

**Attachment 5**

Discussion Agenda item for  
May 8, 2012 Faculty Senate meeting

Business Administration – New Minor (approved 3-28-12)

Pages 2-10

Graduate School – New Graduate Certificate (approved 4-3-12)

Pages 11-28

## College of Business Administration (Approved on March 28, 2012)

Add:

### Minor in Entrepreneurship

#### Rationale

1. Centrality to the mission of Kansas State University

In late January 2007, Provost Nellis appointed a group of K-State faculty, administrators, and alumni to serve on the Entrepreneurial Curriculum Task Force. The charge to the task force was to develop an interdisciplinary undergraduate academic program in Entrepreneurship.

Based on a review of entrepreneurship programs, the task force made the following recommendations regarding an undergraduate academic program:

- a. Establish a Minor in Entrepreneurship.
  - i. Establish a curriculum for the Minor in Entrepreneurship that includes three core courses (9 SCH) and two elective courses (6 SCH) selected from an approved list.
  - ii. Define student learning outcomes for the Minor in Entrepreneurship.
  - iii. Develop an assessment plan for all curricular offerings and experiential learning activities and identify metrics that will establish benchmarks and measure progress of the program.
  - iv. Assign to the Center for the Advancement of Entrepreneurship the oversight and management of this interdisciplinary minor.
- b. Identify a group of individuals to assist in administrating and implementing these recommendations.
- c. Establish an Advisory Council, composed of entrepreneurs, business professionals, and faculty members who are entrepreneurs or are interested in entrepreneurship.

To quote the task force...

*“The Task Force believes that developing and nurturing an entrepreneurial culture is critical to achieving the long term goals of the Minor in Entrepreneurship Studies at K-State. The institution will also benefit from harnessing and harvesting the skills and resources of its faculty, students, staff, friends and supporters to create and support a vibrant entrepreneurial culture. This will allow us to identify and use new and innovative ways to create and disseminate knowledge to our students and to transfer that knowledge to application, all of which are at the core of our academic mission. This is a challenging vision, but one that we believe will propel K-State to even greater success.”*

The proposed Minor in Entrepreneurship will be a collaborative, cross-disciplinary program that will build upon existing course work at Kansas State University. The minor will be a program housed with the College of Business Administration. It will be open to students from any University discipline. Students who enroll in the minor will be able to select supporting electives based on their particular venture ideas, interests, and degree program. It will target highly motivated, entrepreneurially minded individuals who want to build entrepreneurial skills along with their chosen degree program. The minor, its cross-disciplinary focus, and the operation of the courses all fit into the University's focus on developing an entrepreneurial culture and building highly ranked programs and colleges. The minor will develop student's capacity to understand the financial, marketing, managerial, and operational sides of starting and running a successful business as well as focus on how these skills can be utilized in corporate or nonprofit settings. This theme is consistent with the Mission Statement of Kansas State University.

## 2. Student demand for the program

Entrepreneurship is the fastest growing major in Business schools across the country. The Kauffman Foundation in Kansas City reports that there were fewer than five entrepreneurship courses offered in the early 1970s. Recent statistics report over 2,100 colleges and universities offer at least one course in entrepreneurship. The 2008 *US News and World Report* lists 128 colleges and universities with majors in Entrepreneurship/Entrepreneurial Studies. Enrollment in such programs has been growing as more undergraduate students are seeking careers in which they make the decisions. The growth of online businesses among the younger generation demonstrates a clear motivation for new venture creation and the desire to "be your own boss."

Regional schools across Kansas have experienced success with similar Entrepreneurship programs. Wichita State University reports 163 students enrolled in the Entrepreneurship curriculum last semester. The University of Kansas reports an average of 200 undergraduate students per semester in the Entrepreneurship program.

In order to be more competitive with regional schools and attract a broader range of budding entrepreneurs to K-State, it is necessary to develop a Minor in Entrepreneurship. Each spring semester, the Center for the Advancement of Entrepreneurship hosts a University-wide student idea competition. In the past three years, a total of 497 students (Freshman through Senior) have signed up for the competition representing seven colleges at K-State. The students voluntarily attended a series of noncredit seminars to learn how to research and write a feasibility plan for their entrepreneurial idea. Ultimately, the students presented their ideas to a panel of community judges for prize money.

In October 2010, the Center for the Advancement of Entrepreneurship administered a university-wide survey to gauge the interest of students in entrepreneurship programs. An email survey was created using the Axio survey tool, the link to the survey was emailed to students, and the survey remained open for seven days. In that time, 1,493 students provided responses to the survey. The results of the survey are as follows:

- 36% of respondents are Interested or Very Interested in taking at least one entrepreneurship course
- 22% of respondents would enroll in an entrepreneurship minor if offered today

3. Demand for graduates of the program

The opportunities upon graduation are boundless. Along with the training received in their major degree program, the Entrepreneurship minor will help students accelerate the development of venture ideas and shorten the gap between ideation, business plan, and start-up. Coupled with other Center for the Advancement of Entrepreneurship activities such as the Next Big Thing and the planned mentorship and incubator programs, students will be provided the knowledge, tools, and resources to prosper. The minor will also assist those who do not seek to start their own venture arming them with the tools to think more creatively, engage in business development, and be a corporate entrepreneur. The degree will enhance students' marketability and competitiveness for positions.

4. Locational and comparative advantages of the program

The K-State campus and the Center for the Advancement of Entrepreneurship are positioned well to serve as a valuable springboard for this program. At the University level, the Provost's office has taken a leadership role in urging colleges and faculty to be more entrepreneurial in what we do as well as what we teach. The cross-campus support for the minor and participation in 2008-2009 entrepreneurship activities signals that the entire K-State campus is ready to support a new academic venture into entrepreneurship. The resources on campus that will support some internal as well as outside programming include the Advanced Manufacturing Institute (AMI) and the National Institute for Strategic and Technological Acquisition and Commercialization (NISTAC). AMI has assisted budding inventors and entrepreneurs with business planning for many years. NISTAC holds a catalogue of over 1,000 patented technologies donated from major corporations for which its staff has researched and developed business plans and/or licensing agreements. The KSU Research and Extension division also assists rural entrepreneurs and small town businesses in planning, marketing, and economic development. These cross-campus resources will be available for partnerships with the Center for the Advancement of Entrepreneurship as the minor takes shape. The College of Business Administration has developed resources for supporting the efforts of the new Entrepreneurship major. There are also faculty members in other Colleges who have expressed interest in entrepreneurship and would likely be participants or partners in the program in the roles of instructors or mentors. Two internal advisory boards have been developed and operational for the past year to advise the Center for the Advancement of Entrepreneurship on curriculum and operational issues. See Appendix A for a list of advisory board members.

Beyond campus are the local entrepreneurs and business community of Manhattan, the region, the state of Kansas, and alumni from across the globe. Many from these constituencies have already made it clear that they are willing to serve as mentors, teachers, and advisors for the program. This component will be very important to the success of the minor and the Center for the Advancement of Entrepreneurship. Student contact with successful entrepreneurs provides a clear application of the processes of starting a new business venture.

5. Characteristics of students who will participate in the proposed program

Students who apply to the proposed program will be students from across the University who are motivated to start a new venture, those who are interested in corporate entrepreneurship, and those who are simply interested in new venture creation. Many of the students enrolled in the minor will seek to develop entrepreneurial skills to compliment their chosen major (e.g., hotel and restaurant management, food and grain science, music, industrial engineering, architecture,). Initially due to staffing and funding issues, *only 30-40 students per year will be admitted into the minor*. In the future when resources and staffing allow, this cap could be increased. Admittance into the minor will occur after the student has successfully completed the Introduction to Entrepreneurship class. Students will be asked to submit all completed materials from that class as well as an online application. While GPA will be a consideration, student performance on the assignments in the Introduction to Entrepreneurship course and their perceived passion for entrepreneurship will be considered for admittance. The process will abide by University initiatives on diversity and seek to have representation from all colleges.

### **Impact on Other Units**

The Department of English has agreed to reserve seats in ENGL 455: Exploring Creativity for students enrolled in the minor in entrepreneurship. This is a proposed required course for the minor and will allow students the opportunity to learn about creative problem solving from an entrepreneurial context.

The proposed minor in entrepreneurship would also require students to choose two elective courses from outside of their curriculum for their major. The electives must be shown to support the student's entrepreneurial goals and will be approved on an individual basis by the Center for the Advancement of Entrepreneurship.

### **Effective Date**

Fall 2012

### **Core Courses**

#### **GENBA 340 Introduction To Entrepreneurship**

Credits: (3)

The foundation course in the program, this course examines the nature of entrepreneurship and the role of entrepreneurship in society. The role of the entrepreneur and the process of entrepreneurship is introduced and examined in the conception, start-up, organization, and development of new ventures. New venture problems to be studied include identification of possible new products and services, evaluation of practical commercial/value potential, and assessment of venture feasibility, with attention to financing, operating, and marketing the venture idea. Concepts related to traditional, organizational, and social entrepreneurship will be introduced.

#### **ENGL 455 Exploring Creativity**

Credits: (3)

A study of creative thinking. (Prerequisite: ENGL 200 or ENGL 210 or ENGL 415.)

This course will review state-of-the art theoretical and applied models of creativity and innovation as they apply to individuals, groups, and organizations. Extensive practice in opportunity recognition and ideation will be utilized to develop individual and team-based skills in creative problem solving. By the end of the term, students should be familiar with the concept of the creative mindset able to apply the concepts to relevant concepts to building a venture.

**GENBA 350 NEW VENTURE CREATION** (New Course)

Credits (3)

This course examines the entrepreneurial process, especially as it relates to creating a business plan and launching a venture. We will address the process of creativity and innovation and its impact on the success of business start-up. Specific topics covered include new venture planning, marketing, financing, and management. This course will serve as a strong foundation for those aspiring to own and operate their own businesses as well as a real-world heads-up course for students who acknowledge that their future with larger businesses could very well include dealing with entrepreneurs/small businesses. (Prerequisites: GENBA 340 and ENGL 455)

This course will serve as a capstone course for the minor and is designed to expose students to the process of conceptualizing and creating a new venture. Using the central concepts of creativity, innovation, and opportunity recognition, students will evaluate opportunities and consider the value proposition of launching the venture. Additionally, students will work individually or in teams to develop business plans in which they address the issues critical to a start up venture

**Electives:**

The two three-hour courses must be approved by the internal advisory board to be relevant to the minor and the student's venture interests. Below are some of the suggested course pairings. An approved list of pairings will be maintained on the Center for the Advancement of Entrepreneurship's website but students will be allowed tailor their selection of course electives by seeking approval of courses beyond those already approved.

List of Elective Courses for the Entrepreneurship Minor

**AGEC 202 - Small Business Operations**

Credits: (3)

Opportunities in business ownership, principles governing the starting of a small enterprise; importance, status, problems, and management of a small business.

### **ASI 333 - Equine Enterprise Management**

Credits: (1)

Emphasis will be placed on management issues affecting the successful development and operation of an equine facility. Topics covered include health care, diet formulation, equipment needs, facility design and management, and equine business considerations.

### **AT 576 - Principles of Buying**

Credits: (3)

Introduction to the processes and methods used by apparel buyers to purchase merchandise assortments. Application of fashion theory and principles, sources of information, knowledge, techniques and skills for assortment planning, buying, vendor negotiations, and profit planning. Emphasis on merchandising mathematics.

### **AT 625 - Apparel and Textile Business Strategy**

Credits: (3)

Evaluation of the external and internal factors impacting apparel and textile business performance; development and analysis of creative and responsible strategic response.

### **CIS 548 - Software Management**

Credits: (3)

Topics related to the management of software, including organization, project planning, process models, life cycle models, TQM, software quality assurance, cost estimation, configuration management.

### **CIS 562 - Enterprise Information Systems**

Credits: (3)

Conceptual models for E-Commerce and for business applications, database management systems, relational data model, normal forms, query language, security features, web access and scripting languages, development process and management, issues in management of enterprise information systems.

### **CIS 597 - Information Systems Project**

Credits: (3)

Directed studies: selection and completion of a project; may include collaboration with other students; may include design, analysis, and implementation. Completion of a plan, two progress reviews, and a final report with literature review and project evaluation.

### **CIS 598 - Computer Science Project**

Credits: (3)

Directed studies: selection, investigation and report on some topic not covered in prior courses; may include an implementation and/or experimentation component; may be done in collaboration with other students. Completion of a plan, two reviews, and a final report with literature review and project evaluation.

### **FINAN 561 - Finance for Entrepreneurs**

Credits: (3)

A comprehensive set of knowledge and tools to start, run, and exit an entrepreneurial or small business. These tools include financial forecasting and business planning, financing operations and capital investments, evaluation of asset acquisitions, tax planning, short-term capital management, mergers/acquisitions, and evaluation of exit strategies.

### **HMD 640 - Entrepreneurship in Hospitality Management and Dietetics**

Credits: (3)

Development and management of small businesses or private practice within the dietetics or hospitality industry. Business plan development, marketing, cost considerations. Overview of consulting to healthcare and hospitality operations and examination of skills required for success.

### **HORT 760 - Business Management for Horticultural Enterprises**

Credits: (3)

Focus is on developing a detailed business plan for the service, design and production businesses in horticulture that incorporates considerations of start-up capitalization, insurance, investments, legal accounting and employee compensation. Strategic decision-making and aspects of a horticulture firms that are unique to its industries, such as product seasonality and perishability, will be discussed.

### **AGCOM 400 - Agricultural Business Communications**

Credits: (3)

Written communications as used in agricultural industries. A writing course emphasizing the tools and techniques of writing memos, letters, short and long reports, proposals, and presentations.

### **AT 625 - Apparel and Textile Business Strategy**

Credits: (3)

Evaluation of the external and internal factors impacting apparel and textile business performance; development and analysis of creative and responsible strategic response.

### **ART 577 - Matrix Studio and Business Practices**

Credits: (3)

Students are selected by portfolio review, design projects are completed to client specifications. Professional design management, ethics, setting up a business, client/designer relationships, and contractual options, billing practices, and operating procedures will be covered.

### **HMD 370 - The Business of Wedding and Event Consulting**

Credits: (2)

This course will introduce the student to the competencies required to become a professional wedding and event consultant. Students will analyze essential services that provide the necessary infrastructure for a wedding event and will examine the business, creative, and practical aspects of coordinating the wedding environment

### **MKTG 241 - Marketing for New Ventures**

Credits: (3)

Marketing plans for new ventures will give students the opportunity to develop practical skills in marketing new products or services in an entrepreneurial, small business environment. Students will create a marketing plan for a new product or service working in collaboration with other students. This plan will include decisions concerning the 4 P's of marketing—product, price, promotion and place, with the greatest emphasis on promotional activities.

**MANGT 540 - Entrepreneurial Consulting**

Credits: (3)

This course is designed to provide students and faculty in the Entrepreneurship program the opportunity to give business assistance to small firms in the University community.

FROM: (Current list of courses for the curriculum, curriculum description, and admission criteria.)

TO: (Proposed list of courses for the curriculum, curriculum description, and admission criteria.)

	<p><b>Entrepreneurship Minor</b></p> <p><b>Required Courses – 9 hours</b></p> <ul style="list-style-type: none"> <li>• <b>GENBA 340 Introduction To Entrepreneurship.</b> Credits: (3)</li> <li>• <b>ENGL 455 Exploring Creativity.</b> Credits: (3)</li> <li>• <b>GENBA 350 New Venture Creation.</b> Credits: (3)</li> </ul> <p><b>Electives – 6 hours</b></p> <p>The two three-hour courses must be approved by the internal advisory board to be relevant to the minor and the student's venture interests.</p> <ul style="list-style-type: none"> <li>• <b>AGEC 202 - Small Business Operations</b> Credits: (3)</li> <li>• <b>ASI 333 - Equine Enterprise Management</b> Credits: (1)</li> <li>• <b>AT 576 - Principles of Buying</b> Credits: (3)</li> <li>• <b>AT 625 - Apparel and Textile Business Strategy</b> Credits: (3)</li> <li>• <b>CIS 548 - Software Management</b> Credits: (3)</li> </ul>
--	--

	<ul style="list-style-type: none"> <li>• <b>CIS 562 - Enterprise Information Systems</b> Credits: (3)</li> <li>• <b>CIS 597 - Information Systems Project</b> Credits: (3)</li> <li>• <b>CIS 598 - Computer Science Project</b> Credits: (3)</li> <li>• <b>FINAN 561 - Finance for Entrepreneurs</b> Credits: (3)</li> <li>• <b>HMD 640 - Entrepreneurship in Hospitality Management and Dietetics</b> Credits: (3)</li> <li>• <b>HORT 760 - Business Management for Horticultural Enterprises</b> Credits: (3)</li> <li>• <b>AGCOM 400 - Agricultural Business Communications</b> Credits: (3)</li> <li>• <b>AT 625 - Apparel and Textile Business Strategy</b> Credits: (3)</li> <li>• <b>ART 577 - Matrix Studio and Business Practices</b> Credits: (3)</li> <li>• <b>HMD 370 - The Business of Wedding and Event Consulting</b> Credits: (2)</li> <li>• <b>MKTG 241 - Marketing for New Ventures</b> Credits: (3)</li> <li>• <b>MANGT 540 - Entrepreneurial Consulting</b></li> </ul>
--	--

# GRADUATE CERTIFICATE IN APPLIED MATHEMATICS

## New Interdisciplinary Certificate Program Application

### A Statement of need

The objectives of the proposed interdisciplinary certificate program focus on providing the graduate students of Kansas State University with both fundamental applied mathematics training as well as experience in applying this training to relevant problems in science and engineering disciplines. Applied mathematics research lies at the heart of an increasing number of research programs both inside academia and outside; the U.S. Departments of Energy and Defense as well as the National Science Foundation, for example, all have specific programs to sponsor applied mathematics and interdisciplinary research. Thus, the analytical and computational skills provided by the proposed program form a firm foundation for the careers of graduate students in mathematics, statistics, engineering and the sciences by preparing these students to participate in cutting-edge multidisciplinary research projects.

Despite the significance of the subject area, Kansas State University currently has no applied mathematics component within its graduate program. This stands in stark contrast to all seven of the benchmarking institutions identified as part of the K-State 2025 planning process (see the Benchmarking presentation link under Phase 2 at <http://www.k-state.edu/2025/resources/>). As summarized below, each of these seven universities has an applied mathematics component within its respective graduate program.

- Auburn University offers a **Masters of Applied Mathematics** (<http://www.auburn.edu/academic/cosam/departments/math/grad/>).
- Clemson University offers a **PhD degree in Mathematics with concentration in Applied and Computational Analysis** (<http://www.clemson.edu/ces/math/graduate/degree.html>).
- Oklahoma State University offers a **PhD degree in Applied Mathematics** ([http://www.math.okstate.edu/phd\\_applied\\_math](http://www.math.okstate.edu/phd_applied_math)).
- Oregon State University, offers a **PhD degree in Mathematics with emphasis in Applied Mathematics** ([http://www.math.oregonstate.edu/grad\\_programs](http://www.math.oregonstate.edu/grad_programs)). The largest research group in the Mathematics Department at OSU is the Applied Mathematics group ([http://www.math.oregonstate.edu/research\\_groups](http://www.math.oregonstate.edu/research_groups)).
- Colorado State University offers a **Masters in Computational and Applied Mathematics** (<http://www.math.colostate.edu/programs/graduate/>).

- Iowa State University offers both a **Masters degree and a PhD degree in Applied Mathematics** (<http://www.math.iastate.edu/Graduate/Programs.html>).
- North Carolina State University offers a **PhD degree in Applied Mathematics** along with a **specialized track in Interdisciplinary Mathematics** ([http://www.math.ncsu.edu/grad/brochure/grad\\_study.php](http://www.math.ncsu.edu/grad/brochure/grad_study.php)). Additionally, their PhD students can acquire early research experience by participating in the **Industrial Applied Mathematics Program** (<http://www.ncsu.edu/crsc/iamp.html>).

The introduction of a Graduate Certificate in Applied Mathematics therefore marks an important first step in the development of a competitive applied mathematics program at Kansas State University.

## B Educational objectives

The proposed Certificate in Applied Mathematics is intended to meet the needs described in Section A through the pursuit of three principal objectives:

1. To introduce students from mathematics, science, and engineering to a common foundational set of tools from modern mathematical analysis, and
2. To prepare the students to use these tools for the analysis and solution of mathematical model equations arising in interdisciplinary research.

## C Certificate courses

The required coursework for the Certificate in Applied Mathematics will consist of a minimum of 12 credit hours, including 6 credit hours in two required core mathematics courses and at least 6 additional credit hours in elective courses from various disciplines. The core courses and elective courses in each discipline are listed below.

