background to excel in their career;

c. To provide the necessary training for students who are interested in Biosystems Engineering teaching, research and outreach at the university and college levels;

d. To recruit new faculty that are qualified and trained in Biosystems Engineering and whose training will stimulate the growth of new research direction;

e. To continue to add new state-of-the-art equipment to our existing laboratories for conducting research and for student training; and

f. To strengthen existing and develop new linkages with other Auburn University departments and college, and with other universities.
3. **Will this program be related to other graduate programs at your institution? If so, how?**

   This program is not related to other graduate programs at Auburn University and in the state of Alabama. The program systems approach to solving engineering problems in agriculture, food, bioenergy and bioproducts, water and natural resources, forestry, and the environment.

4. **Please identify any existing program, option, concentration or track that this program will replace.**

   This proposed program will not replace any Ph.D. program at Auburn University or at any other institution in the state of Alabama.

5. **Is it likely that this program will reduce enrollments in other graduate programs at your institution? If so, please explain.**

   No. The proposed program will not reduce enrollments in other graduate programs and will not compete for existing students in other graduate programs. Presently, students who are interested in graduate studies in Biosystems Engineering at Auburn University are enrolled in another program (through collaborative agreements with these programs) with their research theses and majority of the graduate courses from Biosystems Engineering. This temporary arrangement was put in place because of the high interest by students in a graduate program that involves solving engineering problems in agriculture, bioenergy and bioproducts, food, water and natural resources, forestry and the environment. A side-benefit of this temporary arrangement is Biosystems Engineering faculty have been able to carry out graduate teaching and advising, while developing their research programs. It should be pointed out that the graduate students that are and have been part of this temporary arrangement have been funded on extramural grants secured by faculty in Biosystems Engineering (see Appendix E for summary of extra-mural funds secured by the faculty in the last 5 years). This temporary arrangement however has some limitations because a major portion of the research interest of the faculty does not fit into the goals of the programs at Auburn University that are assisting/hosting Biosystems Engineering' graduate students under this temporary arrangement. Thus, a significant amount of high-quality prospective students that would otherwise have been recruited to Auburn University (and the state of Alabama) had to move to another state to pursue graduate studies in Biosystems Engineering. It should be emphasized that the graduate students that are and have been part of this temporary arrangement at Auburn University would not have, under normal circumstances, applied to graduate studies in the departments that are 'hosting' this temporary arrangement. Even though this has been a temporary arrangement, the average number of Ph.D. students in the last three years has increased from two in 2005 to nine students in 2008.
Enrollment of Ph.D. graduate students in Biosystems Engineering topics from 2005-2008

<table>
<thead>
<tr>
<th>Year</th>
<th>Spring</th>
<th>Fall</th>
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<tbody>
<tr>
<td>2005</td>
<td>2</td>
<td>4</td>
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<tr>
<td>2006</td>
<td>4</td>
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<td>2007</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>2008</td>
<td>7</td>
<td>9</td>
</tr>
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</table>

6. List new courses that will be added to your curriculum specifically for this program. Indicate number, title and credit hour value for each course.

New courses will not be added to the curriculum. There are 18 graduate courses in Biosystems Engineering that are currently available to ‘Biosystems Engineering’ graduate students. They are listed below:

**BSEN 6220 (3): Introduction to Spatial Technologies for Biosystems** Spatial technologies including GPS, GIS and remote sensing systems applied to biosystems. Collecting, managing, and analyzing spatial data for agricultural and forest systems.

**BSEN 6250 (3): Deterministic Modeling for Biosystems.** Modeling of biosystems, methods to deal with complexity and validation tools.

**BSEN 7020 (3): Mechanized Agricultural and Forestry Systems – Enhancement of Site-Specific Technologies for Agriculture and Forestry**
Introduction to advanced concepts of off-highway vehicle equipment for use in agricultural and forestry production with emphasis on site-specific management (Precision Agriculture/Forestry).

**BSEN 7050 (3): Soil Dynamics of Tillage and Traction.** Analyses and measurements of soil reactions as affected by physical properties of soil when subjected to forces imposed by tillage implements and traction devices.

**BSEN 7110 (3): Fundamentals of Instrumentation for Biological Systems**
Fundamentals of sensing and sensors, simple digital electronics and analog measurement circuits, introductory digital signal processing, and computer data acquisition, building and testing instrumentation to collect data on biological systems that might include fluid flow, pressure, force, or other transducers.

**BSEN 7120 (3): Stochastic Modeling for Biosystems.** Solving problems in biosystems engineering and related fields by modeling data with probability distributions, spatial statistics, autoregressive models, Monte-Carlo simulation and reliability methods.

**BSEN 7220 (3): Renewable Energy System Design, Analysis and Application**
Basic principles, applications, modeling, energetic and economic analysis of the renewable energy resources namely solar, biomass, wind, hydropower and geothermal.
BSEN 7240 (3): Bulk Solids Storage, Handling and Transportation
Bulk and flow properties of bulk solids, analysis and design of facilities and equipment needed in the storage, handling and transport of bulk solids and safety issues (e.g. dust control, explosion and health hazards) associated with the handling of bulk solids.

BSEN 7260 (3): Advanced Unit Operations in Bioprocess Engineering
Understanding of the unit operations used in biological systems, analyzing the components of a system by simple mathematical relationships, evaluation of performance of a system, size and select the components of the system.

BSEN 7280 (3): Food Thermal Processing
Technologies and approaches used in food thermal processing for commercial purposes as well as emerging research purposes.

BSEN 7310 (3): Nonpoint Source Pollution
Non-point source (NPS) transport of nutrients, sediment, pesticides, pathogens, and a multitude of other chemicals from agricultural, forestry, and urban activities.

BSEN 7320 (3): Nonpoint Source Pollution Modeling
Modeling of non-point source (NPS) pollution at the watershed scale, simulation of transport of nutrients, sediment, pesticides, and pathogens from agricultural, forestry, and urban activities by SWAT(Soil and Water Assessment Tool) model.

BSEN 7330 (3): Soil-Plant-Environmental System Design
Designed systems and applications for plant uptake of nutrients and/or heavy metals for remediation of soil-based contaminants, constructed wetlands, drip irrigation of wastewater effluent, disposal of municipal sludge, and phytoremediation of contaminants in shallow groundwater.

BSEN 7350 (3) – Engineering Analysis of Lakes and Reservoirs
Knowledge and understanding of the causes, impacts, and methods of restoring water quality impairments, with emphasis placed on impounded water bodies and perennial streams.

BSEN 7900 – Special Problems in Biosystems Engineering

BSEN 7950 – Seminar

BSEN 7970 – Special Topics in Biosystems Engineering

BSEN 8990 – Research and Dissertation

7. Please list any existing undergraduate programs at the institution which are directly or indirectly related to the proposed graduate program. If this is a doctoral proposal, also list related master's programs at your institution.

The only undergraduate program directly related to the proposed program is B.S. Biosystems Engineering, and M.S. Biosystems Engineering (proposed). Other
undergraduate engineering programs that are indirectly related include B.S. and M.S. in Civil Engineering, Mechanical Engineering and Chemical Engineering.

8. Program Completion Requirements

Course work:
The Ph.D. degree requires at least 60 semester credit hours of graduate-level course work (6000-level or above), as follows:

- At least 30 semester credit hours must be engineering courses, 15 of which must be BSEN course
- At least 12 credit hours of BSEN 7990 (Research and Dissertation)

Additional requirements such as preliminary qualifying examination, comprehensive examination, thesis, dissertation, practicum or internship, some of which may carry credit hours included in the list above.

Examinations

All Ph.D. students must take three examinations to demonstrate their ability to conduct independent scientific research, including the breadth of scientific knowledge beyond a specific field. Proficiency at an advanced level in a specialized field, and ability to develop, complete and defend a research project. The examinations, in order of the sequence, are as follows:

Qualifying Examination: This examination tests the student’s depth and breadth of knowledge in Biosystems Engineering, and their potential to conduct research. This examination must be taken during the first two years of the student’s residency in the department if the student does not have an M.S. in Biosystems Engineering, and during the first year if the student already has an M.S. in Biosystems Engineering or a related discipline.

Preliminary Examination: This examination tests the student’s ability to carry out dissertation research. It focuses on the viability of the dissertation project and on the student’s ability to complete it. The examination should be taken about a year after the Qualifying examination.

Final Examination: This examination is conducted to determine whether the dissertation is adequate and that the Ph.D. candidate understands all aspects of the dissertation.

Advisory and Dissertation Committee:

All Ph.D. students will be assigned a research advisor by the end of the first year of admission into the department. The research advisor will identify appropriate faculty members to serve on the student's dissertation committee. The committee should
meet at least once year after the student has passed the preliminary examination do discuss research progress, including accomplishments, remaining tasks, and schedule for completion. The committee will approve the student’s program of study and direct the student project as the need arises.

Dissertation Defense:
The student must arrange for and take the dissertation defense examination. The purpose of the dissertation defense is to determine whether or not the dissertation, and the student’s defense of research are of acceptable quality to permit granting of the Ph.D. degree in Biosystems Engineering. The examination consists of a 60 minutes research presentation by the students (open to the general public), followed by an oral questioning session by the dissertation committee. This questioning session is not open to the public. After this session, the student is excused temporarily while the committee deliberates on the outcome of the examination. The committee decides among the following options, and the decision must be unanimous. If a unanimous decision cannot be reached, the committee chair is must confer with the Dean of the Graduate School. Outcomes of the examination include: (1) Pass – Each committee member must indicate that the dissertation has been read and approved, (2) Deferred – This option is used if substantial changes are required in the dissertation. The student is given one more opportunity, within six months, to take the examination. The Graduate School is informed of this decision, and the committee chair will indicate that the student should be given a second examination. If the second examination results in a failure, the student must leave the department without a Ph.D. degree; (3) Fail – The department notifies the Graduate School immediately and the student may not continue in the Ph.D. program, (4) Pass with minor corrections – If minor changes are required in the dissertation, this option is used. The student will not be subjected to another examination but the changes suggested by the committee members must be incorporated into the dissertation before the committee chair forwards the paperwork to the Graduate School.

A typical curriculum by semester can be found in Appendix A.

9. Accreditation

If there is a recognized (USDE or CHEA) specialized accreditation agency for this program, please identify the agency and explain why you do or not plan to seek accreditation.

None. The undergraduate Biosystems Engineering program is already accredited by ABET. We do not plan to seek additional accreditation for the Ph.D. program at this time.

C. Program Admissions Requirements, Enrollment Projections and Completion Projections

1. Describe briefly the criteria and screening process that will be used to select students for the program.

(a) Candidates must be accepted by the Graduate School by the deadline for completed applications. The candidate must have a written commitment from the major professor to serve as his/her advisor.
(b) Applicants must hold a M.S. degree in Biosystems Engineering or closely related engineering/science discipline. However, evidence of exemplary potential (e.g. written record of prior scholarly and professional accomplishment) may be considered as a criterion for admission with a bachelor’s degree. Applicants lacking necessary preparatory courses or with undergraduate degrees other than Biosystems Engineering will be required to correct deficiencies by satisfactorily completing additional courses, as approved by the graduate program committee.

(c) Applicants must have a minimum GPA of 3.0 (undergraduate record).

2. Please describe your methodology for determining enrollment projections. If a survey of student interest was conducted, please attach a copy of the survey instrument with a summary of results as Appendix B.

According to the latest Science and Engineering Indicators (published in 2006) (www.nsf.gov/statistics/nsf06325/), the number of Biosystems Engineering (sometimes referred to as Agricultural Engineering) graduate students enrolled increased by 11% between year 2000 and 2004. This trend is expected to continue because of the current focus in the country on bioenergy and bioproducts, and on the environment. It is expected that the increase in graduate enrollment will be much higher than this in the foreseeable future because of the strong demands for energy and environmental engineering specialists in the job market.

3. Provide a realistic estimate of enrollment at the time of program implementation and over a five-year period based on the availability of students meeting the criteria stated above.

