ATTACHMENT 3A-1

LETTER OF NOTIFICATION - 10

GRADUATE CERTIFICATE PROGRAM

(15 SEMESTER CREDIT HOURS)

1. Institution submitting request:
   University of Arkansas, Fayetteville, Dale Bumpers College of Agricultural, Food and Life Sciences

2. Contact person/title:
   Sharon Gaber, Provost and Vice Chancellor for Academic Affairs
   ADMN 422, University of Arkansas, Fayetteville, AR 72701

3. Phone number/e-mail address:
   479-575-5459/sgaber@uark.edu

4. Proposed effective date:
   Spring 2012

5. Name of proposed Graduate Certificate Program (Program must consist of 12-18 semester credit hours from existing graduate courses).
   Bioenergy and Sustainable Technology

6. Proposed CIP Code
   01.0308

7. Reason for proposed program implementation?

Widespread interest in "Green" industries is a result of a general recognition of the need for systems that meet societal needs without long-term degradation of the environment or change in the climate. A new generation of professionals needs to be equipped to function in the interdisciplinary environment typical of biotechnologies and economies. The target audience for the Bioenergy and Sustainable Technology Program is threefold: students preparing to be 1) generalists – administrators and managers and 2) specialists – scientists, engineers and other experts in specific aspects of biobased technologies and economies, as well as 3) students in existing graduate programs that want to take one or more selected courses in this program. The students may have baccalaureate degrees in agriculture, engineering, business, physical sciences, biological sciences, social sciences, or human sciences. Therefore, the curriculum must accommodate a wide range of educational backgrounds. The program must provide both breadth and depth.

Even when industry demand is clear and pressing, universities have difficulty reallocating or locating new resources to hire the critical mass of faculty needed to offer high-quality academic programs in emerging fields. By partnering, a collaborative, interdisciplinary distance education program can be implemented that meets the

significant and broad-based demand for postsecondary education covering the various aspects of biobased products and bioenergy.

The purpose of the program is to provide current and future bioenergy professionals and others with distance education opportunities that lead to a graduate certificate in bioenergy sustainable technology using the cooperative resources of the University of Arkansas (UA), Kansas State University (KSU), Oklahoma State University (OSU) and South Dakota State University (SDSU). As is the case with many agricultural and natural resource programs at land grant universities, the bioenergy-related programs at these four cooperating universities are dispersed throughout the University and relatively small. The resources that can be allocated to these small programs at each university are limited and graduate and undergraduate programs in this new area are unavailable. We can overcome these limitations by combining forces to form a consortium of land grant universities throughout the Great Plains to provide high quality on-line graduate education in bioenergy sustainable technology. Through this endeavor, we will continue to meet the ever-changing needs of students and professionals in the arena of sustainable bioenergy development and technologies.

In 2006, KSU conducted a survey to assess workforce educational needs in this field. The respondents represented companies involved in ethanol; biodiesel; biobased fibers, lubricants and polymers; adhesives, downstream processing; fermentation; and nutraceuticals. The survey respondents were very interested in a graduate certificate in biobased materials processing for current employees as opposed to a masters or doctoral degree. They also indicated a need for both generalists (administrators and managers) and specialists (scientists, engineers, etc.).
Other industry survey findings:

76% are considering expanding in areas of biobased materials processing.
86% anticipate an increase in the demand for their company's biobased materials.
69% characterize the size of the labor pool to be marginally adequate or inadequate.
74% characterize the quality of the labor pool to be not qualified or under-qualified.

The overwhelming message from the survey was that the employee pool lacked knowledge and experience with biobased processes. The survey findings demonstrated that there exists an urgent need for specialized training that is accessible for on-campus students as well as industry personnel who would like to pursue distance education while working full-time.

8. Provide documentation that proposed program has received full approval by licensure/certification entity. (A graduate certificate offered for teacher licensure must be approved by the Arkansas Department of Education prior to consideration by the Coordinating Board).
   At the current time there is no organization outside of higher education that has developed a certification or licensure program. Therefore, each

participating institution will award the Bioenergy and Sustainable Technology graduate certificate of completion to students who are enrolled in their institution.

9. Will this program be offered on-campus, off-campus, or via distance delivery?

This program will be offered via distance delivery, specifically online web classes.