### C.1 Core courses (6 credit hours)

**MATH 715** Applied Mathematics I — 3 credits — Fall.

**MATH 716** Applied Mathematics II — 3 credits — Spring.

### C.2 Elective courses (minimum of 6 credit hours)

#### Mathematics

**MATH 615** Introduction to Digital Image Processing — 3 credits — Spring.

**MATH 635** Dynamics, Chaos, and Fractals — 3 credits — Fall.

**MATH 789** Combinatorial Analysis — 3 credits — Spring (alternate years).

#### Industrial and Manufacturing Systems Engineering

- IMSE 881** Linear Programming — 3 credits — Fall (odd years).  
**IMSE 882** Network Flows and Graph Theory — 3 credits — Spring (odd years).  
**IMSE 884** Integer Programming and Combinatorial Optimization — 3 credits — Spring (even years).  
**IMSE 982** Nonlinear Programming — 3 credits — Summer (even years).

### **Electrical and Computer Engineering**

- ECE 840** Computer Engineering Methods for Analysis, Simulation, and Design — 3 credits — Spring and online (every year).  
**ECE 861** Noise Theory — 3 credits — Fall and online (every year).  
**ECE 963** Signal Detection Theory — 3 credits — Spring (odd years).  
**ECE 965** Information Theory — 3 credits — Fall (even years).

### **Statistics**

- STAT 704** Analysis of Variance — 2 credits — Fall, Spring, Summer.  
**STAT 705** Regression and Correlation Analysis — 2 credits — Fall, Spring, Summer  
**STAT 710** Sample Survey Methods — 2 credits — Fall (even years)  
**STAT 713** Applied Linear Statistical Models — 4 credits - Fall  
**STAT 716** Nonparametric Statistics — 2 credits — Fall (odd years).  
**STAT 717** Categorical Data Analysis — 3 credits — Spring.  
**STAT 720** Design of Experiments — 3 credits — Spring, Summer.  
**STAT 722** Experimental Design for Product Development and Quality Improvement — 3 credits — Fall.  
**STAT 730** Multivariate Statistical Methods — 3 credits — Spring.  
**STAT 736** Bioassay — 2 credits — Spring (odd years).  
**STAT 745** Statistical Graphics — 3 credits — Spring (even years).

### **Civil Engineering**

- CE 803** Numerical and Analytic Techniques for Engineers — 3 credits — Fall.

## **D How the courses meet the stated objectives**

The core and elective courses support Objectives 1 and 2 stated in Section B. In these courses, the students will learn to use techniques from applied and computational mathematics to solve a number of relevant problems arising in various disciplines. These courses, which were chosen based on their incorporation of advanced mathematical theory and techniques, offer the students an opportunity to directly explore the practical use of applied mathematics within different disciplines.

## E Certificate program administration

The certificate program will be administered within the Department of Mathematics and through the offices of the Center for the Integration of Undergraduate, Graduate and Postdoctoral Research (I-Center). A program coordinator will have primary responsibility for administering the program with the support of a Certificate Supervisory Committee chaired by him/her. The I-Center Director will be part of the Supervisory Committee. Since the Certificate will be housed by the Mathematics Department, the Certificate program coordinator will respond to the Head of the Mathematics Department.

To gain admission to the certificate program, the student must be approved for admission by the Certificate Supervisory Committee and by the Graduate School. Students should apply directly to the coordinator of the graduate certificate program, who will forward the Certificate Supervisory Committee's recommendation for admission to the Graduate School. Admission requires evidence of completion of a bachelor's degree from an accredited university with minimum GPA as established by the Graduate School; or concurrent enrollment in a graduate degree program at Kansas State University or an accredited University. In instances where the graduate certificate program is not linked with a graduate degree program at Kansas State University, the student must meet the entrance requirements for graduate study, including English language proficiency requirements as specified in Chapter 1 of the Graduate School Handbook and relevant documentation must be forwarded to the Graduate School before the student can be admitted.

## F Estimated budget

With the exception of the two core courses, all courses included within the proposed certificate's program of study are taught routinely within their respective departments. In addition to serving as the core of the proposed certificate, the courses MATH 715 and MATH 716 are a part of an ongoing effort within the mathematics department to offer a much-needed applied mathematics curriculum to its students. These courses would be offered even if the proposed certificate were not approved. Moreover, the certificate committee and program coordinator will serve voluntarily, as part of their professorial duties at Kansas State University. Thus, the proposed certificate program will utilize only existing resources and will not incur additional costs for any department involved.

## G Associated and contributing faculty

**Supervisory Committee:** Nathan Albin (Chair), Todd Easton, Diego Maldonado, Virginia Naibo (I-Center Director), Balasubramaniam Natarajan, and Haiyan Wang.

**Nathan Albin** PhD, Assistant Professor, Department of Mathematics, KSU.

**Todd Easton** PhD, Associate Professor, Department of Industrial and Manufacturing Systems Engineering, KSU.

**Diego Maldonado** PhD, Associate Professor, Department of Mathematics, KSU.

**Virginia Naibo** PhD, Associate Professor and I-Center Director, Department of Mathematics, KSU.

**Balasubramaniam Natarajan** PhD, Associate Professor, Department of Electrical and Computer Engineering, KSU.

**Haiyan Wang** PhD, Associate Professor, Department of Statistics, KSU.

## H Program coordinator

Nathan Albin, PhD, Assistant Professor  
 Department of Mathematics, 138 Cardwell Hall, Kansas State University.  
 albin@math.ksu.edu 785-532-0582

Professor Albin’s outstanding expertise in the field of Applied Mathematics makes him the ideal choice for this role.

## I Student Learning Outcomes and Program Assessment Plan

Successful application of mathematics to a real-world problem typically requires two fundamental aptitudes: the ability to analyze mathematical equations that model the problem, and the ability to develop mathematically correct computer programs to solve the model equations.

The three KSU graduate Student Learning Outcomes are: Knowledge, Skills and Attitude and personal conduct. The SLOs of the Graduate Certificate in Applied Mathematics are:

1. To demonstrate the ability to produce correct computer algorithms for solving difficult mathematical equations, and
2. To demonstrate the ability to apply advanced analytical techniques to relevant mathematical models.
3. To demonstrate the ability to apply mathematical model equations arising in interdisciplinary research.

The following table shows the correlation between these two sets of SLOs.

<b>Grad Certificate SLOs</b>	Knowledge	Skill	Attitude and personal conduct
Demonstrate the ability to produce correct computer algorithms for solving difficult mathematical equations	X	X	
Demonstrate the ability to apply advanced analytical techniques to relevant mathematical models	X	X	X
Demonstrate the ability to to apply mathematical model equations arising in interdisciplinary research	X	X	X

The following table shows the measure/target and tools in the assessment for each SLO.

<b>Grad Certificate SLOs</b>	<b>Indirect Measure and Target</b>	<b>Direct Measure and Target</b>	<b>Who will be assessed?</b>
Demonstrate the ability to produce correct computer algorithms for solving difficult mathematical equations		Math 715 Final exam, see rubric in Appendix A1	All students in the program
Demonstrate the ability to apply advanced analytical techniques to relevant mathematical models		Math 716 Final exam see rubric in Appendix A2	All students in the program
Demonstrate the ability to to apply mathematical model equations arising in interdisciplinary research	GPA of 3.5 or higher in elective courses		All students in the program

The program coordinator will work together with the instructors of the core courses to ensure consistency of measurement among years. The data associated with the indirect and direct measures will be collected at the end of each semester. The certificate committee will meet once per year to discuss the results of the student assessments and to assess the effectiveness of the program as a whole. In each year, regarding SLOs 1 and 2, the Committee will consider the average score in each category mentioned in the rubric tables shown in appendices A1 and A2. The target is an average of 3 or greater in each category. If in a given year the average score in any category falls below 3, the Committee will determine the necessary program changes. A similar procedure will be implemented for assessing SLO 3, now based on the indirect measure of a GPA of 3.5 or higher in the elective courses.

To aid in the program assessment, each student will be asked to participate in an exit survey upon completion of the program. The survey, which will also include a self-evaluation part, will be designed by the committee and will be used, together with the results of the student learning outcome measurements, to identify potential improvements to the certificate program, including modifications of the core course contents and inclusion of additional elective courses. This will allow the program to naturally evolve and improve as we are assessing and reviewing not only the students but the overall program.

The following table shows where students enrolled in the program will gain exposure to the program's SLOs and where they will be assessed on these SLOs. "X" indicates Exposure or Attainment and "A" indicates assessment.

<b>Grad Certificate SLOs</b>	Core Courses	Elective Courses
Demonstrate the ability to produce correct computer algorithms for solving difficult mathematical equations	X, A	X,A
Demonstrate the ability to apply advanced analytical techniques to relevant mathematical models	X, A	X,A
Demonstrate the ability to to apply mathematical model equations arising in interdisciplinary research	X, A	X,A
<b>University Graduate SLOs</b>		
Knowledge	X	X, A
Skills	X	X, A
Attitudes and Professional Conducts	X	

## **J Endorsements**

**Peter Dorhout**, Dean, College of Arts & Sciences, KSU.

**John English**, Dean & LeRoy C. and Aileen H. Paslay Chair, College of Engineering, KSU.

**Alok Bhandari**, Head, Department of Civil Engineering, KSU.

**Don Gruenbacher**, Head, Department of Electrical and Computer Engineering, KSU.

**Bradley Kramer**, Head, Department of Industrial and Manufacturing Systems Engineering, KSU.

**James Neill**, Head, Department of Statistics, KSU.

**Louis Pigno**, Head, Department of Mathematics, KSU.

**Appendix A1: Rubric for SLO #1**

**SLO #1:** Students will demonstrate the ability to produce correct computer algorithms for solving difficult mathematical equations.

**Rubric:**

	No Attempt 0	Incorrect 1	Partially Correct 2	Generally Correct 3	Completely Correct 4
Identification of an appropriate solution strategy					
Selection of an appropriate numerical algorithm					
Correct implementation of the numerical algorithm					
Correct interpretation of the numerical results					

**Appendix A2: Rubric for SLO #2**

**SLO #2:** Students will demonstrate the ability to apply advanced analytical techniques to relevant mathematical models.

**Rubric:**

	No Attempt 0	Incorrect 1	Partially Correct 2	Generally Correct 3	Completely Correct 4
Interpretation of the variables, parameters, and/or other specific information given in the model					
Selection of appropriate analytical tools					
Correct application of analytical tools					
Correct interpretation of the results of analysis					

March 29, 2012

Dr. Diego Maldonado  
Department of Mathematics  
Cardwell Hall  
CAMPUS

Dear Dr. Maldonado:

The College of Arts & Sciences is supportive of the proposed Graduate Certificate in Applied Mathematics developed by you and your colleagues in Mathematics, Statistics, Industrial & Manufacturing Systems Engineering, and Electrical & Computer Engineering.

The proposed certificate will be of interest to graduate students in Mathematics, Statistics, and Engineering, and likely to some in computational biology or chemistry as well. Its broad-based nature will serve those students well in preparing them to work in interdisciplinary teams in a variety of settings in the future.

Best regards,

A handwritten signature in black ink, appearing to read 'Peter K. Dorhout', with a large, sweeping flourish at the end.

Peter K. Dorhout, Dean

Nathan Albin, Professor  
Diego Maldonado, Professor  
Virginia Naibo, Professor  
Department of Mathematics  
Kansas State University  
138 Cardwell Hall  
CAMPUS

Dear Nathan, Diego and Virginia:

The Department of Mathematics is enthusiastically supportive of the proposed Graduate Certificate in Applied Mathematics. This support was first expressed in Fall 2011 when the Certificate initiative was announced and then through a faculty meeting last February 2nd as faculty overwhelmingly supported the Certificate by vote.

I approve of the courses (Math 715) Applied Math I and (Math 716) Applied Math II as core Mathematics courses. I also approve the following elective courses: (Math 615) Introduction to Digital Image Processing, (Math 635) Dynamics, Chaos, and Fractals, and (Math 789) Combinatorial Analysis.

I have appointed Nathan Albin as Chair of the Graduate Certificate Supervisory Committee due to his remarkable expertise in Applied Mathematics. In this connection, I also appreciate Maldonado and Naibo's leadership and mentoring efforts.

I approve that the Certificate be administered within the Department of Mathematics, under my direct oversight, and through the offices of the I-Center.

Always,



Louis Pigno  
Professor & Department Head

March 6, 2012

Diego Maldonado  
Associate Professor  
Director of Graduate Studies  
Department of Mathematics  
Cardwell Hall  
CAMPUS

Dear Dr. Maldonado,

During our meeting Thursday, February 23, I had the chance to discuss with you the details for proposal on the Certificate in Applied Mathematics.

I find this interdisciplinary Certificate to be a welcome and valuable addition to our graduate program and I enthusiastically support it.

Sincerely,



John R. English, Ph.D., P.E.  
Dean and the LeRoy C. and Aileen H. Paslay Chair in Engineering

cc: Byron Jones  
Gary Clark  
Brad Kramer  
Todd Easton

October 10, 2011



Dr. Virginia Naibo  
Associate Professor  
Department of Mathematics  
CAMPUS

**Department of Civil Engineering**  
2118 Fiedler Hall  
Manhattan, KS 66506 - 5000  
785-532-5862  
Fax: 785-532-7717

Dear Dr. Naibo,

The Department of Civil Engineering is supportive of the proposed Graduate Certificate in Applied Mathematics. I approve our graduate course CE 803 - Numerical and Analytical Techniques for Engineers - being listed as an elective for the certificate program.

Please feel free to contact me if more information is needed from our department.

Best regards,

A handwritten signature in blue ink that reads "Alok Bhandari". The signature is written in a cursive style and is set against a light yellow rectangular background.

Alok Bhandari  
Professor and Head



**Department of Electrical  
and Computer Engineering**  
261 Rathbone Hall  
Manhattan, KS 66506 -5204  
785-532-5600

January 23, 2012

Carol Shanklin, Dean  
Graduate School  
103 Fairchild Hall

Dean Shanklin,

The Department of Electrical and Computer Engineering fully endorses the new graduate certificate in applied mathematics being proposed by the Department of Mathematics. Courses in ECE that we approve for use as elective courses for this certificate are ECE 840, ECE 861, ECE 963, and ECE 965. If there are additional graduate courses in ECE that would also be valuable, we would also be happy to consider those for use as electives for this certificate program.

Sincerely,

*Don Gruenbacher*

George and Alice Fiedler Chair  
Associate Professor and Head

----- Original Message -----

Subject: Re: Graduate Certificate in Applied Mathematics  
From: "Bradley Kramer" <[bradleyk@k-state.edu](mailto:bradleyk@k-state.edu)>  
Date: Thu, October 13, 2011 18:05  
To: "Virginia Naibo" <[vnaibo@math.ksu.edu](mailto:vnaibo@math.ksu.edu)>  
Cc: [bradleyk@ksu.edu](mailto:bradleyk@ksu.edu)  
[teaston@ksu.edu](mailto:teaston@ksu.edu)

Do you need this on letterhead or will email work?

The IMSE faculty are pleased to support the Graduate Certificate in Applied Mathematics. We have the capacity in our classes to welcome graduate students who choose to pursue this certificate. Furthermore, I recognize and support Dr. Easton's involvement in the Certificate's supervising committee as a commitment of our department.

Regards,

Brad

Bradley A. Kramer, Ph.D.  
Professor and Head, Ind. & Mfg. Systems Engineering  
Ike and Letty Evans Engineering Chair  
Director, Advanced Manufacturing Institute

2038 Durland Hall  
Manhattan, KS 66506

Email: [BradleyK@k-state.edu](mailto:BradleyK@k-state.edu)  
Voice: (785) 532-5606  
Fax: (785) 532-3738

On 10/12/2011 10:09 AM, Virginia Naibo wrote:

>  
> Dear Professor Kramer,  
>  
> After conversations with Professor Easton, we would like to include the  
> following courses as elective courses for a Graduate Certificate in  
> Applied Mathematics:  
>  
> IMSE 881, IMSE 882, IMSE 884, IMSE 982  
>  
> Please see below for more information about the certificate. If your  
> department agrees, then we will need an endorsement letter/email from you.  
> This letter or email, stating essentially that your department supports  
> the creation of the Graduate Certificate in Applied Mathematics and that  
> approve the above mentioned courses being elective courses for the  
> certificate, will accompany the application for the graduate certificate  
> program.  
>  
> Please let me know if you would like to meet with me to talk in more  
> detail about the certificate.  
>  
> Many thanks for your time and I hope to hear from you soon.  
>  
> Best Regards,  
>

> Virginia Naibo  
> Associate Professor  
> Mathematics Department  
>  
> -----  
>  
> GRADUATE CERTIFICATE IN APPLIED MATHEMATICS  
>  
> The Mathematics Department is in the process of creating a Graduate  
> Certificate in Applied Mathematics, which is intended to start running in  
> Fall 2012. The target audience is engineering and mathematics graduate  
> students.  
>  
> In order to get a Graduate Certificate in Applied Mathematics, a graduate  
> student will need to take 12 hours of graduate credit. Six of those will  
> be obtained through the certificate's core courses (Math 715 and Math 716,  
> the attached files contain a description of the contents of these  
> courses). The remaining hours can be obtained through the certificate's  
> elective courses. The list of elective courses, most of them of 3 credits,  
> will include courses from mathematics, statistics and some engineering  
> departments. We intend to include a distance learning component in the  
> future and expand the program as needed.  
>  
> A committee for the certificate has been formed: Nathan Albin (Chair,  
> Math), Todd Easton (IMSE), Diego Maldonado (Math), Virginia Naibo (Math),  
> Bala Natarajan (EECE).

From: "James Neill" <jwneill@k-state.edu>  
Subject: Re: Graduate Certificate  
Date: Fri, November 4, 2011 9:27 am  
To: dmaldona@math.ksu.edu

---

Dear Diego,

Attached is a letter indicating agreement to participate in the proposed Graduate Certificate in Applied Mathematics. I have listed possible applied Statistics courses to serve as electives. As I note in the letter, these courses are available as on-campus offerings. As I mentioned previously, the ability to offer such courses on-line through DCE would depend on additional staffing resources.

Please let me know of any questions and thanks again for the opportunity to participate.

Best,  
Jim

James W. Neill  
Professor and Head  
Department of Statistics  
Kansas State University  
Manhattan, KS 66506  
785.532.0516  
[jwneill@ksu.edu](mailto:jwneill@ksu.edu)

----- Original Message -----  
From: [dmaldona@math.ksu.edu](mailto:dmaldona@math.ksu.edu)  
To: "James Neill" <[jwneill@k-state.edu](mailto:jwneill@k-state.edu)>  
Cc: [dmaldona@math.ksu.edu](mailto:dmaldona@math.ksu.edu)  
Sent: Monday, October 31, 2011 8:53:18 AM  
Subject: Graduate Certificate

Dear Jim,  
This is a follow up to our nice conversation last week. In order to add the Statistics Department as a participant of the upcoming Graduate Certificate in Applied Mathematics, I would need a letter from you agreeing to be part of this initiative and indicating a list of Statistics graduate courses that can serve as elective courses for the Certificate. Thank you very much for all your and your faculty support. I'm looking forward to many more collaborative endeavors between Math and Stats.  
Cheers,  
Diego

--  
Diego Maldonado  
Associate Professor  
Director of Graduate Studies  
Department of Mathematics  
Kansas State University  
<http://www.math.ksu.edu/~dmaldona/>



Department of Statistics  
and Statistical Laboratory  
101 Dickens Hall  
Manhattan, KS 66506-0802  
785-532-6883  
Fax: 785-532-7736  
E-mail: [statdept@ksu.edu](mailto:statdept@ksu.edu)  
<http://www.ksu.edu/stats>

November 4, 2011

Dr. Diego Maldonado  
Director of Graduate Studies  
Department of Mathematics  
Cardwell Hall  
Kansas State University  
CAMPUS

Dear Diego:

Thank you for inviting the department to participate in the proposed Graduate Certificate in Applied Mathematics. The department would be pleased to be a part of this interdisciplinary endeavor. The following list of applied Statistics courses may serve as elective courses for the Certificate: 704, 705, 713 (note that a student may not receive credit for both the 704/705 sequence and 713), 710, 716, 717, 720, 722, 730, 736, 745. These courses are regularly available on-campus according to the schedule on the department website.

Please let me know of any questions regarding this list of possible electives. I look forward to further collaborations between our departments.

Best Regards,

A handwritten signature in cursive script that reads 'Jim'.

James W. Neill  
Professor and Head