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<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Total*</th>
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<tbody>
<tr>
<td>Full-time Enrollment</td>
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<td>9</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>22</td>
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<tr>
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<td>2</td>
<td>3</td>
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<tr>
<td>FTE Enrollment</td>
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*Total number of individuals participating in program over the first 5-year period, assuming four degree candidates per year and a 3-year completion cycle

4. Projected Program Completion Rates.

Please indicate the projected number of program graduates for the first five years.

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<th></th>
<th>Year 1</th>
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<th>Total</th>
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<td>0</td>
<td>0</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>14</td>
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</table>

D. Program Need Justification

1. Will the program satisfy a clearly documented need (institutional and societal) in an effective and efficient manner? If the program duplicates or closely resembles
another program already offered in the State, can this duplication be justified? What characteristics of the identified need require that it be met by a new program rather than an existing program? (Note: In explaining how the proposed program meets this criterion, an institution may refer to the criterion on collaboration and develop a response that addresses both criteria simultaneously). For purposes of this criterion, duplication is defined as the same or similar six-digit CIP code and award level in the Commission's academic program inventory. Institutions should consult with the Commission staff during the NISP phase of proposal development to determine what existing programs are considered duplicative of the proposed program.

Evidence has shown that without human intervention, the world (including the State of Alabama) is gradually reaching the limits of the finite amount of natural resources that are available to support our existence. It is therefore imperative that the utilization of our natural resources must be done in a sustainable manner. Biosystems Engineers are uniquely trained to solve problems dealing with the production, collection and conversion of natural resources that are vital for the necessities of life in a manner that sustains the environment. Obtaining renewable energy from natural resources, and utilization and protection of water resources are two of the most critical natural resources issues that currently face the world.

The importance of having sufficient and reliable supply of energy (especially from natural resources) is evidenced from the recent emphasis placed on renewable energy in the President’s 2006 and 2007 state of the union address. Quoting part of the 2006 state of the union address: “Keeping American competitive requires affordable energy. And here we have a serious problem: America is addicted to oil, which is often imported from unstable parts of the world”. Our reliance on energy from non-renewable fossil fuels has become an issue of national security. In the recently delivered 2007 State of the Union address, the President set the following two goals: (a) reducing gasoline usage in the United States by 20 percent in the next 10 years, and (b) mandatory fuels standard to require 35 billion gallons of renewable and alternative fuels by 2017. In reality, biological resources have the greatest potential to reducing the nation’s dependence on fossil fuels since it is the only renewable source of carbon. Therefore carbon-based products such as liquid fuels, chemicals, materials and products (e.g. plastics) that are currently manufactured from petroleum can be obtained from biomass feedstocks (e.g. dedicated energy crops, agricultural wastes, and forest residues). An evidence of this is the fact that the amount of ethanol produced in the country has tripled in the last five years (2.12 billion gallons in 2002 to more than 6.5 billion gallons in 2007). There are currently 167 ethanol production plants in operation in the country while 42 more are under construction (www.ethanol.org). Similarly, the amount of biodiesel produced has increased several fold within the same time period (15 million gallons in 2002 to 450 million gallons in 2007, www.biodiesel.org). The increase in biofuel production will require a corresponding increase in the amount of biomass feedstocks. According to the MultiYear Program Plan (2007-2012) document that was prepared by the Office of Biomass Program of U.S. Department of Energy, some of the research and development (R&D) technical barriers identified for biomass feedstocks include sustainable production and harvest, engineering systems to handle variability in feedstock supplies, bulk handling equipment limitations, feedstock quality and monitoring, dry and wet storage systems, biomass material properties, biomass physical state alteration and biomass bulk material handling and transportation.
Similarly, water consumption has been out-pacing population growth at global to regional scales for the past two decades. Even though many southeastern states are blessed with abundant water quantity, water scarcity issues which is tied to water quality and human health is still a problem. According to the United Nations, more than one billion people on earth lack access to adequate supplies of fresh drinking water. If the current trend persists, by 2025 the demand for fresh water will rise by 56 percent and as much as two-thirds of the world’s population will have to cope with serious water shortage. Furthermore, it is anticipated that concerns regarding shortage of potable water will supersede those for liquid fuel in the coming decades since there are alternatives for liquid fuel but none for water. Fortune Magazine (money.cnn.com/magazines/fortune/fortune_archive/2000/05) has predicted that water will be to the 21st century what oil was to the 20th century. The U.S. National Intelligence Council, a group that reports to CIA, warns that water (in addition to food and energy) will become the main resource-scarcity problem by 2015 (www.cia.gov/cia/public_affairs/speeches/2000/gannon_speech_05022000.html) and that instability created by water shortages will increasingly affect national security of the United States. It should be expected that the large-scale production of biomass feedstocks will accelerate these scarcity problems due to increase demand for water and the subsequent negative impact (water quantity and quality) on our water resources.

Thus professionals such as those with advanced degrees in Biosystems Engineering will be needed in national laboratories, industry and universities to design, develop, regulate, research and manage the systems and technologies that will be needed to produce, harvest, store, handle, process and convert these biomass feedstocks, including water, natural resources, and environmental/ecological issues that are associated with biomass feedstock availability for manufacture into biofuels and bioproducts. Biosystems Engineers are trained traditionally to use systems approaches to solve problems and will therefore perfectly fit into solving today’s complex problems involving the production, collection and conversion of renewable natural resources that are vital for the necessities of life in a manner that sustains the environment.

The faculty of the department of Biosystems Engineering at Auburn University has been carrying out research, teaching and outreach activities (with some level of difficulty because of the absence of an approved graduate program) in these areas. The proposed Ph.D. program in Biosystems Engineering will be geared towards adequately preparing students for new job opportunities in the academia, public and private sectors in emerging areas of bioenergy, bioproducts and environmental/ecological engineering.

Institutionally, Auburn University has recently created the Natural Resources Management and Development Institute. Two centers that were created along with the institute are the Center for Bioenergy and Bioproducts, and the Alabama Water Resources Center. Faculty members in Biosystems Engineering are an integral part of the two centers. Therefore, a graduate program in Biosystems Engineering will be important to the success of these centers since the amount and quality of research that are implemented at university are highly dependent on graduate programs. The proposed graduate program will therefore strengthen the research activities of the Department of Biosystems Engineering directly and the College of Agriculture, School of Forestry and Wildlife Sciences, Samuel Ginn College of Engineering, Center for Bioenergy and Bioproducts, and Water Resources Center indirectly.
Finally, the proposed graduate program does not duplicate or closely resemble another program offered in the state. The Biosystems Engineering Department is the only department in the state that has the mission to develop and disseminate engineering knowledge to solve problems in agriculture, food, fiber, bioenergy and bioproducts, water and other resources, forestry and the environment.

2. Based on your research on the employment market for graduates of this program, please indicate the total projected job openings (including both growth and replacement demands) in your local area, the state, the SREB region, and the nation. These job openings should represent positions that require graduation from a program such as the one proposed.

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<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Total</th>
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<tbody>
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<tr>
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<tr>
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<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>150</td>
</tr>
</tbody>
</table>

3. Please give a brief description of the methodology used to determine the projected job openings. If a survey of employment needs was used, please attach a copy of the survey instrument with a summary of results as Appendix C.

Biorelated engineering profession has been undergoing significant changes in the last 15 years. This engineering profession that used to focus mostly on agriculture has broadened its focus into all aspects of biological systems that include agriculture, food, forest, natural and water resources, bioenergy and bioproducts, and the environment. This correspondingly led to surge in enrollments in undergraduate and graduate programs in bio-related engineering programs. According to the Science and Engineering Indicators of 2006 (www.nsf.gov/statistics), the number of Biosystems Engineering (sometimes referred to as Agricultural Engineering) graduate students enrollment increased by 100 between year 2000 and 2004. This trend is expected to continue if not at a higher rate because of the current focus in the country on bioenergy and bioproducts, and on utilization and conservation of natural and water resources as discussed in the previous section. This is confirmed by a U.S. Department of Labor Statistics (www.bls.gov/oco) publication that reported that increases of up to 17 percent (translates into a need for 584 more agricultural engineering graduates) can be expected for agricultural engineers (with graduate and undergraduate degrees) between 2004 and 2014. Informal survey of graduates from Biosystems Engineering (or similarly named programs) across the country indicate that a significant amount of these graduates are employed in consulting firms and government agencies (e.g. Alabama Department of Environmental Management - ADEM) that deal with environmental engineering related problems. The publication of the U.S. Department of Labor statistics also showed that increases more that 27% (translates into a need for 13,230 more environmental engineering graduates) can be
expected for professionals with skills in environmental engineering between 2004 and 2014.

4. If the program is primarily intended to meet needs other than employment needs, please present a brief rationale.

The proposed program is designed to meet growing employment needs which are tied to societal needs to address new demands in areas of bioenergy, bioproducts, natural and water resources conservation and utilization, food, agriculture and the environment.

5. If similar programs are available at other institutions in the state, will any type of program collaboration be utilized? Why or why not? What specific efforts have been made to collaborate with institutions to meet the need for this program? Address qualitative, cost, and access considerations of any collaboration that was considered.

The proposed program is not available elsewhere in the state.

6. Please identify any similar programs at institutions in other SREB states. If the proposal is for a doctoral program, also identify similar programs in the nation.

Except for the states of Delaware and West Virginia, all the other SREB states have Biosystems Engineering (or similarly-named engineering program) Ph.D. programs at the 1862 land-grant university for the state. Nationwide, only two (apart from Auburn University) of the remaining 1862 land-grant universities that award B.S. degree in Biosystems Engineering (or similarly named program) does not have a Ph.D. program in Biosystems Engineering.

5. Will any type of distance education technology be utilized in the delivery of the program on your main campus or to remote sites? If not, why? Address the quality, access and cost considerations of using distance technology in the program.

No. Most of the courses involve laboratory exercises and/or field trips that cannot be accomplished by distance learning.

E. Program Resource Requirements

1. Number of currently employed qualified faculty who will teach in the program:

   Primary Faculty-- 10
   Full-time: 10
   Part-time:
   Support Faculty-- 2
   Full-time: 2
   Part-time:
Please attach the curriculum vita of each existing faculty member to this proposal as Appendix D.

2. Number of additional qualified faculty who will be employed to teach in the program during the first five years:

None planned at present. The department has just hired 7 new faculty in the last 6 years. All of the faculty in the department are currently involved in graduate research, teaching and advising under the temporary arrangement. However, the long-term (5 to 10 years) goal of the department is to increase the number of faculty from 12 to 15.

Primary Faculty--
   Full-time:  
   Part-time:  
Support Faculty--
   Full-time:  
   Part-time:  

3. Briefly describe the qualifications of new faculty to be hired.

Not applicable

4. Briefly describe available and additional support staff that will be provided for the program.

The Biosystems Engineering Department currently has 8 staff personnel who have been successfully used to support current graduate teaching, research and outreach activities. However, we anticipate that the department will need a wet chemistry full time technician in the next three to five years.

5. Describe any special equipment that is necessary for this program, indicating what is currently available and what would be added, including the cost of any additional equipment.

The classroom, research facilities and laboratories necessary for this program are currently available. As mentioned before, faculty in the department have been directing an average of 16 graduate students per semester in the past two years. Some of the equipment available includes: pellet mill, thermogravimetric analyzer (TGA), FTIR spectrometer, FTNIR spectrometer, muffle furnace, differential scanning calorimeter (DSC), rheometer, instron (1000 lb capacity), two models of texture analyzer (50 kg capacity model and 500 kg capacity model), radio-frequency heating system, shear tester for flowability determination, humidity chambers, gas analyzer, solar-water heating system, automated particle density analyzer, automated particle size analyzer, bomb calorimeter, atomic force microscope (AFM), high pressure reactor, gas chromatograph/mass spectrometry (GC/MS), pyroprobe, fast pyrolysis unit, John Deere 6420 tractor (with infinitely variable transmission, AutoTracTM assisted steering system, Trimble EZ-Guide light bar system, Trimble EZ-Steer guidance system), GPS receivers, various GPS equipment from Trimble (GPS survey grade system, robotic total station, Ag 132 receiver, GeoXH, Geo XT), Agilent mixed signal oscilloscope, biomass harvester (large square baler), oilseed expeller, CNC
plasma table, iron worker, horizontal band saw, Agheader precision agriculture system, small engine dynamometer, acoustic non-destructive testing equipment and variety of timber harvesting equipment.