10. Provide the following:

A. Curriculum outline - List of required courses

Bioenergy and Sustainable Technology Curriculum

Students seeking the Bioenergy and Sustainable Technology graduate certificate will be required to take and pass nine credit hours of core courses and at least six hours of elective credits for a minimum of 15 credit hours. Students will work with their institutional advisors to develop a plan of study most beneficial to the student.

Required Courses*	Elective Courses*
• Fundamentals of Biomass Conversion BENG 5303 • Bioenergy Feedstock Production CSES 4303 • Bioenergy Economics and Sustainability AGEC 5733	• Advanced Biomass Thermochemical Conversion BENG 5343 • Biochemical Engineering BENG 5333 • Bioseparations BENG 5323 • Fundamentals of Bioprocessing BENG 5313 • Soil/Water Quality in Bioenergy Feedstock Production Systems CSES 5323 • Crop Simulation Models in Research, Management and Policy CSES 5313 • Life Cycle Assessment BENG 5623 • Bioenergy & Resource Economics AGEC 5723 • Community and Natural Resources RSOC 5603 • Environment and Ecological Risk Assessment BENG 5933 • Feasibility and Commercialization • Sustainability Seminar (1 credit hour) BENG 5351

*all courses are 3 credit hours unless otherwise noted.

B. New course descriptions

Core Course Descriptions

- ***Fundamentals of Biomass Conversion (3 cr.)***. BENG 5303. Web-based overview of the technology involved in the conversion of biomass to energy, including associated sustainability issues. Overview of biomass structure and chemical composition; biochemical and thermochemical conversion platforms; issues, such as energy crop production related to water consumption and soil conservation. Further topics include: biomass chemistry, logistics and resources; biological processes; and thermochemical processes. *Prerequisite: Graduate Standing or Instructor Consent.*

- ***Bioenergy Feedstock Production (3 cr.)*** CSES 4303. Overview of production and characteristics of cultivated crops, perennial grasses, and woody species as feedstocks for bioenergy. Fundamentals of plant growth factors, culture, harvest and storage, quality and improvement, and introduction to environmental impact, modeling, and resource utilization. Prerequisite: None. Knowledge of Microsoft-compatible word processing and spreadsheet programs including graphing is required. *Prerequisite: MATH 1203 and BIOL 1543 or CSES 1203. Courses in introductory chemistry or soil science are preferred.*

- ***Bioenergy Economics and Sustainability (3 cr.)*** AGEC 5733. This course will provide an understanding of the economic issues relating to overall supply chains producing bio-energy and bio-based products. The course will address the economic, sustainability and social dimensions of these industries. Participants will gain an understanding of triple bottom line objectives, life cycle analysis and the principles of feasibility analysis.

Elective Course Descriptions

- ***Advanced Biomass Thermochemical Conversion (3 cr.)*** BENG 5343. This course will describe thermochemical methods to convert biomass to fuels and chemicals. Four general classes of conversion technologies will de described: liquefaction, pyrolysis, gasification, and heterogeneous catalysis. A general overview of these methods will be provided, but the main thrust of the course is to analyze the chemical reactions and chemical reactors associated with these methods. Extensive attention will be paid to reaction kinetics and to analyzing mass, heat, and momentum transfer in chemical reactors. These very general concepts will be applied to the specific cases of biomass gasifcation, liquefaction, pyrolysis, and catalytic treatment. *Prerequisites: Instructor Consent.*

- ***Biochemical Engineering (3 cr.)*** BENG 5333. The analysis and design of biochemical processing systems with emphasis on fermentation kinetics, continuous fermentations, aeration, agitation, scale up, sterilization, and control. *Prerequisites: Instructor Consent Required.*

- ***Bioseparations (3 cr.)*** BENG 5323. Study of separations important in food and biochemical engineering such as leaching, extraction, expression, absorption, ion exchange, filtration, centrifugation, membrane separation, and chromatographic separations. *Prerequisites: Instructor Consent.*