The Biosystems Engineering’s Soil and Water Laboratory has about 1013 ft² of dedicated, temperature-controlled space. The laboratory has 8 ISCO automated samples, 6 CR10X dataloggers, multiplexers, pressure transducers, real time nutrient analyzer, Doppler flow meter, real time conductivity meter, current meters and other equipment for field use. The department also has a wet lab for water, soil, and sediment sample processing. In addition, the department also has access to the Soil Physics Laboratory, Soil Microbiology Laboratory, and Civil Engineering Laboratories. Some of the equipment in these laboratories includes Beckman LS 6500 Series Scintillation Counter, HPLC, Gas Chromatography (GC), ICAP, AA atomic adsorption, spectrophotometer and colorimetry, and support meters (pH, conductivity, etc.), Biometra T-Gradient 48 thermocycler, agarose gel rigs, Kodak Gel Logic 200 photodocumentation system consisting of a UV transilluminator, camera, computer, microcentrifuges, refrigerators, freezers, Nikon and Leitz epifluorescence microscopes, Waters 2690 Alliance HPLC system equipped with an autosampler, two-channel UV/VIS detector, conductivity detector, Shimadzu 1601 UV-Visible scanning spectrophotometer, Sorvall Super T21 centrifuge, Labconco Class II biological safety cabinet, analytical balances, autoclave, New Brunswick incubator shaker, New Brunswick platform shaker, benchtop incubator, rotating mixers, reciprocating shaker, water baths, rotary evaporator, pH meter, and other routine laboratory equipment.

In addition, all of the equipment and facilities that the Auburn University Center for Bioenergy and Bioproducts use for research, teaching and outreach activities are currently available to Biosystems Engineering graduate students. This includes mobile biomass gasification and power generation unit, stationary biomass gasifier, biomass fractionation unit, biodiesel production units, and state of the art laboratory for analyzing biomass feedstocks, biofuels and bioproducts.

Additional efforts are underway to create an advanced water quality laboratory to be operated by the Water Resources Center. The equipment in this laboratory will also be available to students conducting water quality and related research.

6. Describe facilities required for the program, indicating what is currently available and any necessary renovations or additional facilities that would be added. Provide a cost estimate for any renovations or additions.

The Biosystems Engineering department is currently housed in the Tom Corley main building and associated Annex. Renovation of the Tom Corley Building was carried out in 1984 and subsequent periodic maintenance activities have provided excellent facilities for much of the teaching program and some of the research activities in the department. Many of the laboratories are in the Corley Building Annex. As funding allows, safety and infrastructure upgrades are being made in the Corley Annex. Both the main building and the Annex house 12 laboratories, three primary classrooms, 2 conference rooms, an electronics fabrication shop and a research equipment fabrication shop. These laboratory facilities occupy more that 17,500 square feet of space. The department also has access to and has used the following facilities for research, teaching and outreach activities – all of the Alabama Agricultural Experiment Stations; Colleges of Agriculture and Engineering; Auburn University
7. Using the Collection Assessment Manual of the Network of Alabama Academic Libraries (NAAL), provide an indication of the current status of the library collections supporting the proposed program. Please describe how any deficiencies will be remedied, including the cost of such remedies.

See Appendix B.

8. How many assistantship/fellowship stipends will be provided and what will be the range of support involved?

The stipends of current and past graduate students have been provided almost entirely from extramural grants secured by Biosystems Engineering faculty. We expect that this trend to continue. However, we expect that Auburn University will fund 2 M.S.-level teaching assistantships (at $17,000 per year). Currently, the Alabama Agricultural Experiment Station provides $28,000 per year for graduate research assistantships for the department. This is generally enough to support one Ph.D. and one-half M.S. assistantships. As the program grows, additional funds will be needed to help supplement extramural funds.

F. Costs and Financial Support of the Program

Provide a realistic estimate of the costs of the program. This should only include the additional costs that will be incurred, not current costs. All sources and amounts of funds for program support should be indicated.

<table>
<thead>
<tr>
<th>Estimated New Funds Required to Support the Program</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Year 1</td>
</tr>
<tr>
<td>Faculty</td>
</tr>
<tr>
<td>Library¹</td>
</tr>
<tr>
<td>Facilities</td>
</tr>
<tr>
<td>Equipment</td>
</tr>
<tr>
<td>Staff²</td>
</tr>
<tr>
<td>Assistantships/</td>
</tr>
<tr>
<td>Fellowships³</td>
</tr>
</tbody>
</table>
Sources and Amounts of Funds Available for Program Support

<table>
<thead>
<tr>
<th></th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Reallocation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Extramural</td>
<td>$72,000</td>
<td>$126,000</td>
<td>$180,000</td>
<td>$180,000</td>
<td>$180,000</td>
<td>$748,000</td>
</tr>
<tr>
<td>Tuition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$72,000</td>
<td>$126,000</td>
<td>$180,000</td>
<td>$180,000</td>
<td>$180,000</td>
<td>$748,000</td>
</tr>
</tbody>
</table>

*Attach a statement identifying actual or probable sources of extramural funds for the program as Appendix E. Be as specific as possible.

Biosystems Engineering faculty in the last 5 years have successfully obtained extramural funds from the following agencies: USDA, NSF, EPA, Commodity Agencies in Alabama, ADECA, various initiatives (Poultry, Blackbelt, Natural Resources, Water, Bioenergy and Bioproducts) funded by the state of Alabama, AALGA (Alabama Agriculture Land Grant Alliance), and US Forest Service. Some of the funds that were secured from these agencies have been used to fund current and past graduate students. We expect that this trend will continue in the next 5 years. A summary of the funds from these agencies is given in Appendix E.

G. Institutional Program Evaluation and Approval Process

1. Please describe the process used by your institution in its internal evaluation and approval of this program.

The Departmental curriculum committee develops the program proposal and is presented to the departmental faculty for approval. The department chair then forwards the program proposal to the Colleges of Agriculture and Samuel Ginn.
College of Engineering for evaluation and approval by the curriculum committee and Dean of each college. If approved, the proposal is sent to the Graduate Council via the Provost's office. After evaluation by the Graduate Council, the program proposal is sent to the University Curriculum Committee for approval. The program proposal is then sent to the Provost, who then makes a recommendation to the Board of Trustees. If the new program is reviewed favorably and is approved by the Board, the proposal is submitted for ACHE review.

2. It is expected that the institution will utilize one or more external consultants for all doctoral program proposals and the more esoteric or unusual master’s programs. Please attach the consultant’s report as Appendix F.

Program review by external consultant is pending.

H. Program Review and Assessment

Approval of this program will be on the basis of certain program outcomes agreed upon by the institution and the Commission. The outcomes will be based on the stated objectives of the program and enrollment and productivity projections. In the final analysis, the institution and its governing board are accountable for the quality, utility and productivity of this and all other programs of instruction. With this in mind, please describe the procedures that will be used in assessing program outcomes. Among other things, include an assessment process for student learning outcomes and a follow-up plan to determine accomplishments of graduates such as obtaining relevant employment or being admitted to a doctoral program.

Normal assessment procedures as outlined by SACS guidelines will be used. The portion of the guidelines that were relevant for the undergraduate Biosystems Engineering program have been used and documented in the report submitted to ABET during their last accreditation visit to the department. We will be using the appropriate portion of the SACS guidelines for review and assessment of the Ph.D. program in Biosystems Engineering.
APPENDIX A
CURRICULUM MODELS

The following timetable applies to students entering with a B.S. degree in Biosystems Engineering or related engineering program. Students with an M.S. degree may progress more quickly in the first two years of the program.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Normal Progress</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select research advisor</td>
<td>End of 2\textsuperscript{nd} semester</td>
<td>End of 4\textsuperscript{th} semester</td>
</tr>
<tr>
<td>Complete course work</td>
<td>End of 6\textsuperscript{th} semester</td>
<td>End of 8\textsuperscript{th} semester</td>
</tr>
<tr>
<td>Qualifying examination</td>
<td>End of 7\textsuperscript{th} semester</td>
<td>End of 9\textsuperscript{th} semester</td>
</tr>
<tr>
<td>Preliminary examination</td>
<td>End of 9\textsuperscript{th} semester</td>
<td>End of 12\textsuperscript{th} semester</td>
</tr>
<tr>
<td>Dissertation Completion</td>
<td>End of 12\textsuperscript{th} semester</td>
<td>End of 114\textsuperscript{th} semester</td>
</tr>
<tr>
<td>Final Examination</td>
<td>End of 12\textsuperscript{th} semester</td>
<td>End of 14\textsuperscript{th} semester</td>
</tr>
</tbody>
</table>

Course Work Year 1: 18 credit Hours

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>BSEN 7120 - Stochastic Modeling for Biosystems</td>
<td>3</td>
</tr>
<tr>
<td>Fall</td>
<td>Approved Concentration Course* 1</td>
<td>3</td>
</tr>
<tr>
<td>Fall</td>
<td>Approved Concentration Course 2</td>
<td>3</td>
</tr>
<tr>
<td>Spring</td>
<td>Approved Concentration Course 3</td>
<td>3</td>
</tr>
<tr>
<td>Spring</td>
<td>Approved Concentration Course 4</td>
<td>3</td>
</tr>
<tr>
<td>Spring</td>
<td>Approved Concentration Course 5</td>
<td>3</td>
</tr>
</tbody>
</table>

*Concentration areas in Biosystems Engineering are ecological engineering, food and biological engineering, off-highway vehicle engineering, and production and process engineering (which includes bioenergy and bioproducts). Approval of the concentration courses will be made by the student’s advisory committee.
### Course Work Year 2: 18 credit Hours

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Approved Concentration* Course 6</td>
<td>3</td>
</tr>
<tr>
<td>Fall</td>
<td>Approved Concentration Course 7</td>
<td>3</td>
</tr>
<tr>
<td>Fall</td>
<td>Approved Elective 1</td>
<td>3</td>
</tr>
<tr>
<td>Spring</td>
<td>Approved Concentration Course 9</td>
<td>3</td>
</tr>
<tr>
<td>Spring</td>
<td>Approved Concentration Course 10</td>
<td>3</td>
</tr>
<tr>
<td>Spring</td>
<td>Approved Elective 2</td>
<td>3</td>
</tr>
</tbody>
</table>

### Course Work Year 3: 12 credit Hours

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Approved Elective 3</td>
<td>3</td>
</tr>
<tr>
<td>Fall</td>
<td>Approved Elective 4</td>
<td>3</td>
</tr>
<tr>
<td>Spring</td>
<td>Approved Elective 5</td>
<td>3</td>
</tr>
<tr>
<td>Spring</td>
<td>Approved Elective 6</td>
<td>3</td>
</tr>
</tbody>
</table>

### Summary

Required Formal courses: 30 Credit Hours  
Elective Courses: 18 Credit Hours  
Dissertation Research Courses: 12 Credit Hours  

Total: 60 Credit Hours
Summary

We used the guidelines established by the Network of Alabama Academic Libraries (NAAL) Collection Assessment Manual (1) to measure both the extent to which our existing library holdings and the ongoing collecting activity can support the proposed masters and doctoral level study of biosystems engineering at Auburn University. Our assessment indicates that holdings in this subject in general not only meet, but in some areas, far exceed the criteria for doctoral level studies. Auburn University Libraries has in place a 4C research level collection of books, journals and databases; and is collecting at levels 3 - 4, a selective research level collecting intensity. Auburn University Libraries has comprehensive collections of high impact journals in biosystems engineering and related areas. The Libraries has in place: reference, instructional document delivery; computer information services for storing, accessing and delivering information to support undergraduate, and graduate instructional, research and outreach programs in biosystems engineering.
Description of Auburn University Libraries; Staff, Services

Auburn University Libraries include the Ralph Brown Draughon Library (the main library), the Library of Architecture, Design and Construction and the Charles Allen Cary Veterinary Medical Library. The Libraries has combined collections of over 2.7 million volumes; 2.6 million government documents, 2.5 million microforms, and over 148,000 maps. The Libraries receive over 35,000 current periodicals, many which are available online. And the Libraries provides access to over 227 electronic databases. Books are arranged by subject in open stacks using the Library of Congress (LC) system.

The Libraries support the mission of the University by actively engaging in and contributing to the teaching, learning, research and outreach needs of the Auburn University community. The Libraries employs over 100 library faculty and staff who have in place scholarly collections, programs and library services that link faculty, staff, and students transparently to the widest possible selection of global information sources in print and electronic formats in support of instructional, research, and service programs of Auburn University. Auburn University Libraries provides research support to faculty, staff, students, and members of the public through a centralized Reference Desk. Each college and academic department at Auburn is served by one of the 16 reference librarians who serve as subject specialists for the assigned departments with responsibility for providing reference services, library instruction, and collection development. In consultation with Biosystems Engineering faculty, staff, and students, the Agriculture Librarian has responsibility for developing collections, and providing library services, research support, and instructional services to Biosystems Engineering faculty, staff, and students. The Libraries offers a library user instruction program that encourages the development of critical thinking, research skills and information literacy to enable the students, staff, and faculty to function independently in this information rich and technology driven environment.

Auburn University Libraries is a member of the Association of Research Libraries (ARL); the Southeastern Library Network (SOLINET); and the Network of Alabama Academic Libraries (NAAL). It also serves as a federal depository library, and member of the Patent and Trademark Depository Library (PTDL) of the United States Patent and Trademark Office. The Libraries has cooperative working relationships with members of these associations, whose services and collections are used to enhance and complement the collections and services of Auburn University Libraries to fully address information needs of Auburn University faculty, staff, and students, as needed.
Assessment of Collections

Aims

The aim of this report is to evaluate the biosystems engineering collection in the Auburn University Libraries, and assess the extent to which the collection and collecting activity would support the proposed masters and Ph.D programs of study in biosystems engineering. A related objective is to identify areas of the collection which need improvement in currency and scope. A final objective is to lay the foundation for a collection management policy for biosystems engineering to guide current and future collecting efforts in support of the proposed programs.

Methods

The collections were assessed using criteria laid down in the Network of Alabama Academic Libraries (NAAL) Manual, which included:

- List checking of core journals in this field;
- Shelf checking to ascertain book volume counts in this field; and
- Needs assessment of faculty to discover unmet information needs.

Book Collections

Table 1: Number of Books in Biosystems at Auburn & Peer Institutions

<table>
<thead>
<tr>
<th>Subject (LC)</th>
<th>Auburn</th>
<th>Mississippi State Univ.</th>
<th>Virginia Tech</th>
<th>Univ. of Georgia</th>
<th>Cornell</th>
</tr>
</thead>
<tbody>
<tr>
<td>G 70.2</td>
<td>278</td>
<td>92</td>
<td>276</td>
<td>320</td>
<td>304</td>
</tr>
<tr>
<td>Geographic Information systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G 70.3</td>
<td>39</td>
<td>11</td>
<td>55</td>
<td>45</td>
<td>68</td>
</tr>
<tr>
<td>Remote Sensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G109.5</td>
<td>8</td>
<td>11</td>
<td>20</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Global Position Systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S 494.5</td>
<td>425</td>
<td>362</td>
<td>452</td>
<td>679</td>
<td>1,582</td>
</tr>
<tr>
<td>Special Aspects of Agriculture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S 600 – S605.5</td>
<td>306</td>
<td>213</td>
<td>300</td>
<td>474</td>
<td>1,071</td>
</tr>
<tr>
<td>Agricultural Conservation, Meteorology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S606 – S621.5</td>
<td>182</td>
<td>189</td>
<td>176</td>
<td>325</td>
<td>740</td>
</tr>
<tr>
<td>Category</td>
<td>Code Range</td>
<td>204</td>
<td>243</td>
<td>214</td>
<td>352</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>--------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Land Reclamation, Irrigation</td>
<td>S622 – S627</td>
<td>204</td>
<td>243</td>
<td>214</td>
<td>352</td>
</tr>
<tr>
<td>Soil Conservation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S671 – S760</td>
<td>Farm Machinery &amp; Farm Engineering</td>
<td>479</td>
<td>501</td>
<td>264</td>
<td>466</td>
</tr>
<tr>
<td>S770 – S790.3</td>
<td>Agricultural Structures</td>
<td>3</td>
<td>1</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>SB 186</td>
<td>Field Crops. Harvesting, Drying, Storage</td>
<td>13</td>
<td>34</td>
<td>16</td>
<td>30</td>
</tr>
<tr>
<td>SB 189.73 – SB 190</td>
<td>Grain. Cleaning, Drying, Grading, Storage</td>
<td>32</td>
<td>22</td>
<td>33</td>
<td>55</td>
</tr>
<tr>
<td>SB 319.73 – SB 319.77</td>
<td>Horticultural Crops. Harvesting, Grading, Storage</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>SD 388 – SD 390</td>
<td>Forestry Machinery &amp; Engineering</td>
<td>181</td>
<td>44</td>
<td>36</td>
<td>134</td>
</tr>
<tr>
<td>TC 801 – TC 957</td>
<td>Irrigation Engineering</td>
<td>107</td>
<td>1,014</td>
<td>111</td>
<td>134</td>
</tr>
<tr>
<td>TC 970 – TC 978</td>
<td>Land Drainage</td>
<td>45</td>
<td>44</td>
<td>37</td>
<td>47</td>
</tr>
<tr>
<td>TD 930</td>
<td>Agricultural Waste</td>
<td>66</td>
<td>42</td>
<td>42</td>
<td>64</td>
</tr>
<tr>
<td>TD 878 – TD 994</td>
<td>Special types of environment; air, soil, and noise pollution</td>
<td>946</td>
<td>631</td>
<td>1,040</td>
<td>676</td>
</tr>
<tr>
<td>TH 4911 – TH 4975</td>
<td>Building Construction. Farm Buildings</td>
<td>105</td>
<td>45</td>
<td>73</td>
<td>66</td>
</tr>
<tr>
<td>TJ 807 – TJ 830</td>
<td>Renewable Energy Sources</td>
<td>377</td>
<td>119</td>
<td>422</td>
<td>248</td>
</tr>
<tr>
<td>TJ 900 – TJ 935</td>
<td>Pumps and Pumping Engines</td>
<td>193</td>
<td>79</td>
<td>250</td>
<td>31</td>
</tr>
<tr>
<td>TJ 1480 – TJ 1496</td>
<td>Agricultural Machinery</td>
<td>31</td>
<td>25</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>TK4018</td>
<td>Applications of Electric Power to Agriculture and the Farm</td>
<td>27</td>
<td>86</td>
<td>26</td>
<td>23</td>
</tr>
<tr>
<td>TP 370 – TP 465</td>
<td>Food technology, manufacturing, and processing</td>
<td>642</td>
<td>514</td>
<td>708</td>
<td>936</td>
</tr>
</tbody>
</table>
Table 1 above shows the number of monographs in the various subject areas of biosystems engineering, in Library of Congress subject classification order. Auburn’s book and monograph collections are shown alongside those of peer institutions that have Ph.D. programs in biosystems engineering. The collections at Auburn are comparable to those of peer institutions that offer research level biosystems programs. With 5 as the highest most comprehensive collecting level, the present collection overall is rated at 4C, which is a research collection level that includes selections of the majority of the important undergraduate and graduate level texts published in English, core journals of the field, and some selected titles of books and journals in modern European languages when desired.

Books from well-established science publishers that support both the undergraduate and graduate programs of instruction and research are purchased automatically using the Blackwell North America book approval program. In addition, faculty, staff, undergraduate and graduate students suggest books to add to the library collections. The library also makes efforts to purchase publications from important professional societies such as the American Society of Agricultural and Biological Engineers (ASABE).

However, the Biosystems Engineering Department and the Auburn University Libraries will need to continue to work together to maintain current collecting efforts; update collections overall; and pay particular attention to strengthen expanding areas of research interest once the proposed programs are place.

**Journal Holdings**

To get an indication of how adequately our current journal collections would support the proposed masters and Ph.D programs in biosystems, we checked some selected lists of journals which are likely to cover biosystems research work. All the lists are from the Science Citation (Web of Science) Journal Citation Reports (JCR) database. Science Citation Index JCR lists journals under various subject categories.

Because biosystems is a highly inter-disciplinary area, it was necessary to check journals under several subject categories that included: agricultural engineering; energy and fuels; environmental engineering; environmental sciences; food science and technology; remote sensing; and water resources. While the number of journals in each subject category is small compared to the thousands of science journals in these areas, the selected Science Citation Index journals are the most respected, most cited, high impact journals in each field.

The Biosystems Engineering Department, with its 85-year history, has developed many comprehensive areas of research and outreach that fall in the selected SCI subject categories above. Among the major research emphases for the Department and University in the coming years are: forest engineering; precision agriculture; off-highway vehicle engineering; biological and food engineering; ecological engineering; water resources; and alternative fuel and renewable energy resources.
Table 2: Science Citation Index High Impact Journal Holdings at Auburn

<table>
<thead>
<tr>
<th>SCI Subject Category</th>
<th>Total Journals</th>
<th>Total at Auburn</th>
<th>Auburn Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Engineering</td>
<td>9</td>
<td>9</td>
<td>100%</td>
</tr>
<tr>
<td>Energy and Fuels</td>
<td>63</td>
<td>49</td>
<td>78%</td>
</tr>
<tr>
<td>Environmental Engineering</td>
<td>37</td>
<td>34</td>
<td>92%</td>
</tr>
<tr>
<td>Environmental Sciences</td>
<td>140</td>
<td>105</td>
<td>75%</td>
</tr>
<tr>
<td>Food Science and Technology</td>
<td>93</td>
<td>71</td>
<td>76%</td>
</tr>
<tr>
<td>Remote Sensing</td>
<td>10</td>
<td>7</td>
<td>70%</td>
</tr>
<tr>
<td>Water Resources</td>
<td>57</td>
<td>46</td>
<td>81%</td>
</tr>
</tbody>
</table>

The results in Table 2 show that Auburn University Libraries owns most of the core journals that report biosystems engineering research. From a quick sample of these titles, over 30% of these journals are available in electronic format for the latest 7 years at least, and would be accessible from any desktop computer on campus and from remote locations.

For journal titles that are not held at Auburn, the Libraries offer graduate students, staff and faculty the option of using the Ingenta Connect journal article delivery service that has a 24-48 hour turn-around time. In addition, Auburn University faculty, staff, and students can request needed journals and books through the Inter-Library Loan services with a 3-5 work day turnaround time. Between collections that we have in the
Libraries; and materials accessed through Ingenta and Inter-Library loan, our students, faculty and staff have nearly 100% of their information needs fulfilled.

From this assessment and the book counts and journal holdings shown in Tables 1 & 2 above, I rate the journal and book holdings in biosystems as adequate for supporting the proposed masters and Ph.D programs in biosystems engineering. The collections are comparable to holdings of peer institutions who currently offer the proposed programs.

**Agriculture Library Budget, for Journals & Books**

In general, books represent a small proportion of the agriculture budget; while journals account for most of the library materials budget, as do computer abstracting and indexing databases. Books that do not come on approval are purchased selectively. Atlases, conference proceedings, book series are acquired selectively. Criteria for selection include author and publisher reputation, relevance to instruction, outreach and research interests of faculty and students, and cost.

This proportion is appropriate for the sciences, which are heavily dependent on research work published in journals. Large journal cuts in the last few years and the continual increase in journal prices mean that we are collecting only a fraction of relevant journal titles and adding minimal to no new journals. As is the case with most research libraries, we must depend on "access" to some of these journals rather than acquire of all titles in the library collections. For our collections in this area, we are attempting to collect the most relevant, prestigious and frequently used titles that will address the instruction, research, outreach needs of the Department.

**Abstracting and Indexing Services**

Auburn University Libraries provides access to the major indexes and abstracts for identifying research articles published in biosystems engineering. All of these indexes are provided in electronic format, and are accessible campus-wide and from any remote computers. These include the following databases:

- AGRICOLA
- CAB
- Biological Abstracts
- Engineering Village 2 (EI Village 2)
- GeoRef
- Environmental Sciences and Pollution Management
- Web of Science (Science Citation Index)
- Digital Dissertations/Dissertations and Theses
- United States Patents
- Current Contents
I would rate the computer database collection provided as adequate for supporting programs of research, instruction, and outreach for the proposed masters and Ph.D. programs in biosystems engineering. This collection meets and exceeds set expectations for proposed programs.

**Dissertations**

Auburn University Libraries collects two sets of masters and dissertation reports from Auburn University Departments. One is in the special collections for research and preservation, while the second copy is available for circulation. Masters and dissertations are accessible through the Auburn University Libraries catalog. The library collects thesis and dissertations from other universities only selectively, often done in response to order requests from students, staff, and faculty. To identify masters and dissertation research conducted at other universities world-wide, Auburn University researchers rely upon searching the *Digital Dissertations/Dissertations and Theses* database; and then any needed copies are purchased on demand. Copies can also be provided through Inter-Library Loan.

Auburn University Libraries provides links to electronic copies of dissertations from Auburn and elsewhere, when those are available.

*Given the ease of searching and accessing dissertations and thesis and the ease of placing requests for needed copies; I rate the access to dissertations and thesis research as adequate and exceeding set expectations in support of proposed masters and Ph.D. programs in biosystems engineering.*

**Standards**

Auburn University Libraries subscribes to the ASABE Technical Library, which includes current ASABE standards and the earlier ASAE standards back to 1954. In assessing the information needs of faculty, staff and students, we notice that ASABE has the standards that are most heavily used for instructional, outreach and research programs in biosystems engineering. In addition, the Libraries has current holdings of other professional standards such as the ASTM standards that are needed in this area. For standards that are not currently held in the collections, the Libraries acquires needed titles on demand through a rush order process.

*I rate the standards collections and the on-demand standards order process as adequate for supporting the proposed masters and Ph.D. program in biosystems.*
As a Patent and Trademark Depository Library (PTDL), Auburn University Libraries provides access to over 7 million U.S. patents available in microfilm, DVD, and online formats. Through the PTDL network, the Libraries provide comprehensive patent search support to students, staff, faculty, and inventors from the region who need to research U.S. and foreign patents.

Biosystems Engineering students, staff, and faculty are among the regular users of this service, especially for design work.

I rate this portion of the collections as adequate and exceeding expectations set for supporting graduate studies and research studies in biosystems engineering.

To help capture impressions and experiences of library users on how well the biosystems engineering collections meet their instructional, research, and outreach information needs, the library periodically administers campus-wide assessments of library collections and services. Assessment tools include use informal focus groups of students, staff and faculty and use of formal surveys of collections and services such as LibQUAL, a survey instrument that is developed and implemented by the Association of Research Libraries (ARL).

Through such measures, user ratings of Auburn University Libraries are consistently favorable overall. Auburn University Libraries users overall judge the collections as adequate and services as effective and responsive to their needs. Specific services that users rate as ‘exceeding set standards’ include the assessment that: the library provides a comfortable, inviting environment for study and research to promote reflection and creativity; and library faculty and staff are judged as most willing to help students, staff and faculty with their information research. Things to improve include the need for: complete runs of journals; need for more electronic journals and technology that facilitates research; having longer opening hours; and need for additional computers, laptops, and computer connectivity.

From similar observations and impressions, biosystems faculty, staff, and students indicate that Auburn University Libraries collections and services adequately meet their needs.
Biosystems faculty have suggested that the library make efforts to update the book collections in all areas of biosystems engineering.

Even with the favorable feedback, because of the impact of information technologies, Auburn University Libraries is being challenged to re-examine and re-configure the delivery of research information for remote and onsite use and also balance this with the predominant needs of undergraduate students. Library environmental scans have been developed from this user feedback and additional library strategic planning summits with library constituent user groups. Auburn University Libraries has developed action plans have to address expressed needs.

**Digital Resource Laboratory**

Auburn University Libraries provides to Auburn university students, staff and faculty use of multimedia materials and equipment for class assignments and projects. The Digital Resource Laboratory (DRL) at RBD Main Library houses the latest multimedia hardware and software that includes equipment for graphics layout and design, image scanning, audio and video editing, analog-to-digital conversions, CD and DVD authoring, video editing and creating and printing of posters.

A related unit, that is also in the main library, the Music Movies and More, housed in the Circulation Department, contains books, journals, and software in audio, video, CD, DVD formats.

Because of the increased demand for services in this unit, there are plans underway to expand this unit to over twice its current size. Biosystems Engineering faculty, staff, students are among library users with needs for services of this unit.

**Computer Workstations, Wireless Laptops**

The library provides over 50 Office of Information Technology (OIT) computer workstations for students, staff, and faculty to use. The computers are located on each of the four floors of the main library. In addition there are over 50 wireless computer laptops that Auburn University faculty, staff, and students can check out from the 1st Floor Main Circulation Desk.

**Conclusions**

The existing biosystems engineering collections in Auburn University Libraries is currently at a level that can adequately support masters and doctoral studies in biosystems engineering.

The book collections are at research level but require updating, especially in expanding areas of research interests. On a five point scale, with 5 as the highest most
A comprehensive collection, the journal collections are also at a research level 4 and contain the majority of the key journals in biosystems and related areas. The abstracting and indexing services for researching biosystems topics are adequate and far exceed set expectations for materials. In addition, there are comprehensive collections of the patent literature, and access to dissertations and thesis, and standards collection.

The book budget is limited; and the journal budget is static, while journal prices increase at about 10% annually. Factoring in access to desired resources, the overall current collecting level is at a research level. On a five point scale, with 5 as the highest most comprehensive collecting level, the collecting level for books is selective and estimated at level 3 – 4; the current collecting level for journals is at a reduced level, level 3 given the overall inability to add new journals. The collecting level for abstracting and indexing databases is estimated at a level 4 – 5.

There are library services and programs in place to ensure storage, search, retrieval and delivery of needed information from the Auburn library collections; through access to library subsidized fee-based delivery services; and through library cooperative lending networks.

**Recommendations, Desired Improvements**

As an ideal and ongoing goal, as funds become available, and in consultation with Biosystems Engineering faculty, staff, and students; the Auburn University Libraries should add the following to the collections: SCI top-ranked journals; E-Journal formats to replace print; fill journal gaps; and Update book collections

**References**

APPENDIX D

CURRICULUM VITA OF EXISTING BIOSYSTEMS ENGINEERING FACULTY
SUSHIL ADHIKARI
Assistant Professor
215 Tom Corley Building
Phone: (334) 844-3543, Fax: (334) 844-3530
E-mail: sza0016@auburn.edu

EDUCATION

2008 - Ph. D., Agricultural and Biological Engineering, Mississippi State University
2003 - MS, Energy Technology, Asian Institute of Technology (AIT), Thailand
2000 - BS, Mechanical Engineering, Tribhuvan University, Nepal

EXPERIENCE

Years of experience at Auburn: 0
2008 - Present: Assistant Professor, Biosystems Engineering, Auburn University
2005 - 2007: Graduate Research Assistant, Agricultural and Biological Engineering,
Mississippi State University
2003 - 2005: Research Associate, Energy Technology, Asian Institute of Technology,
Thailand
2000 - 2001: Lecturer, Civil and Computer Engineering, Kantipur Engineering College, Nepal

GRADUATE FACULTY STATUS AT AUBURN UNIVERSITY

New faculty (applied for Level 1 status)

SCIENTIFIC AND PROFESSIONAL SOCIETIES

2007 - Present: American Chemical Society
2007 - Present: American Institute of Chemical Engineers
2005 - Present: American Society of Agricultural and Biological Engineers
2005 - Present: Institute of Biological Engineers

INSTITUTIONAL AND PROFESSIONAL SERVICES

2007 - Present: Member - Sigma Xi, Scientific Research Society

HONORS AND AWARDS

2003: The Asian Institute of Technology Alumni Association Prize - Asian Institute of Technology.
2003: The Yoshiro Takasaki Prize - Asian Institute of Technology.
2000: Outstanding Student Award - Mechanical Engineering Department, Tribhuvan Uni.

PROFESSIONAL DEVELOPMENT ACTIVITIES
- 2008 - Present: Reviewer for Int. J. of Hydrogen Energy
- 2008 - Present: Reviewer for Trans of ASABE

RESEARCH INTERESTS

Biomass Gasification and Pyrolysis; Hydrogen Production; Biodiesel Production; and Nanocatalysis.

SELECTED PUBLICATIONS

JAMES O. DONALD, P. E.
Professor and Extension Biosystems Engineer
228 Tom Corley Building
Phone: (344) 844-3544, Fax: (344) 844-3548
E-mail: jimdonald@aces.edu
Website: http://www.poultryhouse.com

EDUCATION

1970 - MS, Agricultural Engineering, University of Georgia
1969 - BS, Agricultural Engineering, University of Georgia

EXPERIENCE

Years of experience at Auburn: 38
1998 - Present: Adjunct Professor, Poultry Science Department, Auburn University
1988 - Present: Professor and Extension Engineer, Biosystems Engineering Department, Auburn University
1970 - 1988: Extension Agricultural Engineer, Agricultural Engineering Department, Auburn University

GRADUATE FACULTY STATUS AT AUBURN UNIVERSITY

None (Extension faculty)

SCIENTIFIC AND PROFESSIONAL SOCIETIES

American Society of Agricultural Engineers
Poultry Science Association

INSTITUTIONAL AND PROFESSIONAL SERVICES

1996 - Present: Industry Advisor - US Poultry and Egg Association
1992 - Present: Board of Directors - Alabama Poultry and Egg Association

HONORS AND AWARDS

1993: Distinguished Leadership Award - ALFA Farmers Federation. Outstanding Contributions and Service to Alabama Agriculture
1993: Certificate of Merit - US Department of Agriculture. For Reduction of Environmental Problems in Poultry Production
1990: Presidential Service Award - Alabama Poultry and Egg Association. *Environmental Educational Program Development*
1990: Extension Excellence Award - Auburn University Alumni Association. *Outstanding Agricultural Extension Educational Program*

**PROFESSIONAL DEVELOPMENT ACTIVITIES**

2003 - 2003: Extension sabbatical New Zealand Poultry Industry - *Study tour of poultry structural and environmental control systems*
2001 - 2001: Teach Accredited Professional Development Session - *Design of Animal Shelters presented to AL ASAE-March 2001*

**RESEARCH INTERESTS**

Serve as leader of Engineering Educational and Applied Research Program supporting Alabama's $1.9 Billion dollar poultry industry. Major program efforts are in education and training of poultry producers and integrated company personnel on design and management of poultry housing and ventilation and energy management systems for maximum production and energy conservation. Applied research on housing and energy management projects are currently underway.

**SELECTED PUBLICATIONS**


**CONSULTING EXPERIENCE**

Advisor to Poultry Companies world-wide on design and management of housing systems

**REGISTERED PROFESSIONAL ENGINEER:** State of Alabama
EDUCATION

2004 - PhD, Civil Engineering, Virginia Tech
1995 - MS, Agricultural Engineering, Virginia Tech
1990 - BS, Agricultural Engineering, Texas Tech
1978 - BS, Geography, Clarion State College

EXPERIENCE

Years of experience at Auburn: 4
2004 - Present: Assistant Professor, Biosystems Engineering, Auburn University
2000 - 2003: Graduate Research Fellow, Civil & Envir. Engineering, Virginia Tech
1998 - 1999: Graduate Research Assistant, Forestry, Virginia Tech
1995 - 1998: Staff Engineer, NRAES, Cornell University Cooperative Extension

GRADUATE FACULTY STATUS AT AUBURN UNIVERSITY

Level 1

SCIENTIFIC AND PROFESSIONAL SOCIETIES

American Society of Agricultural and Biological Engineers
American Society of Civil Engineers
Soil and Water Conservation Society
The Irrigation Association

INSTITUTIONAL AND PROFESSIONAL SERVICES

2008 - Present: Member - College of Agriculture Scholarship Committee
2008 - Present: Vice-Chair Continuing Education - Alabama Chapter - ASABE
2007 - Present: Member - College of Agriculture Diversity Committee
2007 - Present: Member - College of Engineering Scholarship Committee
2005 - 2006: Committee Member - College of Ag Teaching Effectiveness Comm.
2004 - 2006: Committee Member - E.V. Smith Center for Sustainable Rural Living and Learning

HONORS AND AWARDS

2000: Charles E. Via Fellowship Award - Virginia Tech.
1998: ASAE Blue Ribbon Award *Post-Frame Building Handbook*
1998: ASAE Blue Ribbon Award *Liquid Manure Application Systems Design Manual*
1990: Agricultural Engineering Honor Society *Alpha Epsilon*
1990: Honor Society of Agriculture *Gamma Sigma Delta*

**PROFESSIONAL DEVELOPMENT ACTIVITIES**

2008 - 2008: Hyperspectral and Multispectral Imaging - *ASABE Education Course*
2006 - 2006: Land Cover and Land Use Change - *ASPRS/MAPPS Workshop*
2006 - 2006: Hyperspectral Image Processing - *ASPRS/MAPPS Workshop*
2005 - 2006: New Faculty Scholars Program - *Biggio Learning Center*
2004 - 2004: Understanding College Teaching - *Seminar-Bigio Learning Center*
2004 - 2004: Characteristics of Effective College Teachers - *Seminar-Bigio Learning Center*

**RESEARCH INTERESTS**

My long-term goal is to develop tools to assess the impact of engineered water supply and reuse systems on the natural environment. Water resources, engineering aspects of water quality, surveying, mapping, and geographic information systems. Water quality management and source water protection using watershed-scale geographic information and modeling systems. The challenge is to strike a balance between a sustainable environment and an acceptable level of economic progress.

My goal is to advance our awareness of the key environmental and social processes impacting public water resources.

**SELECTED PUBLICATIONS**


CONSULTING EXPERIENCE


REGISTERED PROFESSIONAL ENGINEER

State of Alabama
State of New York
State of Pennsylvania
State of Virginia
OLADIRAN O. FASINA  
Associate Professor  
214 Tom Corley Building  
Phone: (334) 844-3574, Fax: (334) 844-3530  
E-mail: fasinoo@auburn.edu  
Website: http://www.eng.auburn.edu/users/fasinoo

EDUCATION

1994 - Ph.D, Bioprocess Engineering, University of Saskatchewan, Saskatoon, Canada  
1988 - MS, Agricultural Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria  
1985 - BS, Agricultural Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria

EXPERIENCE

Years of experience at Auburn: 0  
2007 - Present: Associate Professor, Biosystems Engineering Department, Auburn University,  
Auburn, AL USA  
2002 - 2007: Assistant Professor, Biosystems Engineering Department, Auburn University,  
Auburn, AL USA  
1998 - 2002: Food Process Engineer (Research Associate), Food Science Research Unit,  
USDA-ARS, Raleigh, NC  
1994 - 1998: Professional Research Associate, Applied Microbiology and Food Science,  
University of Saskatchewan,  
Saskatoon, Canada  
1988 - 1990: Assistant Lecturer, Agricultural Engineering, Obafemi Awolowo University, Ile- 
Ife, Nigeria

GRADUATE FACULTY STATUS AT AUBURN UNIVERSITY

Level 2

SCIENTIFIC AND PROFESSIONAL SOCIETIES

2005 - Present: Institute of Biological Engineers  
1998 - Present: IFT - Institute of Food Technologists  
1996 - Present: Association of Professional Engineers and Geoscientists of Saskatchewan,  
Canada  
1994 - Present: ASABE - American Society of Agricultural and Biological Engineers●

INSTITUTIONAL AND PROFESSIONAL SERVICES

2008 - Present: Vice Chair, FPE 01/02 Executive/Steering Committee - ASABE  
2005 - 2007: Chair - FPE-701, Food and Process Engineering Institute of ASAE  
2003 - Present: Associate Editor - Food and Process Engineering Institute of ASAE  
2003 - 2008: Vice Chair (Continual Education) - Alabama Section of ASAE
HONORS AND AWARDS

2007: ASABE President's Citation - ASABE. For leadership and dedicated service to the Association
2007: Standards (S593) Developer's Award - ASABE.
2005: Outstanding Faculty - Biosystems Engineering, Auburn University.
2004: Director's Research Award - Junior Faculty - Alabama Agricultural Experiment Station.
2003: Adjunct Professor - Tuskegee University, Tuskegee, AL. Resource Person in Food Engineering for the University
2000: Superior Performance in Food Process Engineering - USDA-ARS. For vegetable processing and fermentation
1999: Superior Performance in Food Process Engineering - USDA-ARS. For vegetable processing and fermentation research
1990: Canadian Commonwealth Scholarship - Canadian Government. To pursue a Ph.D. degree in bioprocess engineering

PROFESSIONAL DEVELOPMENT ACTIVITIES

2004 - 2004: High Pressure Processing Workshop and Demonstrat - VPI, Blacksburg, VA May 11th to 12th
2003 - 2003: Teaching with a Twist Workshop - Ford Motor/Tuskegee University Development Training
2002 - 2003: Attended four meetings of Alabama ASAE
2002 - Present: Attended three International Poultry Exposition - Also used as field trip for BSEN 3240 students
2001 - 2001: Modeling of Biological Processes - Course offered at the 2001 ASAE Annual International Meeting
2001 - 2001: Designing for food safety in fresh-cut fruit - Course offered at the 2001 ASAE Annual International Meeting
2001 - 2001: Thermodynamics of Living Systems - Course offered at the 2001 ASAE Annual International Meeting
2000 - 2000: Rheological Analysis of Foods: Theory and Practice - Course offered by NCSU Dept. of Food Science
2000 - 2000: Practical Training Course on TGA, DSC and MDSC - Course offered by TA Instruments, Raleigh, NC

RESEARCH INTERESTS
Renewable Energy
Food Engineering
Postharvest Technology, Drying and Storage of Agricultural and Biological Materials
Agricultural and Biological Materials Handling and Processsing
Engineering Properties of Food, Agricultural and Biological Materials
Compaction (pelleting and cubing) and Extrusion of Biological Materials

SELECTED PUBLICATIONS


JOHN P. FULTON
Assistant Professor
200 Tom E. Corley Building
Phone: (334) 844-3541, Fax: (334) 844-3530
E-mail: fultojp@auburn.edu
Website: http://www.eng.auburn.edu/~fultojp/

EDUCATION

2003 - Ph.D, Biosystems and Agricultural Engineering, University of Kentucky
1999 - MS, Agricultural Engineering, University of Kentucky
1994 - BS, Physics, Wittenberg University

EXPERIENCE

Years of experience at Auburn: 4
2004 - Present: Assistant Professor, Biosystems Engineering, Auburn University
1999 - 2003: Engineer Associate, Biosystems and Agricultural Engineering, University of Kentucky
1996 - 1999: Agricultural Engineer, Biosystems and Agricultural Engineering, University of Kentucky
1994 - 1996: Graduate Research Assistant, Biosystems and Agricultural Engineering Department, University of Kentucky
1993 - 1994: Assistant Test Engineer (summers only), Hartzell Fan Inc.

GRADUATE FACULTY STATUS AT AUBURN UNIVERSITY

Level 1

SCIENTIFIC AND PROFESSIONAL SOCIETIES

2004 - Present: Alabama State Section of the American Society of Agricultural and Biological Engineers
1995 - Present: American Society of Agricultural and Biological Engineers

HONORS AND AWARDS

2007: Biosystems Engineering Outstanding Faculty - College of Engineering, Auburn University.
2006: Biosystems Engineering Outstanding Faculty - College of Engineering, Auburn University.
2006: Faculty Research Award - College of Agriculture, Auburn University.

PROFESSIONAL DEVELOPMENT ACTIVITIES

2005 - Present: ASABE PM-23/4/5 Tractor Implement Committee Member
2005 - Present: ASABE PM-58 Agr. Equipment Automation Committee
2004 - 2006: College of Agriculture Distance Learning Committee
2004 - Present: ASABE T-12 Forest Engineering Committee Member
2004 - Present: Chair BSEN Engr. Information Technology Committee
2004 - Present: Reviewer for Transactions of ASABE
2004 - Present: Reviewer for Applied Engineering in Agriculture
2000 - Present: ASABE PM54 – Precision Agr. Committee Member

RESEARCH INTERESTS

On-Farm Bioenergy Production
Innovative Biomass Collection and Transportation Techniques
Machine Systems
Precision Agriculture/Forestry

SELECTED PUBLICATIONS


PATENTS

DAVID T. HILL  
Professor  
204 Tom E. Corley Building  
Phone: (334) 844-4180, Fax: (334) 844-3530  
E-mail: hilledat@auburn.edu

EDUCATION

1975 - Ph. D., Agricultural / Environmental Systems Engineering, Clemson University
1970 - MS, Agricultural Engineering, University of Georgia
1969 - BSAE, Agricultural Engineering, University of Georgia

EXPERIENCE

Years of experience at Auburn: 29
1986 - Present: Professor (Alumni Professor 1986-1989), BioSystems Engineering Dept., Auburn University
1975 - 1979: Assistant Professor, Agricultural and Biological Engineering Dept., University of Florida
1973 - 1975: Assistant Agricultural Engineer, Agricultural Engineering Dept., Clemson University

GRADUATE FACULTY STATUS AT AUBURN UNIVERSITY

Level 2

SCIENTIFIC AND PROFESSIONAL SOCIETIES

Alpha Epsilon  
Member ASABE  
Member ASEE  
Phi Kappa Phi  
Sigma Xi

INSTITUTIONAL AND PROFESSIONAL SERVICES

2004 - Present: Scholarship Committee, College of Ag - Member
2003 - Present: Visiting Scientist Committee, College of Ag - Member
2003 - Present: IPM & Environmental Committee, College of Ag - Member
2003 - Present: Quality Assurance Committee, College of Ag – Member

HONORS AND AWARDS

1999: Elected Fellow - American Soc. of Agri. and Biological Engineers.
1997: Senior Distinguished Engineer Award - American Soc. of Agri. and Biol. Engrs., AL Sec.
1986: ASABE Outstanding Manuscript Award - American Soc. of Agri. and Biological Engineers.
1985: Director's Research Award - Auburn University, Ag Experiment Station.
1985: FIEI National Engineering Achievement Award - Young Researcher of the Year - American Soc. of Agri. And Biological Engineers.
1984: Appointed Alumni Associate Professor of Agricultural Engineering - Auburn University.
1982: ASABE Outstanding Manuscript Award - American Soc. of Agri. and Biological Engineers.

PROFESSIONAL DEVELOPMENT ACTIVITIES

2007 - Present: Continuing Engineering Education Units - *Al. State Sec., ASABE, for PE*
2007 - Present: USDA CSREES S-1000 Technical Meeting - *May 1-4, 2007, San Juan, PR*
2006 - Present: American Soc. of Agri. and Biological Engineers - *2006 International Meeting, July 9-12, Portland, OR*
2006 - Present: SunBelt Agricultural Exposition - *October 17-19, 2006, Moultrie, GA*

RESEARCH INTERESTS

Primary interest in utilization of agricultural waste by energy recovery, refeeding and land application with secondary interest in synthetic fuels production from biomass. Design refinement and process optimization through mathematical modeling of biological systems used in environmental protection.

SELECTED PUBLICATIONS


REGISTERED PROFESSIONAL ENGINEER

State of Alabama
TIMOTHY P. MCDONALD  
Associate Professor  
224 Corley Building  
Phone: (334) 844-3545, Fax: (334) 844-3530  
E-mail: mcdontp@auburn.edu

EDUCATION

1987 - Ph.D., Agricultural Engineering, Purdue University  
1984 - MS, Agricultural Engineering, Clemson University

EXPERIENCE

Years of experience at Auburn: 6  
2002 - Present: Associate Professor, Biosystems Engineering, Auburn University  
1991 - 2002: Research Engineer, Forest Operations Research Unit, USDA Forest Service,  
Southern Research Station  
1987 - 1991: Agricultural Engineer, Roman L. Hruska Meat Animal Research Center, USDA  
Agricultural Research Service  
1984 - 1987: General Engineer, Soil Erosion Research Laboratory, USDA Agricultural  
Research Service

GRADUATE FACULTY STATUS AT AUBURN UNIVERSITY

Level 1

SCIENTIFIC AND PROFESSIONAL SOCIETIES

2003 - Present: Forest Products Society  
1991 - Present: Council of Forest Engineers  
1984 - Present: American Society of Agricultural Engineers

INSTITUTIONAL AND PROFESSIONAL SERVICES

2005 - Present: Chairman, Alabama State Section - American Society of Agricultural and  
Biological Engineers

HONORS AND AWARDS

2005: Outstanding Faculty Member - Biosystems Engineering Department.

RESEARCH INTERESTS

Performance and preparation of biofuels in IC engines, particularly biodiesel.  
Engineering aspects of forest operations, particularly harvesting and site preparation  
activities. Applications include use of spatial technology in improving harvest system
productivity, environmental impact assessment of forest operations, and design of equipment for specific silvicultural activities.

SELECTED PUBLICATIONS


PUNEET SRIVASTAVA
Assistant Professor
206 Tom E. Corley Building, Auburn University, AL 36849-5417
Phone: (334) 844-7426, Fax: (334) 844-3530
E-mail: srivapu@auburn.edu
Website: http://www.eng.auburn.edu/users/srivapu/

EDUCATION
1999 - Ph.D., Ag and Bio. Engrg. (Minor: Comp. Sc. and Engrg.), Penn State University
1995 - MS, Bio. and Ag. Engrg., University of Arkansas
1992 - BS, Agricultural Engineering, Allahabad University

EXPERIENCE
Years of experience at Auburn: 4
2004 - Present: Assistant Professor, Biosystems Engineering, Auburn University
2001 - 2003: Assistant Curator, Patrick Center, Academy of Natural Sciences of Philadelphia
1999 - 2001: Engineer, Arkansas Department of Environmental Quality
1997 - 1998: Water Quality/GIS Specialist, SWFREC, University of Florida

GRADUATE FACULTY STATUS AT AUBURN UNIVERSITY
Level 1

SCIENTIFIC AND PROFESSIONAL SOCIETIES
2001 - Present: American Geophysical Union
2001 - Present: American Water Resources Association
1994 - Present: American Society of Agricultural and Biological Engineers

INSTITUTIONAL AND PROFESSIONAL SERVICES
2007 - Present: Secretary - Ecological Engineering Group, American Society of Agricultural and Biological Engineers
2004 - 2007: Secretary - Hydrology Group, American Society of Agricultural and Biological Engineers
2004 - Present: Member - Forest Engrg. Group, American Society of Agricultural and Biological Engineers
2003 - 2004: Member - Science Council, The Academy of Natural Sciences
2002 - 2004: Member - STAC, Chesapeake Bay Program
2002 - 2003: Member - Analytical Tools Panel, Chesapeake Bay Research Consortium
2002 - 2004: Member - Water Quality Advisory Comm., Delaware River Basin Commission
2002 - 2004: Treasurer and Secretary - AWRA – Philadelphia Metro Area Section
1999 - Present: Member - Sigma Xi, Scientific Research Society
1998 - Present: Member - Gamma Sigma Delta, The Honor Society of Agriculture
1995 - Present: Member - Alpha Epsilon, Agricultural Engineering Honor Society

HONORS AND AWARDS

1999: 2nd Place, Poster Presentation - Graduate Research Exhibition, Penn State U..
1987: Merit cum Means Scholarship - Indian Council of Agricultural Research.

RESEARCH INTERESTS

Monitoring and modeling of hydrologic and nonpoint pollutant transport and transformation processes at various scales; development and evaluation of best management practices for nonpoint source pollution control; application of geographic information, global positioning, remote sensing, and neural network systems for natural resources management; animal waste management; and effect of climate variability and change on hydrology and water quality

SELECTED PUBLICATIONS

STEVEN E. TAYLOR
Professor, Head, and Director
209 Tom Corley Building
Phone: (334) 844-3534, Fax: (334) 844-3530
E-mail: taylost@auburn.edu
Website: http://www.eng.auburn.edu/bio

EDUCATION

1988 - Ph.D., Agricultural Engineering, Texas A&M University
1985 - MS, Agricultural Engineering, University of Florida
1983 - BS, Agricultural Engineering, University of Florida

EXPERIENCE

Years of experience at Auburn: 19
2007 - Present: Director, Center for Bioenergy and Bioproducts, Natural Resources Management & Development Inst.
2003 - Present: Professor and Head, Biosystems Engineering, Auburn University
1995 - 2003: Associate Professor, Biosystems Engineering, Auburn University
1989 - 1995: Assistant Professor, Agricultural Engineering, Auburn University

GRADUATE FACULTY STATUS AT AUBURN UNIVERSITY

Level 2

SCIENTIFIC AND PROFESSIONAL SOCIETIES

1997 - Present: American Wood Council
1995 - Present: American Society of Civil Engineers
1989 - Present: American Institute of Timber Construction
1989 - Present: Council on Forest Engineering
1989 - Present: National Society of Professional Engineers
1980 - Present: American Society of Agricultural and Biological Engineers

INSTITUTIONAL AND PROFESSIONAL SERVICES

2007 - Present: Chair, Academic Administrators Committee - American Society of Agricultural and Biological Engineers
2007 - Present: Member - Joint Legislative Committee on Energy, Alabama
2004 - Present: Member, Accreditation Committee - American Society of Agricultural and Biological Engineers
2002 - Present: Member Wood Design Standards Committee - American Wood Council
2000 - 2005: Member and Past Chair - Paper Awards Committee - American Society of Agricultural and Biological Engineers
2000 - Present: Member Technical Review Board - ANSI A198 - American Institute of Timber Construction
2000 - 2001: Advisor - Southeast Student Branch - American Society of Agricultural and Biological Engineers
1997 - Present: Coordinator - Auburn MATHCOUNTS - National Society of Professional Engineers
1989 - Present: Member and Past Chair - Structures Group - American Society of Agricultural and Biological Engineers
1989 - Present: Member & Past Chair - Wood Construction & Engr. - American Society of Agricultural and Biological Engineers
1989 - Present: Member and Past Chair - Forest Engineering Group - American Society of Agricultural and Biological Engineers
1989 - Present: Member Technical Advisory Committee - American Institute of Timber Construction

HONORS AND AWARDS

2007: Testified before Committee on Energy and Natural Res. - U.S. Senate.
2001: Outstanding Faculty Member - Auburn University. Biosystems Engineering Department
2000: Outstanding Faculty Member - Auburn University. Biosystems Engineering Department
1996: Distinguished Young Engineer - American Society of Agricultural Engineers. Alabama Section
1991: Marra Award for Excellence in Research - Society of Wood Science and Technology.

PROFESSIONAL DEVELOPMENT ACTIVITIES

2007 - 2007: Shortcourse on Biorefining
2006 - 2006: Shortcourse on Engineering Ethics
2004 - Present: Seminar on CAN Technology
2004 - Present: Seminar on Multibody Physics Simulation
2001 - 2001: Shortcourse - Using Portfolios in Engineering
2000 - 2000: Shortcourse on Structural Steel Welding Design

RESEARCH INTERESTS

Bioenergy and Bioproducts - including feedstock production supply chain, bioenergy conversion methods, and fuel/product testing
Geospatial Technologies (GPS and GIS)- including mapping; site-specific forest and agricultural operations
Forest Engineering - including water quality impacts from forest roads and stream crossings; alternate stream crossing structures; precision forestry; thrown object testing and rollover behavior of excavator based machines; tillage and site preparation; portable bridge systems
Structural Wood Engineering - including glued-laminated timbers; modeling material properties; Monte-Carlo simulation of structural performance; timber bridges
SELECTED PUBLICATIONS


CONSULTING EXPERIENCE

2004 - 2004: Integration of Precision Forestry Techniques into Chilean Forestry – CORMA

REGISTERED PROFESSIONAL ENGINEER

State of Alabama
TED W. TYSON, P.E.
Professor & Extension Biosystems Engineer
218 Tom E. Corley Building
Phone: (334) 844-3542, Fax: (334) 844-3530
E-mail: tysontw@auburn.edu
Website: http://www.aces.edu/dept/irrig/, http://www.aces.edu/aawm

EDUCATION

1973 - MS, Agricultural Engineering, University of Georgia
1969 - BS, Agricultural Engineering, University of Georgia

EXPERIENCE

Years of experience at Auburn: 23
2002 - Present: Professor and Extension Biosystems Engineer, Biosystems Engineering Department, Auburn University
1988 - 2002: Associate Professor & Ext. Biosystems Engineer, Biosystems Engineering, Auburn University
1985 - 1988: Extension Agricultural Engineer, Agricultural Engineering, Auburn University
1983 - 1985: Chief Engineer, Globetronics Corporation
1980 - 1983: District Manager, Colquitt Electric Membership Corporation
1976 - 1980: Manager, Member Services and Power Sales, Sumter Electric Membership Corporation
1972 - 1976: Agricultural Development Engineer, South Carolina Electric & Gas Company
1970 - 1972: U.S. Army,
1969 - 1970: Instructor, Agricultural Engineering, University Of Georgia

GRADUATE FACULTY STATUS AT AUBURN UNIVERSITY

None (Extension faculty)

SCIENTIFIC AND PROFESSIONAL SOCIETIES

2005 - Present: American Society of Agricultural & Biological Engineers
1988 - Present: The Irrigation Association
1969 - 2005: American Society of Agricultural Engineers (ASAE)
1969 - Present: Phi Kappa Phi

INSTITUTIONAL AND PROFESSIONAL SERVICES

2005 - Present: Treasurer - Alabama Section ASABE
2002 - 2006: CAFO Education Co-ordinator - AL Cooperative Extension & ADEM CAFO Workgroup
1995 - 1997: Member International Board of Directors - American Society of Agricultural Engineers
1993 - 1994: Chair, Standards & Specifications Committee - Irrigation Association

HONORS AND AWARDS

2003: Distinguished Engineer Award - American Society of Agricultural Engineers. Alabama Section
2000: Environmental Merit Award - EPA Region IV. (Shared)
1995: Blue Ribbon Educational Award - American Society for Horticultural Science. Southern Region(Shared)
1994: Blue Ribbon Educational Award - American Society of Agricultural Engineers. (Shared)
1968: Membership - The Fraternity of Alpha Zeta. Univ of GA
1968: Membership - Gamma Sigma Delta Agricultural Honor Society. Univ of GA
1968: Senior with Highest Academic Rank-Alpha Zeta - University of Georgia. College of Agriculture

PROFESSIONAL DEVELOPMENT ACTIVITIES

2006 - 2006: USDA-CSREES National Water Conference - San Antonio, TX
2006 - 2006: 3rd GIS Symposium & Workshop - AU Hotel & Conference Center
2005 - 2005: ArcGIS for Regional Extension Personnel - Auburn, AL
2005 - 2005: On Farm Assessment & Environmental Review Course - OFAER ASSESSOR review - St. Louis, MO
2004 - 2004: CSREES Region 4 Nutrient Mgmt Working Meeting - Atlanta, GA
2004 - 2004: EPA Region 4 Tech Fundamentals CAFO Permit Writing - & Inspections - Atlanta, GA
2004 - 2004: ASAE International Meeting - Ottawa, Canada
2004 - 2004: WebCT AU Faculty Professional Dev Seminars (5) - Auburn University, AL
2004 - 2004: OFAER (On Farm Assessment & Env Review) Refresher - web-based refresher course
2003 - 2007: Alabama Water Resources Annual Conference - Orange Beach, AL
2003 - 2005: Southern Region Water Quality Conference - Ruidoso, NM (OCT03), Lex, KY (OCT05)

RESEARCH INTERESTS

Improving design and management of irrigation systems for commercial agriculture, horticulture, turf, and landscape.

SELECTED PUBLICATIONS

CONSULTING EXPERIENCE

2006 - 2006: Design of 700 Cow Dairy Wastewater Storage Pond - VELLIDUS, LLC
2005 - 2006: Wastewater Pivot Irrigation System for Poarch Band Creek Indians - USDA-NRCS
2003 - Present: On-Farm Assessment and Environmental Review Assessor - VELLIDUS, LLC

REGISTERED PROFESSIONAL ENGINEER

State of Georgia
State of South Carolina
YIFEN WANG  
Assistant Professor  
211 Tom E. Corley Building, Auburn University, AL 36849-5417  
Phone: (334) 844-8051, Fax: (334) 844-3530  
E-mail: wangyif@auburn.edu  
Website: http://www.eng.auburn.edu/users/wangyif/

EDUCATION

2003 - MBA, Management Information Systems, Washington State University, Pullman, WA  
2002 - Ph.D., Biological Systems Engineering, Washington State University, Pullman, WA  
1999 - MS in Engineering, Environmental Engineering, University of Washington, Seattle,  
WA  
1990 - BS in Engineering, Food Engineering, Shanghai Fisheries University, Shanghai, China

EXPERIENCE

Years of experience at Auburn: 4  
2004 - Present: Assistant Professor, Biosystems Engineering, Auburn University  
2003 - 2004: Sr. Project Manager, Research Associate, Biological Systems Engineering,  
Washington State University,  
Pullman, WA  
1995 - 1998: Food Scientist, Chinese Academy of Fisheries Science, Shanghai  
1993 - 1995: Director, Manufacturing Plant, Senegal Fisheries Company, Dakar, Senegal  
1990 - 1993: Food Scientist, Chinese Academy of Fisheries Science, Shanghai

GRADUATE FACULTY STATUS AT AUBURN UNIVERSITY

Level 2

SCIENTIFIC AND PROFESSIONAL SOCIETIES

2005 - Present: American Society of Agricultural Engineers  
2001 - Present: Institute For Thermal Processing Specialists  
1999 - Present: Institute of Food Technology

INSTITUTIONAL AND PROFESSIONAL SERVICES

2006 - Present: Visiting Researcher - Hubei Academy of Agricultural Sciences, China  
2005 - Present: Vice Chairman, Public Relations - Alabama State Section of the American  
Society of Agricultural Engineers  
2005 - Present: Member of the Food Safety Expert Board - 2008 Beijing Olympic Games, the  
BMOFSSC and the Olympic Organizing Committee  
2005 - Present: Visiting Professor - Shanghai Fisheries University, Shanghai, China  
1999 - Present: Peer reviewer of Institute of Food Technology –
HONORS AND AWARDS

2002: IFT Travel Award - Institute of Food Technology, Puget Sound Chapter.
2001: Graduate Student Travel Grant - Graduate School, Washington State University.
2001: IFTPS Student Manuscript Competition Award - Institute For Thermal Processing Specialists. Only One Each Year
2000: IFT Scholastic Award - Institute of Food Technology, Puget Sound Chapter.
1998: Claire L. and Evelyn S. Egtvedt (Former President of Boeing) Scholarship - University of Washington.

PROFESSIONAL DEVELOPMENT ACTIVITIES

2002 - 2003: Developed Radio Frequency (RF) Sterilization
1999 - 2002: Finished basic study on Radio Frequency heating
1998 - 1999: Treatments of waste water and drinking water
1995 - 1998: Studied on impact of China's joining the WTO
1995 - 1998: Took part in establishment of a Certification Cent
1993 - 1995: Responsible for budget and expense management
1993 - 1995: Responsible for purchasing raw material
1993 - 1995: Led, motivated and developed a professional team
1993 - 1995: Conducted technical innovation and development
1990 - 1993: Developed and marketed value-added food products
1990 - 1993: Worked on food safety, laws and regulations

RESEARCH INTERESTS

Our research group focuses on applied and fundamental study of food engineering and food safety. In the food engineering area: 1) food processing, especially fisheries processing, including development of value-add products and usage of by-products is explored; 2) nanostructures of fish gelatins are determined and relationships between the nanostructures and physical properties are established; 3) surface-enhanced Raman spectroscopy (SERS) coupled with novel gold nanotextured substrates for rapidly detecting and discriminating among some bacterial spores is being explored; and 4) design and development of a new portable SERS device is currently in progress. In the food safety aspect: 1) emphasis is placed on food supply chain management, traceability systems using RFID technology, and risk assessment; and 2) continued application and development of classic food safety programs such as good manufacturing practices (GMPs) and hazard analysis and critical control points (HACCP).
KYUNG H YOO
Professor
208 T.E.Corley Building
Phone: (334) 844-3532, Fax: (334) 844-3530
E-mail: yookyun@auburn.edu

EDUCATION

1978 - PhD, Agricultural Engineering, University of Idaho
1973 - MS, Agricultural Engineering, University of Idaho
1971 - BS, Agricultural Engineering, Seoul National University, Korea

EXPERIENCE

Years of experience at Auburn: 0
1979 - 1983: Agricultural Engineer, Agricultural Engineering, The University of Idaho
1976 - 1979: Research Associate, Agricultural Engineering, The University of Idaho
1972 - 1976: Graduate Research Assistant, Agricultural Engineering, The University of Idaho

SCIENTIFIC AND PROFESSIONAL SOCIETIES

2007 - Present: American Rainwater Catchment Systems Association
1990 - Present: International Rainwater Catchment Systems Association
1989 - Present: Korean Society of Agricultural Engineers
1985 - Present: U.S. Committee on Irrigation and Drainage
1973 - Present: American Society of Agricultural Engineers

GRADUATE FACULTY STATUS AT AUBURN UNIVERSITY

Level 2

INSTITUTIONAL AND PROFESSIONAL SERVICES

2007 - Present: Senior advisor, Korean Society of Agricultural Eng - Korean Society of Agricultural Engineers
2003 - Present: Reviewer - USDA-NRICGP
2000 - Present: Research Collaborator - Korean Rural Development Administration
1996 - Present: Associate Editor of Soil and Water Division - American Society of Agricultural Engineering
1991 - 1992: Chairman, M612 International Programs Committee - American Society of Agricultural Engineering

HONORS AND AWARDS

2004: Certificate of Appreciation - American Society of Agricultural Engineering. In recognition of outstanding service as an associate editor
2002: Guest Scientist - Kyoto University, Japan.

RESEARCH INTERESTS

Soil erosion prediction and control Agricultural watershed/water quality modeling Small scale irrigation Water harvesting for rural development Roof catchment of rainwater

SELECTED PUBLICATIONS


CONSULTING EXPERIENCE

2006 - External Evaluation of Project - CRSP-Kenya
2005 - Evaluation of irrigation systems - CNFA-Moldova
2000 - Present: Non-point source pollution and water quality - Korea Agricultural and Rural Infrastructure Cooperation
1999 - Present: Rainwater harvesting - Christian Childrens Fund-Brasil
1995 - Water Harvesting and Small Scale Irrigation - Catholic Relief Service-India
1993 - Water harvesting - CARE-Somalia
APPENDIX E: SOURCES OF EXTRAMURAL GRANTS SECURED BY BIOSYSTEMS ENGINEERING FACULTY (2003-2007)*

<table>
<thead>
<tr>
<th>Source</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama Agriculture Experiment Station</td>
<td>56,900</td>
<td>60,590</td>
<td>161,838</td>
<td>553,814</td>
<td>522,110</td>
<td>1,355,252</td>
</tr>
<tr>
<td>Alabama Agricultural Land Grant Alliance</td>
<td>71,666</td>
<td>146,333</td>
<td>100,000</td>
<td>75,000</td>
<td>392,999</td>
<td></td>
</tr>
<tr>
<td>Alabama Cooperative Extension System</td>
<td>186,481</td>
<td>340,000</td>
<td>302,659</td>
<td>125,000</td>
<td>19,050</td>
<td>954,140</td>
</tr>
<tr>
<td>Alabama Catfish Producers</td>
<td></td>
<td></td>
<td>19,050</td>
<td></td>
<td></td>
<td>19,050</td>
</tr>
<tr>
<td>Alabama Department of Agriculture and Industries</td>
<td></td>
<td></td>
<td>10,000</td>
<td></td>
<td></td>
<td>10,000</td>
</tr>
<tr>
<td>Alabama Department of Economic and Community Affairs (ADECA)</td>
<td>99,966</td>
<td>45,728</td>
<td>99,990</td>
<td></td>
<td></td>
<td>245,684</td>
</tr>
<tr>
<td>Alabama Cotton Commission</td>
<td>12,500</td>
<td>17,500</td>
<td>19,300</td>
<td>15,500</td>
<td></td>
<td>64,800</td>
</tr>
<tr>
<td>Academy of Natural Sciences, Philadelphia (ANSP)</td>
<td></td>
<td></td>
<td>25,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alabama Wheat and Feed Grain Producers (AWFGP)</td>
<td>12,000</td>
<td>7,000</td>
<td>19,900</td>
<td>10,500</td>
<td></td>
<td>49,400</td>
</tr>
<tr>
<td>Environmental Protection Agency (EPA)</td>
<td></td>
<td></td>
<td>50,000</td>
<td>12,672</td>
<td></td>
<td>62,672</td>
</tr>
<tr>
<td>Industry</td>
<td>2,800</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Carolina State University</td>
<td>10,000</td>
<td>17,500</td>
<td></td>
<td></td>
<td></td>
<td>27,500</td>
</tr>
<tr>
<td>National Oceanic &amp; Atmospheric Administration (NOAA)</td>
<td></td>
<td></td>
<td></td>
<td>96,140</td>
<td></td>
<td>96,140</td>
</tr>
<tr>
<td>National Science Foundation (NSF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>63,458</td>
<td>63,458</td>
</tr>
<tr>
<td>Tennessee Value Authority (TVA)</td>
<td>64,425</td>
<td>9,064</td>
<td></td>
<td></td>
<td></td>
<td>64,425</td>
</tr>
<tr>
<td>University of Arkansas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9,064</td>
</tr>
<tr>
<td>U.S. Dept. of Agriculture (USDA)</td>
<td>27,534</td>
<td>568,064</td>
<td>684,245</td>
<td>589,281</td>
<td>595,822</td>
<td>2,464,946</td>
</tr>
<tr>
<td>U.S. Forest Service (USFS)</td>
<td>65,039</td>
<td>39,575</td>
<td>9,995</td>
<td>26,424</td>
<td></td>
<td>141,033</td>
</tr>
<tr>
<td>U.S. Geological Survey (USGS)</td>
<td></td>
<td></td>
<td>24,944</td>
<td>42,335</td>
<td>22,772</td>
<td>90,051</td>
</tr>
<tr>
<td>Other/Misc.</td>
<td>24,730</td>
<td>28,070</td>
<td>11,000</td>
<td>3,000</td>
<td></td>
<td>66,800</td>
</tr>
<tr>
<td>Total by Year/TOTAL</td>
<td>365,894</td>
<td>1,005,510</td>
<td>1,603,991</td>
<td>1,736,701</td>
<td>1,737,000</td>
<td>6,449,096</td>
</tr>
</tbody>
</table>

Note that these funds were obtained for multi-disciplinary projects. Therefore, the amounts shown above represent the portion of the total project award that were/are directly under the control of faculty in Biosystems Engineering.