- ***Fundamentals of Bioprocessing (3 cr.)*** BENG 5313. This course is designed for students who want a clear understanding of Bioprocessing principles as applied to the emerging bio-based industry. This course covers the fundamentals of mass and energy balances, fluid dynamics, heat and mass transfer, as applied to Bioprocessing. The microbial growth, kinetics and fermenter operation as applicable to Bioprocessing will be covered in this course. Industrial Bioprocessing case studies that involve the integration of the course contents will be discussed*. Prerequisites: MATH 2554, CHEM 3813, PHYS 2054.*

- ***Soil/Water Quality in Bioenergy Feedstock Production Systems (3 cr.)*** CSES 5323. An examination of the fundamentals of soil and water applied to proposed and existing bioenergy feedstock production systems. Current research results related to biomass removal and by-product addition to soils will be discussed and evaluated. *Prerequisites: MATH 1203 and CSES 2203 or equivalent or consent of instructor. CSES 4303 preferred.*

- ***Crop Stimulation Models in Research, Management and Policy (3 cr.)*** CSES 5313. Systems approach is vital for overcoming challenges associated with food, fuel, feed and fiber production. The course uses crop simulation models & decision support systems to teach the systems approach concept to graduate students. Students will understand the basics of crop simulation models and will learn to use crop simulation models (CSM) as research, management, and policy tools. Students will use CSM as surrogates to field studies and learn to design experiments to fill in knowledge gaps. *Prerequisites: MATH 1203 and BIOL 1543 or CSES 1203 or consent of instructor. Courses in introductory chemistry and plant physiology are preferred.*

- ***Life Cycle Assessment (3 cr.)*** BENG 5623. This course will examine the process and methodologies associated with Life Cycle Analysis. The participants will apply the methods developed in the course to a project to gain experience in defining and quantifying uncertainty associated with human perturbation, management and utilization of biofuels and other complex processes.

- ***Bioenergy & Resource Economics (3 cr.)*** AGEC 5723. Bioenergy and Resource Economics surveys the allocation and conservation of natural resources from a perspective of optimal use and sustainability. Emphasis is placed on the tradeoffs and issues related to the production of biomass and

development of the biofuels market including resource allocation, valuation methodology, economic growth, and market development.

- ***Community and Natural Resources (3 cr.)*** RSOC 5603.The course will introduce students to the breadth of consideration involved in community resource management. Included in the course are theoretical frameworks, methodological investigation and applied practices to enhance the ability of community development professionals to work with their communities to plan, develop, and monitor the conversation and development of natural resources with multiple functions.

- ***Environment and Ecological Risk Assessment (3 cr.)*** BENG 5933. This course will examine the process and methodologies associated with ecological risk assessments. The participants will apply the methods developed in the course to a project to gain experience in defining and quantifying uncertainty associated with human perturbation, management and utilization of biofuels and other complex processes.

- ***Feasibility and Commercialization (3 cr.)*** Introduction to the concepts involved in feasibility and commercialization of biofuel and biobased products. Participants will gain an understanding of issues and processes in moving a project from pilot scale into commercialization.

- ***Sustainability Seminar (1 cr.)*** BENG 5351. Topics in environmental sustainability, green engineering, life cycle analysis, sustainable development, and sustainability science. *Prerequisites: CHEM 1123*

C. Program goals and objectives

Objectives of the program are:

1. Provide participating students with a broad education in several disciplines which comprise biobased products and bioenergy.
2. Increase student awareness of the potential of biobased resources as fuels and industrial raw materials.
3. Provide a documented course of study for students preferring a freestanding certificate program in biobased products and bioenergy.

D. Expected student learning outcomes

Student Learning Outcome(s)

To earn the certificate in Bioenergy and Sustainable Technology, students will demonstrate:

1. An ability to articulate the multiple aspects of a biobased economy, including economic, environmental and social implications.
2. An ability to combine diverse concepts from multiple disciplines to effectively communicate, interact, collaborate and work in the field of Bioenergy and Sustainable Technology.
3. An ability to utilize a systems approach to problem solving in this field.
4. An ability to apply the knowledge base of a specific discipline to this field.

11. Identify off-campus location.

Participating institutions include: Kansas State University, Manhattan KS; South Dakota State University, Brookings, SD; Oklahoma State University, Stillwater, OK.

President/Chancellor Approval Date:

Board of Trustees Notification Date:

Chief Academic Officer: Date: