University of Georgia

Proposal

for

Master of Science with Major in Engineering

Institution: University of Georgia  Date: May 23, 2011

College/Unit: Institute of Faculty of Engineering

Name of the Proposed Program: Master of Science with major in Engineering

Degree: M.S.  Major: Engineering

Starting Date: Fall 2012

Approved by: E. Dale Threadgill, Director, Faculty of Engineering

Sr. Vice President and Provost

President of the University

Prepared by the Faculty of Engineering:
William Kisaalita, Faculty of Engineering, Biological and Agricultural Engineering
Brahm Verma, Faculty of Engineering, Biological and Agricultural Engineering
1. PROGRAM ABSTRACT

Provide in a one or two page abstract a summary of the proposed program. This section should be written in a manner suitable for presentation to the Board of Regents and should briefly state the objectives of the program, identify the needs which the program would meet, and include information related to costs, curriculum, faculty, facilities, desegregation impact, enrollment, etc.

This is a proposal from the University of Georgia (UGA) Faculty of Engineering (FE) to offer a “Master of Science with major in Engineering” degree. Its goals are a) to educate engineers with advanced technical and professional knowledge and adaptability to innovate in the global competitive environment of the 21st Century, and b) to prepare and motivate students for subsequent Ph.D. degree programs devoted to advanced research training. Specific objectives are:

1. To graduate engineers with broad training in science and engineering oriented to problems of unprecedented complexity that transcend classical academic disciplines;

2. To provide a rigorous, adaptive curriculum and research environment that prepares students to integrate discoveries from multiple fields and address multi-scale problems beyond the bounds of traditional engineering disciplines.

Beyond broad technical literacy, the graduates are expected to have an entrepreneurial mindset and a propensity for adapting to an unpredictable future. This program is consistent with the University of Georgia’s social contract as a land- and sea-grant institution to provide citizens of Georgia with opportunities to study and learn, to expand the bounds of old knowledge, to discover new knowledge, and to improve the quality of life.

Graduate degree programs are the backbone of a research university. Graduate students are a critical link to frontier research. Outstanding faculty cannot be recruited without access to outstanding graduate students. The proposed degree will enable the creation of advanced technologies through discoveries of scientific research, particularly in biological and other complex systems where the University of Georgia has nationally prominent programs, and also meet society’s future needs for engineers who are integrators, innovators and problem solvers in the complex-interconnected world of globalization. The proposed M.S. in Engineering degree is not designated to any specialized engineering discipline or field but open to making new and unique connections with disciplines and fields of study important for future needs. As compared to a M.S. in a “named” area of engineering (e.g., Mechanical Engineering or Electrical Engineering), the M.S. in Engineering will encourage exploration of new engineering approaches and would not require renaming the degree with the emergence of new engineering fields. The rigor for quality and an open structure for connecting and integrating for solving problems at the interstices of complex webs are what this degree will offer. Increasingly there are more nontraditional students who wish to interface multiple disciplines and choose an engineering degree at the graduate level after a degree in science or mathematics. These students bring additional perspectives to the graduate engineering experience. This is a direction by which future
engineering knowledge and practice will benefit. It will also provide leaders and scholars needed by the state and nation to maintain a leadership position in our highly competitive world.

Addressing the question of student demand passively by only considering past trends, (i.e., number of U.S. engineering graduates and job projections) is not likely to serve the region well in the future and create the desired Global Georgia. While addressing the market for engineers, Charles Vest, President of the National Academy of Engineering, asked: “The world is changing remarkably fast, and leadership in science and engineering will drive it. Where will this leadership come from? China? India? The United States? The choice is ours to make.” Studies report that Georgia relies on immigration from other states and other countries to fill nearly half of all engineering jobs in the state, and less than two-thirds of the qualified Georgia high school graduates (SAT scores of 1100 to 1600) with an expressed interest in majoring in engineering were enrolled in engineering in USG institutions of higher education. Additionally, the University System of Georgia (USG) is expecting a continued increase in enrollment in the coming decade. No institution in the state offers a M.S. in Engineering degree similar to the proposed degree objectives.

The University of Georgia, with the arts, humanities and all sciences underpinning engineering, provides the opportunity to develop genuine engineering scholars and thinkers capable of integrating diverse perspectives and innovating solutions for problems in commerce, finance, education, health care, infrastructure, transportation, communication, and many other sectors of interacting societies. This degree at UGA will be supported by exceptional faculty and outstanding facilities in sciences and arts and a series of interdisciplinary centers of excellence. UGA faculty and academic resources will support needs for the degree through the new engineering program recently approved and funded.

UGA has a very strong commitment to recruiting students from underrepresented groups. Under the leadership of President Michael Adams the University has made significant progress. The open structure that invites non-traditional students and opportunity to integrate such disciplines as biology, ecology and public health are particularly attractive to women and other underrepresented groups. This program will actively recruit students and faculty from these groups and build partnerships with colleges and universities whose student body is predominantly from them. UGA already has more than 50 percent women students who will be targeted for this degree program. Partnerships with the Honors program and active participation with the Center for Undergraduate Research Opportunity (CURO) will invite outstanding undergraduate non-engineering majors to this program. There is strong evidence that public health, biology, ecology/environment, and sustainable systems and technology and social interplays attract women and underrepresented minorities.
2. **OBJECTIVES OF THE PROGRAM**

List the program objectives and indicate how they are related to the mission and strategic plan of the institution, as filed with the Office of the Vice Chancellor for Research and Planning.

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Specific objectives are:

1. *To graduate engineers with broad training in science and engineering oriented to problems of unprecedented complexity that transcend classical academic disciplines;*

2. *To provide a rigorous, adaptive curriculum and research environment that prepares students to integrate discoveries from multiple fields and address multi-scale problems beyond the bounds of traditional engineering disciplines.*

Beyond the broad technical literacy, the graduates are expected to have an entrepreneurial mindset and a propensity for adapting to an unpredictable future.

This program is consistent with the University of Georgia's social contract as a land- and sea-grant institution to provide citizens of Georgia with opportunities to study and learn, to expand the bounds of old knowledge, to discover new knowledge, and to improve the quality of life.

UGA’s Strategic Plan, *The First Decade of the 21st Century*, included “Comprehensive Engineering: A Strategic Institutional Initiative.” The goal of this initiative was to establish new academic studies in engineering and research inspired simultaneously by considerations of use and by the quest for fundamental understanding. It would not pursue a traditional model with separated departments and academic specialties, but would instead implement an evolutionary approach designed to bring many disciplines to bear on the complex problems of our time.

The UGA Faculty of Engineering has been a model for this since its inception on October 1, 2001. The present proposal mirrors the essential interdisciplinarity of the FE, and now endeavors to take this to the next level by forging it into a formal graduate academic program inspired by the same goals that not only serve UGA’s Strategic Plan, but also the University System of Georgia’s (USG) Strategic Goals as follows:
USG Strategic Goal 1 – Renew excellence in undergraduate engineering education to meet students’ 21st century educational needs

Graduate students enrolled in the proposed MS-E degree program will be exemplars for undergraduate engineering students and will create a “near-peer” learning environment that contributes to undergraduate engineering education excellence.

USG Strategic Goal 2 – Create enrollment capacity to meet needs of 100,000 additional students by 2020

The proposed MS-E degree will add enrollment capacity to meet the increasing demand in Georgia and the nation for innovative, U.S.-educated engineers.

USG Strategic Goal 3 – Increase the USG’s participation in research and economic development to the benefit of a Global Georgia.

The central objective of the proposed MS-E degree is to address this strategic goal. Graduates of the program will fill a key role in the continuum between discovery and knowledge transfer to innovative technology, and will serve as a lynchpin in the “Global Georgia” concept.

USG Strategic Goal 4 – Strengthen the USG’s partnership with the state’s other education agencies.

This proposed major in “Engineering” is an important element in the education of engineers for 2020 and beyond. The degree will be adaptive and responsive to opportunities accorded by unpredictable combinations of discoveries from the multiple fields of science. In Georgia, the University of Georgia is uniquely positioned to offer a M.S. degree with these unique characteristics because of its academic programs in all areas of sciences, applied sciences, humanities and the arts, as well as the recent addition of public health and medicine. This proposed degree program does not duplicate other engineering programs, rather it complements them and promises to create an environment in which students will be catalysts and faculty will forge partnerships with other USG institutions to benefit from their strengths, and they from ours.
3. **JUSTIFICATION AND NEED FOR THE PROGRAM**

a. Indicate the societal need for graduates prepared by this program. Describe the process used to reach these conclusions, the basis for estimating this need, and those factors that were considered in documenting the program need.

During the past five years numerous studies have concluded that there are growing concerns about the need for more U.S.-educated engineers, and for future engineering to differ from past engineering to better address the needs of the 21st century. The most compelling studies are:


*Moving Forward to Improve Engineering Education*, National Science Board (NSB, 2007)

*The National Innovation Initiative, Council of Competitiveness* (Council of Competitiveness, 2006)


*Engineering Research and America’s Future: Meeting the Challenges of a Global Economy*, National Academy of Engineering (Duderstadt, 2005)


These studies conclude that *globalization* across many fronts will call upon the new engineers to interact with other citizens of the world, technical and nontechnical, to solve problems that transcend traditional boundaries of nation-states. These problems will not be locally contained in time and space, but will instead be distributed and hidden in the interstices of *complex webs* of interconnection – in commerce, finance, education, health care, infrastructure, transportation, communication, and many other sectors of interacting societies.

Engineering has many definitions. Joseph Bordogna, former Deputy Director of the National Science Foundation, found Fumio Kodama’s definition poignant: "Engineering is the integration of all knowledge to some purpose.” Unlike the specialized characteristic of scientific inquiry, engineers are society’s master integrators. They work across different disciplines and fields, make connections for deeper insights to understand the intricacies of the problems and imagine creative solutions; in other words, they are onto getting things done. Thus, engineering education is under increasing pressure to move away from specialization to a more comprehensive education that better connects and integrates discoveries and knowledge of multiple fields.

The University of Georgia began focusing on the changing engineering needs and their importance to Georgia and the nation in 1992. Over the years it studied emerging trends
influenced by the growing understanding of complex systems and holistic approaches in engineering. UGA Engineering organized university-wide symposia and discussions with national leaders and visited change-making programs such as Olin College in Needham, MA. It began implementing actions to address these changes; some of these precede the first high-profile national report published in 2005 listed above. In 2001, UGA established the Faculty of Engineering with the central objective “to increase opportunity for learning, research and outreach at the confluence of disciplines – preparing students for careers devoted to the integration of discoveries from multiple fields.” The three undergraduate degrees proposed by the Faculty of Engineering in 2003 and approved by the Board of Regents in 2005, were designed to move away from classical specializations to a more comprehensive engineering education in a liberal arts environment. The character and content of these proposals addressed the critical conclusions of the aforementioned studies.

Another factor looms in the coming times as well. With the accelerating growth of technical knowledge and need to make connections with other fields of study, it is becoming evident that it is no longer possible to build the content of the four-year undergraduate engineering curriculum that meets the needs of this profession. Today, engineering is one of the very few knowledge-intensive professions that require only the undergraduate degree for professional status. The inadequacies of the undergraduate degree for professional practice are increasingly causing employers to look for Master’s or Ph.D. graduates for technical work. Building a baccalaureate through doctoral level continuum of engineering education at UGA is important for meeting the future needs of the state, region and nation and it is critical for the engineering profession.

Graduate degree programs at the Master’s level are essentials of a research university. They prepare students for the practicing of the profession with high technical competency. The Master’s degree is also a valuable apprenticeship for entering the Ph.D. degree and a critical link for preparing to do frontier research. Outstanding faculty cannot be recruited without access to outstanding graduate students. The proposed degree will enable the creation of technological solutions and meet society’s future needs for engineers who are integrators, innovators and problem solvers in the complex interconnected world of globalization. The proposed M.S. in Engineering degree is not designated to any specialized engineering discipline or field but open to making new and unique connections with disciplines and fields of study important for future needs. As compared to a M.S. in a “named” area of engineering (e.g., Mechanical Engineering or Electrical Engineering), the M.S. in Engineering will encourage exploration of new engineering approaches and would not require renaming the degree with the emergence of new engineering fields. The rigor for quality and an open structure for connecting and integrating for solving problems at the interstices of complex webs are what this degree will offer. Increasingly there are more nontraditional students who wish to interface multiple disciplines and choose an engineering degree at the graduate level after a degree in science or mathematics. These students bring additional perspectives to the graduate engineering experience. This is a direction by which future engineering knowledge and practice will benefit. It will also provide leaders and scholars needed by the state and national to maintain a leadership position in our highly competitive world.
b. Indicate the student demand for the program in the region served by the institution. What evidence exists of this demand?

The University System of Georgia’s (USG) Strategic Goal Three is to “Increase the USG’s participation in research and economic development to the benefit of a Global Georgia.” Georgia must increasingly compete not only within fifty states, but also with other countries, create and attract intellectual resources, draw the best talent, and control its own future in a global economy. To achieve this strategic goal Georgia has to increase the number of scientists and engineers in its workforce and, thus, move up from being the 40th state in this category (The U.S. Council of Competitiveness, 2000).

The projection of student demand for the proposed M.S. in Engineering requires a study not only of the historic student enrollment in engineering programs in Georgia and the United States (which is projected to increase by 11% between 2006 and 2016) but also the consideration of factors that may affect an increase in engineering enrollments due to new opportunities and new engineering approaches proposed herein.

Currently at the undergraduate level, the U.S. produces only 8% of engineers globally each year, and only 4.5% of college students major in engineering as compared to 12% in Europe and 40% in Asia. The number of U.S. baccalaureate engineering graduates peaked to 85,000 in 1985 but then dropped by over 24,000 to 61,000 in mid-1990s. It seems to have stabilized at about 74,000 in 2007. This rate of graduation provides a small pool of students for U.S. engineering graduate programs. Such a small number of engineering graduates is grossly inadequate to fill a reasonable percent of even Master’s level seats (which peaked at 91,000 students in 2003) with U.S. graduates. As graduate degrees continue to become requirements for engineering practice, building a strong continuum of undergraduate and graduate engineering education is essential to meeting state and national needs.

In 2006, the U.S. graduated over 39,000 Master’s degree engineering students (total enrollment was 83,000) and over 8,300 Ph.D. students (total enrollment was 57,000). Nearly 40% of the engineering Master’s degree recipients and 61% of the new engineering Ph.D. degrees were granted to foreign nationals. In 2006, China graduated 8,000 Ph.D. degrees, nearly the same as the U.S. While the change in number of Ph.D. engineering graduates in the U.S. is modest, China is doubling its Ph.D. graduation rate every 5 years.

Addressing the question of student demand passively by only considering past trends, (i.e., number of U.S. engineering graduates and job projections) is not likely to serve the region well in the future and create the desired Global Georgia. Charles Vest (President Emeritus of MIT and the current President of NAE) stated that no one can look at today’s market for engineers and predict what students will experience in 30 years. Then he puts the question to us: “The world is changing remarkably fast, and leadership in science and engineering
will drive it. Where will this leadership come from? China? India? The United States? The choice is ours to make” (Clark Kerr Lectures. University of California Press, 2005).

The proposed M.S. in Engineering with its focus on future engineering that integrates disciplines will be attractive not only to students with engineering degrees, but also to talented graduates from other disciplines, particularly the graduates of science and mathematics. Engineering knowledge is increasingly driven by the complexity of such fields as biology and ecology as well as by systems science rather than the current and past reductionism of physics and engineering practice. Future engineering education must accommodate globalization affecting technology, commerce and politics. Many non-engineering graduates interested in solving problems in these complexities will be attracted to this degree program.

UGA, as one of the nation’s leading research universities with extensive leadership in many areas of science, humanities and arts, and a prime engine of the state’s economic and human development, will provide unique opportunities to students enrolled in the proposed degree program. The heightened interplay between sciences and engineering and research and development at UGA will prepare highly competent next generation engineers ready to lead in the integration of knowledge for revealing and understanding complex problems and creating futuristic technological solutions.

c. Give any additional reasons that make the program desirable (for example, exceptional qualifications of the faculty, special facilities, etc.)

The University of Georgia, the largest and most culturally diverse campus in Georgia with the arts, humanities and all sciences underpinning engineering, uniquely provides opportunity to develop genuine engineering scholars and thinkers capable of integrating diverse perspectives and innovating solutions for problems in commerce, finance, education, health care, infrastructure, transportation, communication, and many other sectors of interacting societies. This degree at UGA will be supported by exceptional faculty and outstanding facilities in sciences and arts and a series of interdisciplinary centers of excellence. For example, distinguished faculty in biological and physical sciences and in applied sciences addressing issues related with energy, health, infectious diseases, environment and bio- and natural-resource systems, and many prominent research centers and laboratories, are most valuable and required resources for the proposed degree.

Recognizing that strong graduate programs are critical to the future of the University, the Provost and the Dean of the Graduate School charged a 28-member Task Force in September 2006 to provide recommendations on three major challenges facing the quality of graduate education in all areas of the academy: Innovation, Interdisciplinarity, and Inclusiveness. The proposed degree, accessible to students from multiple disciplines with open structure to form connections and integration, has a high potential for meeting the three challenges. Students who are graduates of multiple disciplines will naturally build a culture of interdisciplinarity. Because of the comprehensiveness of the University of Georgia, it is positioned to offer this degree like no other institution in the State of Georgia.
d. Include reports of advisory committees and supporting statements of consultants, if available.

Georgia needs more engineers. While Georgia’s growth and its stature among states rose in the decade of the 90’s in some important categories (for example, 4th in population growth, 8th in venture capital investment, and 8th in start-up companies), it ranked 40th in the nation in percentage of engineers and scientists in its workforce [The U.S. Council of Competitiveness, 2000 Report]. The February 2002 report by the Washington Advisory Group [Commissioned by the University System of Georgia Board of Regents] notes that Georgia relies on immigration from other states and other countries to fill nearly half of all engineering jobs in the state.

There is also a need to increase the state of Georgia’s capacity for engineering education. Another University System of Georgia (USG)-commissioned report on engineering education needs published in 1998 presented data showing that less than two-thirds of the qualified Georgia high school graduates (SAT scores of 1100 to 1600) with an expressed interest in majoring in engineering were enrolled in engineering in USG institutions of higher education. The Georgia Financial Commission recognized the need for Georgia to graduate more engineers when it created, under the HOPE Scholarship Program, a “Scholarship for Engineering Education (SEE)” with the objective “To provide service-cancelable loans to Georgia residents who are engineering students at private accredited engineering universities in Georgia and retain them as engineers in the State.” With the increasing need for Master’s and Ph.D. degree engineers to enter and succeed in the engineering profession, the adding of capacity to offer graduate degrees is becoming imperative for future engineering.

Since 2001, prominent participants in the UGA organized engineering symposia, numerous invited distinguished guest-lectures (including the immediate past president of NAE and the President of Olin College) and the UGA Engineering Advisory Board composed of nine distinguished leaders from industry, government and academia have commended the UGA Faculty of Engineering as both innovative and farsighted. They have unanimously and strongly recommended the addition of Master’s and Ph.D. degrees molded in the conceptual framework of the UGA Comprehensive Engineering and the UGA Engineer profile. The proposed degree is molded by these views that also align with the recommendations of the several cited NAE and the University of Michigan Millennium Project reports published since 2005.

e. List all public and private institutions in the state offering similar programs. If no such program exists, so indicate.

No institution in the state offers a M.S. in Engineering degree similar to the proposed degree objectives.
Georgia Institute of Technology’s M.S. degrees in engineering are offered by several disciplinary units with commensurate disciplinary objectives. Its bioengineering program is an interdisciplinary degree available to most of the engineering academic units interfacing aspects of biology in their disciplinary perspectives.

4. PROCEDURE USED TO DEVELOP THE PROGRAM

Describe the process by which the committee developed the proposed program.

This proposal for a new graduate degree is a result of a deliberate process initiated in 1999 in response to the University’s Strategic Plan for the First Decade of the 21st Century.

In February 2000, a position paper prepared by Professors Brahm Verma and Dale Threadgill entitled “Comprehensive Engineering at UGA” was submitted to the Vice President for Strategic Planning with the request that Engineering be included as a Strategic Issue in the University’s Strategic Plan. The “Comprehensive Engineering at UGA” paper identified Georgia needing more engineers and how the University of Georgia had the responsibility and capacity for developing new approaches for future engineering. It proposed a strategic approach to build engineering in a new way and advance the institution's capacity for meeting not only the shortage of engineers, but also for educating engineers of the future. It demonstrated that Comprehensive Engineering will add new dimensions to the University that will provide advanced technology for research in highly complex systems, including biology and ecology and the ability to rapidly translate scientific discoveries into technology. The University Strategic Planning Advisory Board included Engineering as a new Strategic Institutional Initiative, and it is now a part of the UGA Plan for the first decade of the millennium.

In April 2001, a Symposium, Towards 2010: Comprehensive Engineering at UGA, was held to engage UGA faculty from across campus in a daylong effort to identify engineering initiatives of significance and to articulate ways in which Comprehensive Engineering will strengthen a range of UGA programs. More than 100 faculty members from 9 Colleges/Schools participated in the Symposium. Thirteen faculty members highlighted engineering opportunities in research, graduate and undergraduate studies, and outreach. Their perspectives represented the disciplines of physics, chemistry, pharmacy and health sciences, biochemistry and molecular biology, veterinary sciences, computer science, mathematics, ecology, marine sciences, environmental sciences, textile science, food science, business and engineering. They identified the important dimensions in which the University’s current programs are unable to grow due to lack of Comprehensive Engineering at UGA and shared experiences on how the University has been handicapped in capitalizing on opportunities for meeting the needs of the state of Georgia. At that time (i.e., in 2001) the UGA faculty identified the following ten engineering program areas as high priority needs and opportunities: bioprocess/biochemical engineering, metabolic engineering, pharmaceutical engineering, nanotechnology, ecological/environmental engineering, information/computer systems engineering, sensors and controls, marine engineering,
engineering management and engineering education. A task committee with membership including UGA faculty from diverse but related disciplines was formed for each of these program areas and charged with further developing the needs and opportunities. Another task committee was charged with proposing ideas to create an innovative approach for organizing Comprehensive Engineering at UGA. The concept of a Faculty of Engineering originally proposed in the “Comprehensive Engineering at UGA” document was recommended. The UGA Faculty of Engineering was formally established on October 1, 2001, with Dr. E. Dale Threadgill appointed as its Director.

To gain insight from state and national leaders about building programs in the UGA Faculty of Engineering, a second daylong Symposium, Towards 2010: Faculty of Engineering at UGA, was organized with invited leaders from industry, business, government agencies and academia participating. The Symposium, held in April 2002, was open to the UGA faculty. More than 100 individuals attended the Symposium. UGA President Michael Adams in his opening remarks explained the needs for engineers in the state of Georgia. He cited the February 2002 report, prepared by a Washington Advisory Group commissioned for the Board of Regents, conclusively stating that Georgia relies on immigration from other states and other countries to fill nearly half of all engineering jobs in the state. President Adams further stated, “UGA has a social and charter responsibility as Georgia’s flagship institution to provide innovative services for the economic development of the state. Engineering is a key linchpin in this effort.” Dean Kristina Johnson from Duke University (now Provost and Senior Vice President of academic Affairs at Johns Hopkins University) stated that a “modern research university is incomplete and obsolete without comprehensive engineering.” Discussions during breakout sessions reinforced the need for engineering in the program areas identified at the 2001 Symposium as well as identified new opportunities with biomedical engineering. At the conclusion of the April 2002 Symposium, the UGA Faculty of Engineering established several task groups and charged them with developing academic programs and other recommendations for meeting the identified engineering needs.

These seminal events began a course for the development of Comprehensive Engineering at UGA. Actions listed below have been key contributors to the process of identifying the need for the proposed degree.

- Since 2002, receiving regular advice and recommendations of the UGA Engineering Council (made up of UGA faculty from multiple disciplines) who study future trends and review progress of Comprehensive Engineering at UGA.
- Since 2003, studies to identify future engineering directions and needs that led to successful undergraduate and graduate degree proposals in BioChemical Engineering and Environmental Engineering built from the “systems and engineering ecology” prospective, and an undergraduate degree in Computer Systems Engineering.
- In 2006, the UGA Think Tank report defined the profile for a UGA Engineer. This recommendation formed the core for UGA engineering program curricula and the basis for the recruitment of faculty and students.
- In 2007, Dr. William Wulf, the Immediate Past President of the National Academy of Engineering (NAE) during his visit to UGA for the inaugural presentation in the
Distinguished Engineering Lecture Series commended the UGA’s foresighted approach to engineering and identified the importance of M.S.- and Ph.D.-level degree programs for furthering the vision of Comprehensive Engineering and the University of Georgia’s research and educational mission.

- In 2008, the Faculty of Engineering Advisory Board in its inaugural meeting in November made strong and unequivocal recommendation for the need for graduate-level engineering degrees. They also recommended that the degree should be “Engineering” with the flexibility to create new and unique integrations for solving problems of the future.

This proposal is a result of these deliberate efforts. The faculty and student participants in this program will be from all corners of the University. The program will attract outstanding students with engineering and non-engineering degrees. The range of the development of future technology for solving complex problems will exceed the norms of the past. In Georgia, the Georgia Institute of Technology offers numerous discipline-based engineering M.S. degrees. No institutions in the state offer a M.S. in Engineering degree.

The philosophy of engineering on the UGA campus was the guiding framework in preparing this M.S. in Engineering program. The proposal was prepared with the support and input of faculty in UGA Engineering and related UGA Colleges/Schools.

5. CURRICULUM

List the entire course of study required and recommended to complete this degree program. Give a sample program of study that might be followed by a representative student. Indicate also the existing courses and any new courses that will be added. Append a course description for existing courses as well as new courses that will be added.

Requirements for the MS-E degree will include completion of course requirements in compliance with the University of Georgia Graduate School requirements. That is, a student’s program of study will include a minimum of 24 semester credit hours, 12 of which must be from UGA courses open to only graduate students exclusive of thesis. The 12 hours may not be satisfied by transfer credit, Master’s research (7000), thesis writing (7300), or independent study courses. To receive the MS-E degree, each student will be required to present a satisfactory research proposal approved by the advisory committee and the graduate coordinator and pass a final examination and successfully defend the research thesis.

Each student will have an advisory committee consisting of a major professor and at least two additional members as per the University guidelines. The committee is responsible for ensuring the quality of the program of study and research. It is the prerogative of each student’s advisory committee, in consultation with the student, to plan and supervise all aspects of the Master’s study. The committee will be responsible for preparing the program
of study, administering examinations, and assessing quality of the thesis research in accordance with Graduate School requirements and accepted national standards.

The program of study of each student will be designed to achieve the objectives of the degree program. The required 9 hours of courses cover core topics: research methods, design methods, computational methods, entrepreneur skills, and seminar. The remaining courses are selected to provide fundamental knowledge in the selected areas of sciences for interfacing with engineering, advanced engineering sciences, and enabling mathematical sciences (including statistics and computational methods) to build the foundation for scholarly inquiry and creating innovative solutions. Four sample programs of study are presented below, each showing a different field of interest in engineering.

**SAMPLE #1**
**M.S. in Engineering**
(Students integrating biology with mechanics for problems of motion and device designs)

<table>
<thead>
<tr>
<th>Required Courses (9 hours)</th>
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<tbody>
<tr>
<td>ENGR 8910 (new) Research and Design Methods</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 6101, 8102, 8103 Computational Methods Modules</td>
<td>3</td>
</tr>
<tr>
<td>ENGG 8XX1, 8XX2 Technology Based Entrepreneurship</td>
<td>2</td>
</tr>
<tr>
<td>ENGR 8950 Graduate Seminar</td>
<td>1</td>
</tr>
<tr>
<td><strong>Additional Engineering Courses (12 hours)</strong></td>
<td></td>
</tr>
<tr>
<td>ENGR 8160 Advanced Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 8170 Advanced Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 8180 Advanced Mass Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 4760/6760 Biomechanics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 4350/6350 Introduction to Finite Element Analysis</td>
<td>3</td>
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<tr>
<td><strong>Other Courses (7 hours)</strong></td>
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<tr>
<td>CSCI 4810/6810 Computer Graphics</td>
<td>4</td>
</tr>
<tr>
<td>STAT 6310 Statistical Analysis I</td>
<td>3</td>
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<tr>
<td><strong>Total</strong></td>
<td>27-28</td>
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**SAMPLE #2**
**M.S. in Engineering**
(Students integrating biochemical and biological processes and genetics for designing innovative industrial processes)

<table>
<thead>
<tr>
<th>Required Courses (9 hours)</th>
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<tbody>
<tr>
<td>ENGR 8910 (new) Research and Design Methods</td>
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<td>1</td>
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<tr>
<td><strong>Additional Engineering Courses (12 hours)</strong></td>
<td></td>
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<tr>
<td>ENGR 4510/6510 Biochemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 4520/6520 Design of Biochemical Separations Processes</td>
<td>3</td>
</tr>
</tbody>
</table>

1 Each of the three courses is 1 semester hour credit
ENGR 6530  Monitoring and Control of Biological Processes  3
ENGR 8160  Advanced Fluid Mechanics  3

Other Courses (6 hours)
STAT 6310  Statistical Analysis I  3
ADSC 6110-6110L  Experimental Methods in Animal Biotechnology  3  27-28

SAMPLE #3
M.S. in Engineering
(Students integrating advanced computational methods to develop information engineering)

Required Courses (9 hours)
ENGR 8910 (new)  Research and Design Methods  3
ENGR 6101, 8102, 8103  Computational Methods Modules  3
ENGG 8XX1, 8XX2  Technology Based Entrepreneurship  2
ENGR 8950  Graduate Seminar  1

Additional Engineering Courses (9 hours)
ENGR 4230/6230  Sensors and Transducers  3
ENGR 4250/6250  Advanced Microcontrollers  3
CSCI(ENGR) 8940  Computational Intelligence  4

Other Courses (8 hours)
CSCI 8060  Advanced Software Engineering  4
CSCI 8470  Advanced Algorithms  4  25-26

SAMPLE #4
M.S. in Engineering
(Students integrating ecological/environmental systems and public policy for solving problems affecting public policy)

Required Courses (9 hours)
ENGR 8910 (new)  Research and Design Methods  3
ENGR 6101, 8102, 8103  Computational Methods Modules  3
ENGG 8XX1, 8XX2  Technology Based Entrepreneurship  2
ENGR 8950  Graduate Seminar  1

Additional Engineering Courses (12 hours)
ENGR 6410  Open Channel Hydraulics and Sediment Transport  3
ENGR 4440/6440  Environmental Engineering Unit Operations  3
ENGR 4450/6450  Environmental Engineering Remediation Design  3
ENGR 8580  Compost Facility Engineering  3

Other Courses (6 hours)
ENVM 4650/6650  Environmental Economics  3
ECON 4400/6400  Economics of Public and Regulated Enterprises  3  26-27

6. INVENTORY OF FACULTY DIRECTLY INVOLVED
The University of Georgia currently offers M.S. and Ph.D. degrees in five engineering areas. UGA also offers ABET-accredited undergraduate engineering degrees. All required courses in arts and sciences are already available from the UGA Franklin College of Arts and Sciences. Ten engineering faculty members currently offer core engineering science courses. The Faculty of Engineering has more than 60 UGA faculty with engineering degrees that provide a wide range of opportunity for graduate students in this degree program. The need for additional faculty is presented in Section 15.

The faculty who will be directly involved with the proposed degree program are listed below. Additional data on these faculty is provided in Appendix B.

Dr. Mark Haidekker, Faculty of Engineering
Dr. Jenna Jambeck, Faculty of Engineering
Dr. Kyle Johnsen, Faculty of Engineering
Dr. Caner Kazanci, Faculty of Engineering, Mathematics
Dr. William Kisaalita, Faculty of Engineering, Biol. & Agri. Engineering Dept.
Dr. Peter Kner, Faculty of Engineering,
Dr. Ke Li, Faculty of Engineering
Dr. Jason Locklin, Faculty of Engineering, Chemistry
Dr. Sudhagar Mani, Faculty of Engineering, Biol. & Agr. Engineering Dept.
Dr. Leidong Mao, Faculty of Engineering
Dr. Zhengwei Pan, Faculty of Engineering, Physics and Astronomy
Dr. John Schramski, Faculty of Engineering
Dr. Andrew Sornborger, Faculty of Engineering, Mathematics
Dr. William Tollner, Faculty of Engineering, Biol. & Agr. Engineering Dept.
Dr. Joachim Walther, Faculty of Engineering

7. OUTSTANDING PROGRAMS OF THIS NATURE IN OTHER INSTITUTIONS

List three outstanding programs of this nature in the country, giving location and name of official responsible for each program. Indicate features that make these programs stand out.

The University of Georgia’s proposed M.S. in Engineering degree will provide students freedom to explore in whatever combination of disciplines that are needed and prepare them for the profession and academic inquiry as leading experts in the field. Dartmouth College offers an M.S. in Engineering with foci in three impact areas: Engineering in Medicine, Energy Technologies, and Complex Systems. Harvard University recently revived its engineering program and formed a School of Engineering and Applied Sciences in the Faculty of Arts and Sciences. It now offers an M.S. in Engineering Sciences for keeping the interdisciplinary nature of modern research. Thus, these two programs stand out for the similarity in educational approaches and their contact information is listed below.

Dr. Joseph J. Helble, Dean
Thayer School of Engineering at Dartmouth College

Dr. Cherry A. Murray
Dean, Harvard School of Engineering and Applied Sciences
However, whereas the University of Georgia is a state-supported, land-grant university, both Dartmouth College and Harvard University are private institutions without the land-grant mission.

Three land-grant universities that are highly motivated for incorporating interdisciplinarity in their graduate-level engineering degrees and exhibit several features proposed in this M.S. in Engineering proposal are the University of Florida, Purdue University and University of California at Davis. Contact information for these institutions is listed below:

Dr. Cammy Abernathy, Dean
College of Engineering, University of Florida

Dr. Leah H. Jamieson, Dean
College of Engineering, Purdue University

Dr. Bruce White, Dean
University of California, Davis

8. INVENTORY OF PERTINENT LIBRARY RESOURCES

The University of Georgia Library has several campus units. It has a comprehensive collection in arts, sciences and professional subjects and has an archival section that holds special historical documents. The Library has been a member of the Association of Research Libraries, a nonprofit organization of 122 of the largest research libraries in the U. S. and Canada, since 1967. In 2000, UGA was ranked 35th in the total number of volumes and 9th in total number of current serials owned.

The UGA Library is the largest in the state with over 3.8 million volumes. On-line access to full text journals and serials is available both through a consortium of UGA, Emory, Georgia Tech, Georgia State and Medical College of Georgia, and directly to the University of Georgia libraries. In addition, UGA is a leader nationally in offering electronic access to a wide range of electronic resources, including journal articles in full text. The statewide GALILEO system provides electronic access to hundreds of databases, including Chemical Abstracts, Engineering Index, Bioengineering Abstracts, Current Contents, etc. The University subscribes electronically to over 1000 Elsevier titles and to all titles published by Academic Press, Marcel Dekker, Spring Verlag, and Wiley Interscience.

The University Libraries have excellent print and electronic resources, particularly in chemistry, biological sciences, physics, mathematics and computer sciences, ecology and environmental sciences, agricultural sciences and earth sciences. The University of Georgia Science Library would provide the primary resource and support for the proposed program. Some relevant Science Library inventory and operational information is listed below.
a) Total volumes - 750,000 and its catalog is available over the Internet.
b) Volumes pertaining to the engineering and technology – nearly 100,000 and materials accessible via the Internet.

Generally, basic texts and references are available; however, some expansion will be needed as described in the following section.

State of Faculty Instructional Support and Additional Support Needs

State of collections in engineering sciences for the proposed degree programs is as follows:

- Reference Collection: Adequate, but update will be required
- General Book Collection: Additional books on engineering will be needed
- Periodicals, current: Additional engineering periodicals will be needed
- Serials: Adequate
- Documents: Adequate

Projection

The Science Library has made steady progress in upgrading technical holdings. With modest designated funding increases, the library should provide good support for the proposed program. Ongoing improvement in the Science Library holdings will complement the engineering resources.

Additional Information on Library Resources

The Science Library provides reference help, interlibrary loan, circulation and collection development. It has 26 full-time staff including 8 librarians. It has about 750 seating capacity and is open 99.5 hours per week.

The University of Georgia Libraries' fiscal year Total Expenditures show a steady growth.

FY-02 $21,545,504
FY-03 21,010,793
FY-04 21,544,004
FY-05 22,679,865
FY-06 23,014,039
FY-07 23,703,488
FY-08 24,451,142

Georgia Institute of Technology library would also be available to supplement the University’s resources in engineering.

9. FACILITIES
Describe the facilities available for the program. What new facilities and equipment are required?

The University of Georgia has extensive facilities available for the proposed degree program. The following is a selective list most related to the proposed program that gives the range and quality of facilities available for both undergraduate and graduate education.

A. Athens Campus

Instruction Labs:

**Applied Machine Vision Laboratory**: The Applied Machine Vision laboratory supports a course designed to provide students with experience in machine vision systems.

**Bio-Photonics Laboratory** is involved in optical sensing and optical imaging using the visible light spectrum. This includes fluorescent spectroscopy (some instruments are custom-designed to accommodate mechano-sensitive fluorescent molecular rotors), fluorescent imaging, fluorescent microscopy, laser-induced fluorescence. In addition, the lab has the capability of optical coherence tomography and a custom scattered-light confocal scanner exists. There are plans to add X-ray imaging and computed tomography with a custom-built instrument.

**Electronics and Electrical Laboratory** houses comprehensive facilities for teaching basic and advanced courses in electrical and electronic systems.

**Engineering Design Studio** provides dedicated computer facilities for rapid prototyping and CNC machining. Undergraduates enrolled in the sophomore-level Design Methodology course and the senior-level Engineering Project course are required to design, prototype and analyze a new product that meets a real-world need. Projects in these courses are typically sponsored by industry and are used by the companies to solve current problems.

**Engineering a Sustainable Environment**: The laboratory is located at Whitehall Bioconversion Center and is used in courses which focus on environmental monitoring, modeling and process design, solid waste management, hazardous waste management and concepts of risk assessment.

**Fluid Mechanics Laboratory** houses comprehensive facilities for teaching basic and advanced courses in electrical and electronic systems.

**General Computing Undergraduate Study Lab** occupies approximately 1228 ft² and is designed to provide general-purpose computing for undergraduates. This Study Lab is accessible to students for 90 hours per week.

**Industrial Controls Laboratory** is a teaching laboratory which exposes students to motor controllers and programmable logic controllers that are used in industrial control environments.

**Instructional Computer Laboratory** supports courses that require programming and specialty software applications for Active Learning. This lab can be used for long-distance learning and on-line learning courses.
**Materials Testing Laboratory:** The laboratory is equipped to perform: 1) testing of engineering materials and biological materials, 2) properties of soils and granular materials, 3) load cell testing and calibration and photoelastic testing. This laboratory is equipped with equipment for measuring static and dynamics strains.

**Micro-mechatronics Laboratory** has 18 "Intellibrain" controller systems equipped with color vision systems, servo motors with wheel encoders, NIR and SONAR range sensors which can be used for various autonomous mechatronics projects.

**Robotics Laboratory:** This laboratory is design to support hands-on practice of robotics and mechatonics processes. This lab allows for the construction, programming and testing of multi-wheeled and multi-legged robots equipped with servo motors and sensors.

**Smallholder Technology Laboratory** focuses on research and development of products or processes to improve productivity among low income workers in developing countries. Research is done with undergraduate students through international capstone summer research experiences.

**Spatial Data Collection:** This laboratory provides fundamental capabilities for students to collect baseline data in collection, mapping and analysis of line-of-sight spatial data.

**Undergraduate Teaching Laboratories** include two laboratory/classroom areas which are dedicated to classroom labs. One laboratory is a dry lab and the other is a wet lab which contains hookups for gas, air, water and vacuum.

**Research Labs:**

- **Algae Laboratory** is dedicated to the growth of algae, including harvesting and conversion technologies at the bench and pilot scales.

- **Alternative Fuels and Solvents Laboratory** allows engineers to investigate the effects of different biological fuel mixtures on engine performance and reliability.

- **Analytical Laboratory** houses chromatography equipment for the chemical analysis of various materials.

- **Applied Electrostatics Laboratory** contains specialized high-voltage and low-current instrumentation facilitating the research and development of electrostatics processes for beneficial agricultural and biological applications.

- **Applied Machine Vision Laboratory** is equipped with fiber-optic spectrometers, video imaging equipment, light sources and computer-controlled X-Y translation stages for sample presentation, allowing VIS/NIR spectrometry, spectral imaging and basic/high speed image acquisition and processing capabilities. Equipment in this lab is accessible to students via the Web.

- **Bioassessment Laboratory:** Identification and characterization of benthic macroinvertebrates to support the watershed assessment research program. This laboratory is equipped with superb sampling equipment, D-frame and kick nets, and high resolution light microscopes.

- **Biochemical Laboratory** includes facilities for the maintenance of aerobic and anaerobic microorganisms, and for enzyme analysis.
**Bioconversion Laboratory** is equipped to monitor air quality, develop processing technology for solid waste conversion to composts, and evaluate the quality and safety characteristics of compost.

**The Bio-expression and Fermentation Facility** is housed within the Department of Biochemistry and is a molecular biology, protein and biomass production core facility.

**Biomass Processing Laboratory** includes preprocessing technologies such as pelletization, torrefaction, pyrolysis, solvent extraction, and hydrolysis, and includes conversion technologies such as pyrolysis, liquefaction, gasification, catalytic conversion, fermentation, and transesterification. A novel aspect of carbon cycling using bichar (a co-product of pyrolysis) is being studied as a soil carbon sequestration method that simultaneously provides significant agronomic benefits.

**Biomechanics/Gait Analysis Laboratory** is designed to analyze motion of bodies and evaluate tissue mechanics.

**Bio-Photonics Laboratory** is involved in optical sensing and optical imaging using the visible light spectrum.

**Biorefining Research and Education Center (BREC)** hosts a pilot thermochemical biorefinery. The pilot scale refinery system converts peanut hulls to hydrogen (or other fuels) and produces a carbon char co-product, biochar. This byproduct in itself holds tremendous potential for carbon sequestration and soil amendments, which are currently being researched.

**Cellular Bio-Engineering Laboratory** is equipped for a study of enzyme and cell-based sensing. Current focus is on research towards use of nano/micro structures to facilitate the implementation of three-dimensional cultures in drug discovery programs.

**Clean Room** consists of a 500-square-foot microfabrication space equipped with fume hood, DI water, gases, vacuum, exhaust system, air filtration system and chemical storage. The major equipment inside the clean room are one MJB3 mask aligner, one bench-top chemical spinner and one bench-top hot plate. It is designed to carry out fabrication processes for engineering and biomedical research.

**Fermentation Laboratory** is equipped for the growth of microorganisms and for the design of processes to optimize their use.

**Functional Nanomaterials Synthesis and Characterization Laboratory** is equipped with six well-controlled tube furnace synthesis systems, a field-emission gun scanning electron microscope attached with an energy-dispersive x-ray spectrometer, a spectrofluorometer, a UV-vis spectrometer and a variety of other nanomaterials synthesis equipment.

**Geographic Information Systems (GIS) Laboratory:** This laboratory contains workstations and PC’s, color plotters/printers/ high-quality scanners and a Calcomp digitizer to analyze spatial data. SPANS, Arc/Info, ArcView and ERDAS software packages are used in many applications to environmental engineering.

**Materials Testing Laboratory** is equipped for investigating the mechanical properties of
both physical and biological materials undergoing static and dynamic loading.

**MEMS Test and Characterization Laboratory (RBS)** is designed to carry out the research work for microelectromechanical systems (MEMS) device fabrication, testing and characterization.

**Microcontroller Laboratory** houses stations for data acquisition, analog and digital signal applications and machine control.

**Microscopy Laboratory** is equipped with an Olympus IX71 inverted microscope and a variety of lasers, optics, and electro-optic components for research and development of advanced microscopy techniques.

**Molecular Nano-bioengineering/Molecular Nano-bioelectronics Laboratory** houses equipment to investigate organic molecules, especially biological systems on the single molecular level.

**Office of the State Climatologist:** Extensive weather and climate impact data and computer models are available for design to meet Georgia’s environmental conditions.

**Optical Microscopy Laboratory:** This laboratory is being developed to enable research into novel techniques for the advancement of optical microscopy and imaging.

**Polymer Science and Engineering Laboratory (RBS)** includes 1500 square feet of laboratories used to synthesize and characterize polymeric materials.

**Processing Systems and Unit Operations Laboratory:** This laboratory focuses on process and material properties measurements and physical and biological process studies for optimizing energy and environmental pollution abatement.

**Research Shop:** All basic metal and wood working equipment are available.

**Tissue Biomechanics Laboratory** is designed for activities in analyzing the loading behavior of soft and hard animal tissues as well as plant materials.

**Virtual Experiences Laboratory** is equipped for research on the use and development of virtual, mixed, and augmented reality experiences.

**Water Quality Analysis Laboratory/Watershed Center** houses labs for analyzing physical, chemical, and biological characteristics of water samples.

**Watershed Assessment:** Extensive research programs combining bioassessments, physical habitat assessments, water quality analysis and hydrologic modeling. This laboratory offers workstations and PC’s for use in GIS analysis and computer modeling.

**B. Griffin Campus – Research Labs**

**Georgia Automated Weather Station Network and Agrometeorology Laboratory** Statewide Automated Environmental Monitoring Network (AEMN), consisting of over 58 automated weather stations that collect weather and other environmental variables on a continuous basis ([http://www.georgiaweather.net/](http://www.georgiaweather.net/)). An instrument laboratory allows for evaluation and calibration of sensors, data loggers, and other environmental equipment.
Crop Modeling Laboratory
Hardware and software for the development and application of crop simulation models, decision support systems, and Geographic Information Systems (http://www.icasa.net/index.html).

Envirotwon
Multi-disciplinary environmental control facility to study the interaction of environmental factors, including temperature, humidity, radiation, soil moisture, CO2, O3, and other trace gases, on plant growth and development. The facility currently includes nine large indoor growth chambers, eight greenhouses, and three movable controlled-environment sunlit growth chambers, and four rainout shelters.

Electronics Laboratory
Facilities and electronics equipment such as oscilloscopes, multimeters, and Labview software provide capabilities for developing sensors, instrumentation, data acquisition systems, and electronic devices needed for research, extension, and instruction programs.

Food Engineering and Packaging Laboratory
Facilities and electronics equipment such as oscilloscopes, multimeters, and Labview software provide capabilities for developing sensors, instrumentation, data acquisition systems, and electronic devices needed for research, extension, and instruction programs.

Postharvest Systems Laboratory
A pilot plant includes equipment for simulating commercial unit operations for fresh fruits and vegetables including: TEW packing line (wash, dry, inspect visually, wax and size), three walk-in coolers with four chambers in each with independent RH control, vibration table (transport simulation), two Kyser-Werner retail display cases and a home kitchen.

C. Tifton Campus – Research Labs

Water Quality Laboratory
Approximately 3,000 square feet of sample preparation and analysis space with modern instrumentation with NESPAL (http://nespal.cpes.peachnet.edu).

Flexible Laboratory Spaces
Available spaces can accommodate a wide variety of uses. These range in size and characteristics from 400 square feet of clean and conditioned space to 3,000 square feet enclosed, heated, high-clearance space or 2,000 square feet of covered exterior space.

10. ADMINISTRATION
Describe how the proposed program will be administered within the structure of the institution.

The program will be based in the Institute of The Faculty of Engineering. The Faculty of Engineering is a stand-alone academic unit which has a budget provided directly by the Provost. The overall responsibility will reside with the Director of the Faculty of Engineering who reports directly to the Provost. The Director will be the administrative officer of the program and will be responsible for budgetary and related business matters.

The Graduate Coordinator of the Faculty of Engineering will coordinate all academic aspects of this graduate degree program. Applications for admission will include academic records and evidence of earned B.S. degree in engineering or related sciences, GRE test scores, letters of recommendation and statement of purpose. The Graduate Committee will review all applications, and based on its recommendation, the Graduate Coordinator will recommend admission to the Graduate School Dean. The policies and procedures of the University of Georgia Graduate School will govern the administration of the program and the Dean of the Graduate School will certify the compliance by individual students with regard to the requirements for admission and graduation. The Graduate Coordinator will serve as the Chair of the Faculty of Engineering Graduate Committee. This committee will meet quarterly and each member will serve a three-year term and may be reappointed for no more than one consecutive three-year term. The general responsibility of the Graduate Committee will be to oversee all graduate degree programs to recommend guidelines and procedures for enhancing the quality of the programs. The Graduate Committee will be responsible for the following items and will make its recommendations to the Director of the Faculty of Engineering:

a. Guidelines for recruitment, admission and retention/dismissal.
b. Guidelines for assistantships
c. Guidelines for remedial programs to strengthen the background of students in complementary science(s).
d. Guidelines for uniformity of credits for courses.
f. Guidelines for all graduate degree examinations.
g. Guidelines for appointment of graduate advisory committees.
h. New instructional needs and course proposals.
i. Development of collaborative relationships with government research units and industry.
j. Guidelines on other matters ensuring continued program enhancement.

The Director of the Faculty of Engineering, in consultation with the Engineering Council, will act on the recommendations of the Graduate Committee.

11. ASSESSMENT

Indicate the measures that will be taken to assess the effectiveness of the program and the learning outcomes of students enrolled.

The effectiveness of the proposed degree will be assessed by the following methods:
A. Graduates of the program
The performance of graduates of this degree program will be monitored by collecting information on:

i. Employment opportunities

- Number of offers received
- Geographic distribution of offers
- Distribution of industries offering employment
- Type of position obtained
- Starting salary
- Unemployment
- Underemployment
- Advancements in position and salary after five years

ii. Additional Graduate Studies

- Graduate school enrollment
- Nature of graduate programs enrolled
- Professional school enrollment (e.g. M.D.)

iii. Other

- Graduates starting new companies
- Consulting areas

B. Recruitment and Enrollment

The success of this program will be assessed by the impact on recruitment and enrollment:

i. Number and quality of applicants

- GRE scores
- Geographic distribution of applicants
- Undergraduate grade point average
- Distribution of disciplines represented in applicants

ii. Number and quality of applicants from underrepresented groups

C. Performance of Enrolled Students

The performance of students in this program will be assessed by:

i. Overall grade point average

ii. Grades in non-engineering courses (Sciences, Mathematics)

iii. Percent completing degree and time to completion

iv. Scholarships and fellowships awarded

v. Publications in journals

vi. Other recognized tests (e.g., MCAT, GRE)

vii. Scholarly presentations

D. Impact of Enrolled Students

The impact of students enrolled in this program will be assessed by:
i. Departmental, College, Institute and University awards provided to enrolled students
ii. Activities of enrolled students in professional societies
iii. Activities of enrolled students in student organizations
iv. Patent applications of enrolled students

E. Regional and National Standing of the Program

The regional and national standing of the program will be assessed by:
i. Faculty/students invited to consult with other universities
ii. Faculty/students retained as consultants by pharmaceutical and biobased industries
iii. National demand for graduates, assessed from data shared among engineering deans and from the number of faculty and industry positions advertised
iv. Regional and national awards to faculty and students
v. Regional and national media descriptions

12. ACCREDITATION

Identify accrediting agencies and, where applicable, show how the program meets the criteria of these agencies.

The accrediting agency for professional engineering degree programs in the United States is ABET. ABET allows an institution to seek accreditation for a program at only one degree level – B.S., M.S. or Ph.D. The University of Georgia only seeks accreditation for undergraduate engineering degree programs which is the guideline used by most universities for engineering degree programs. Thus, accreditation for this degree program will not be sought.

13. AFFIRMATIVE ACTION IMPACT

Indicate what impact the implementation of the proposed program will have on the institution’s desegregation and affirmative action programs.

The degree program will be open to all qualified persons and shall not discriminate on the basis of race, color, religion, national origin, sex, age, or physical disability. The engineering program at the University of Georgia has focused effort in recruiting students and faculty from under-represented groups and is a charter member of the Southeastern Consortium for Minorities in Engineering (SECME). In addition to continued active participation in SECME, engineering recruiting activities include participation in identifying students in the under-represented populations through letters, personal contacts and visitations. The University has agreements with several HBCU’s and the proposed engineering program in Biochemical Engineering is expected to enhance the effectiveness of these agreements, especially with institutions having established colleges of engineering. The graduate degree program will also foster research collaborations that provide opportunities for graduate student and faculty exchange. It is anticipated that strong biological emphasis in the engineering program will be appealing to students from a broad spectrum of engineering and biological interests. It is expected that this program will enhance minority recruitment and will contribute to the University’s goal of increasing enrollment from the under-represented groups.

14. DEGREE INSCRIPTION
Indicate the degree inscription that will be placed on the student’s diploma upon completion of this program of study.

Master of Science with major in Engineering

15. FISCAL AND ENROLLMENT IMPACT AND ESTIMATED BUDGET

On this form please indicate the expected EFT and headcount student enrollment, estimated expenditures, and projected revenues for the first three years of the program. Include both the reallocation of existing resources and anticipated or requested new resources. Second and third year estimates should be in constant dollars – do not allow for inflationary adjustments or anticipated pay increases. Include a budget narrative that explains significant line items and discusses specific reallocations envisioned.

<table>
<thead>
<tr>
<th></th>
<th>FY12</th>
<th>FY13</th>
<th>FY14</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
</tr>
<tr>
<td>I. ENROLLMENT PROJECTIONS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(indicate basis for projections in narrative)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Student majors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Shifted from other programs</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2. New to institution</td>
<td>2</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Total Majors</td>
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<td>7</td>
<td>15</td>
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<tr>
<td>B. Course sections satisfying program requirements</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1. Previously existing</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>2. New</td>
<td>2</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Total Program Course Sections</td>
<td>10</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>C. Credit Hours generated by those courses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Existing enrollments</td>
<td>240</td>
<td>288</td>
<td>336</td>
</tr>
<tr>
<td>2. New enrollments</td>
<td>54</td>
<td>180</td>
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<tr>
<td>Total Credit Hours</td>
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<td>468</td>
<td>672</td>
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<tr>
<td>D. Degrees awarded</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(yr 2)</td>
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<td>2</td>
<td>5</td>
</tr>
<tr>
<td>(yr 3)</td>
<td></td>
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<tr>
<td>(yr 4)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>II. COSTS</td>
<td>EFT</td>
<td>Dollars</td>
<td>EFT</td>
</tr>
<tr>
<td>A. Personnel–reassigned or existing positions</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1. Faculty</td>
<td>0.5</td>
<td>40,000</td>
<td>1.0</td>
</tr>
<tr>
<td>2. Part-time Fac.</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3. Grad. Assist.</td>
<td>1.0</td>
<td>30,000</td>
<td>1.5</td>
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<tr>
<td>4. Administrators</td>
<td>0.10</td>
<td>10,000</td>
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<tr>
<td>5. Support staff</td>
<td>0.3</td>
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<tr>
<td>6. Fringe benefits</td>
<td>19,125</td>
<td>33,625</td>
<td>66,125</td>
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<tr>
<td>7. Other personnel costs</td>
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<tr>
<td>Total Existing Personnel Costs</td>
<td>106,625</td>
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<td>343,625</td>
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<td>B. Personnel–new positions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Faculty</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2. Part-time Fac.</td>
<td>0</td>
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</table>
### III. REVENUE SOURCES

#### A. Source of Funds

<table>
<thead>
<tr>
<th>Source of Funds</th>
<th>First Year</th>
<th>Second Year</th>
<th>Third Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reallocating existing funds</td>
<td>406,169</td>
<td>359,605</td>
<td>309,121</td>
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<tr>
<td>New tuition</td>
<td>57,456</td>
<td>191,520</td>
<td>357,504</td>
</tr>
<tr>
<td>New student workload</td>
<td>xxxxxxxxxx</td>
<td>xxxxxxxxxx</td>
<td>357,504</td>
</tr>
<tr>
<td>Federal funds</td>
<td>0</td>
<td>100,000</td>
<td>110,000</td>
</tr>
<tr>
<td>Other grants</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Student fees</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>67,331</strong></td>
<td><strong>301,395</strong></td>
<td><strong>477,379</strong></td>
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<tr>
<td>New state allocation requested</td>
<td>0</td>
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</table>

**GRAND TOTAL REVENUES**  
463,625  
651,125  
776,625

#### B. Nature of funds

<table>
<thead>
<tr>
<th>Nature of funds</th>
<th>First Year</th>
<th>Second Year</th>
<th>Third Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base budget</td>
<td>116,625</td>
<td>201,125</td>
<td>373,625</td>
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<tr>
<td>One-time funds</td>
<td>347,000</td>
<td>450,000</td>
<td>403,000</td>
</tr>
</tbody>
</table>

**GRAND TOTAL REVENUES**  
463,625  
651,125  
776,625
Budget Narrative

In November 2010, the Board of Regents approved the University of Georgia proposals for BS degrees in civil, electrical and electronics, and mechanical engineering and their associated budgets. The resources allocated for those three BS degree programs also provide the faculty, staff and other resources required to implement this ME in Engineering degree program. Thus, no new resources are needed for this degree program.

A budget similar to the one above is presented in the companion Ph.D. in Engineering degree program proposal. Upon the approval and funding of the Ph.D. in Engineering proposal, the resources requested above will not be needed because the funds provided for the Ph.D program will also fulfill the budgetary requirements for implementation of this M.S. in Engineering degree program.
Graduate Course Descriptions for the M.S. Degree with Major in Engineering

Course Descriptions for Existing Engineering Courses:

ENGR 6910. Research Methods. The philosophy of engineering research, research methodology, review of the departmental research programs, and writing and presenting thesis and dissertation proposals and grant proposals.

ENGR 6101. Computational Mathematics for Engineers: Fundamentals. The use of computational applied mathematics techniques to develop models to evaluate data and make predictions of relevance to engineering. Numerical differentiation and integration, Taylor series, numerical solutions of ordinary differential equations and programming techniques are examined in the context of engineering applications.


ENGG 8XX1, 8XX2. Technology Based Entrepreneurship. Currently not an approved course.

ENGR 8950. Graduate Seminar. Presentations/discussions related to engineering research, teaching, design, and service presented by students, faculty, and industry leaders.

ENGR 8160. Advanced Fluid Mechanics. A mathematical treatment of fluid mechanics using tensors with emphasis on viscosity, momentum balance in laminar flow, equations of change, velocity distribution in laminar and turbulent flow, interphase transport, macroscopic balance, and polymeric liquids. Analytical and numeric methods for solving fluid mechanic problems will be used.

ENGR 8170. Advanced Heat Transfer. Conduction, convection, and radiation heat transfer will be covered from an analytical and applications viewpoint. Computer tools for solving heat transfer problems will be emphasized. Projects will involve the analyses of a research-related or design-related heat transfer problem involving at least two of the three heat transfer modalities.

ENGR 8180. Advanced Mass Transfer. Basic laws of mass transport will be derived. Advanced mass transport will focus on molar flux, Fick's law, binary diffusion, two phase transfer, convective mass transfer, mass transfer coefficients, and mass transfer with chemical reaction. A project will be assigned requiring numerical solution of governing mass transport equations.

ENGR 4760/6760. Biomechanics. The application of engineering principles to nonlinear solid mechanics and to body dynamics is discussed. The student should understand the mechanics of the musculoskeletal system.


ENGR 4510/6510. Biochemical Engineering. Design and analysis of enzymatic and microbial biological reaction systems.
ENGR 4520/6520. **Design of Biochemical Separations Processes.** Unit operations used for biological processing including filtration, centrifugation, cell disruption, isolation, purification, and polishing.

ENGR 6530. **Monitoring and Control of Biological Processes.** Concepts of biological process controls; modern control techniques and optimization of batch, fed-batch and continuous bioreactors, and other biological systems.


ENGR 4250/6250. **Advanced Microcontrollers.** Using the MC68HCII to solve practical engineering monitoring and control problems. A project-oriented course.

CSCI(ENGR) 8940. **Computational Intelligence.** Programs that solve complex problems in a particular domain, typically independent of knowledge used to direct the search for an optimal solution. Approaches include simulated annealing, genetic algorithms, neural networks.

ENGR 6410. **Open Channel Hydraulics and Sediment Transport.** Fundamental mass, energy, and momentum transport relations in water flows open to the atmosphere. Channel design and measurement of flows in natural channel. Sediment transport relations are introduced.

ENGR 4440/6440. **Environmental Engineering Unit Operations.** Engineering science and design related to treatment of drinking water and wastewater as well as the treatment and ultimate disposal of the sludges created during water treatment.

ENGR 4450/6450. **Environmental Engineering Remediation Design.** Engineering science and design related to environmental modeling, solid waste management, and hazardous waste management. Concepts of risk assessment will also be introduced.

ENGR 8580. **Compost Facility Engineering.** Factors impacting the design and operation of large scale composting facilities.

**Course Descriptions for Existing Courses in Other Departments:**

ADSC 6110-6110L. **Experimental Methods in Animal Biotechnology.** Laboratory methods in molecular biology stressing recombinant DNA techniques. Experiments will include recombination, cloning, restriction analysis techniques, and optional experiments chosen by students.

CSCI 4810/6810. **Computer Graphics.** Principles of two-dimensional and three-dimensional interactive raster graphics. Principles of scan conversion algorithms for two-dimensional and three-dimensional graphics primitives; data structures and modeling techniques for raster graphics; interaction, visual realism, animation and user interface design; ray tracing, illumination, shading, data storage/retrieval, software engineering and parallel computing for graphics.

CSCI 8060. **Advanced Software Engineering.** Analysis of advanced methods in software engineering. Emphasis is placed on formal specification methods, advanced software testing, software reuse, distributed software design, and communication protocol specification. Studies include advanced software development tools and systems.

CSCI 8470. **Advanced Algorithms.** Further study of fundamental algorithms. Topics covered include advanced data structures, graph algorithms, string algorithms, geometric algorithms, parallel algorithms, and approximation algorithms for NP-complete problems.

ECON 4400/6400. **Economics of Public and Regulated Enterprises.** The economic analysis of regulated and nationalized industries and organizations, with emphasis on the regulation of electric, natural gas, and telecommunications enterprises. Methods and implications of privatization of traditionally "public" enterprises are also considered.
ENVM 4650/6650  Environmental Economics. Economic theory and methods applied to environmental problems and policies. Policies affecting individual and business decisions about environmental quality, policy formation, and incentive-based solutions; alternatives for reform evaluated for political and economic acceptability.

STAT 6310. Statistical Analysis I. Basic statistical analysis for students in quantitative disciplines other than statistics. Topics include principles of sampling and descriptive statistics, elementary probability and probability distributions, discrete and continuous random variables, normal distribution, sampling distributions, statistical inference for one and two samples, simple linear regression, basic nonparametrics, and chi-squared tests.

Course Descriptions for New Courses

ENGR 8910  Design and Research Methods (3-hr). Modify the current Research Methods course ENGR 6910 by adding a module for teaching design methodology with a short-term design project.

ENGG 8XX1/2  Technology Based Entrepreneurship (2-hr). The course provides a broad practice-based experience in the process of creating new products. It starts with the idea generation process and ends with plans for the commercialization of new products. The pedagogical objectives are to shape student abilities to think about technology-based business creation, evaluation of situations from a strategic perspective, and reaching strategic decisions. Accomplishing these objectives entails introducing students to how an enterprise must deal with all complexities and constraints of the environment in which it operates, why none of these can be assumed away or ignored, and how situation factors impact strategic decisions. Topics covered include but are not limited to: starting, financing, and managing a technology-based business as well as management of existing enterprises; market analysis; product design specification; proposal preparation; strategic management; manufacturing facilities design; and business plan.
APPENDIX B

Scholarship, Publications and Professional Activities

of the Faculty Directly Involved

a. Name, rank, academic discipline, institutions attended, degrees earned

Mark A. Haidekker
Associate Professor, Faculty of Engineering

Postdoctoral (1999-2002), University of California, San Diego: Biomegineering
Ph.D. 1998 University of Bremen (Germany): Computer Science
Diploma¹ 1990 University of Hannover (Germany): Electrical Engineering

¹ The German university diploma is a 5-year professional degree that culminates in a research-based thesis and is generally considered equivalent to the M.Sc. degree

b. Current workload for typical semester, including specific courses actually taught

ENGG 4620/6620 Biomedical Imaging
Fall 2007 (as ENGR4980/8980), 2008 (as ENGR4620/6620), 2009

ENGR 4220/6220 Feedback Controls
Spring 2008, 2009

ENGR 8980 Advanced Topics
Summer 2008
Fall 2008

c. Scholarship and publication record for past five years

Haidekker MA. Advanced Biomedical Image Analysis (monograph). John Wiley & Sons, planned publication 2010

LaCroix JT, Haidekker MA. Quantifying light scattering with single-mode fiber-optic confocal microscopy BMC Medical Imaging (in press)


Nipper ME, Majd S, Mayer, M, Lee JCM, Theodorakis EA, Haidekker MA. Characterization of changes in the viscosity of lipid membranes with the molecular rotor FCVJ. Biochim Biophys Acta (Biomembranes) 2008; 1778: 1148-1153.


Haidekker MA, Bidesi A, Radmer S, Andresen R. Texturpaprameter zur Bestimmung osteoporotisch bedingter Strukturveränderungen im CT-Bild der Wirbelkörperspongiosa - eine Vergleichsstudie [Texture parameters to quantify osteoporosis-related structural changes in CT images of the vertebral spongiosa - a comparative study]. Osteologie 2006; 15: 120-130 (article in German).


d. **Professional activity**

American Society for Engineering Education (institutional membership)

Biomedical Engineering Society

Institute for Biological Engineering

Sigma Xi, the Research Honors Society

e. **Expected responsibilities in this program**

Teach undergraduate and graduate level courses

Sit on graduate committees and serve as major professor for M.S. and Ph.D. students

a. **Name, rank, academic discipline, institutions attended, degrees earned**

Jenna R. Jambeck

Assistant Professor, Faculty of Engineering

Ph.D. 2004 University of Florida, Environmental Engineering Sciences

M.S. 1998 University of Florida, Environmental Engineering Sciences

B.S. 1996 University of Florida, Environmental Engineering Sciences

b. **Current workload for typical semester, including specific courses actually taught**

**ENVE 2320 Environmental Engineering Urban Systems**

Fall 2009, 2010
ENVE 3510 Statistics, Modeling and Uncertainty  
Spring 2010

ENVE 4530 Energy and Environmental Policy Analysis  
Fall 2010

c. Scholarship and publication record for past five years


Page 38 of 72
Preservative Treated Wood, Ed. Townsend, T. and Solo-Gabriele, H., CRC Press, Boca Raton, FL.


Innovative Control Techniques,” Florida Center for Solid and Hazardous Waste Management, Gainesville, FL.


d. Professional activity

Solid Waste Association of North America

e. Expected responsibilities in this program

Teach undergraduate and graduate level courses
Sit on graduate committees and serve as major professor for M.S. and Ph.D. students

a. Name, rank, academic discipline, institutions attended, degrees earned

caner Kazanci
Asst. Professor, Department of Mathematics
Member, Faculty of Engineering

Ph.D. 2005 Carnegie Mellon University, Mathematical Sciences
M.S. 2000 Carnegie Mellon University, Mathematical Sciences
B.S. 1999 Bilkent University, Department of Mathematics

b. Current workload for typical semester, including specific courses actually taught

MATH 2200 Calculus I
Fall 2005

MATH 2700 Differential Equations
Spring 2008

MATH 4500/6500 Numerical Analysis I
Fall 2006

MATH 4510/6510 Numerical Analysis II
Spring 2007

MATH 4700 Qualitative Differential Equations
Fall 2009

ENGR 6101 Computational Engineering: Introduction
Fall 2008, 2009

ENGR 8102 Computational Engineering: Elliptic Partial Differential Equations
ENGR 8103 Computational Engineering: Parabolic Partial Differential Equations

ENGG 8110 Mathematical and Computational Biology

MATH 8850 VIGRE Research Group
Fall 2008, 2009
Spring 2008

c. Scholarship and publication record for past five years


d. Professional activity

SMB, Society of Mathematical Biology
SIAM, Society of Industrial and Applied Mathematics
ISEM, International Society for Ecological Modeling

e. Expected responsibilities in this program

Teach undergraduate and graduate level courses
Sit on graduate committees and serve as major professor for M.S. and Ph.D. students

a. Name, rank, academic discipline, institutions attended, degrees earned

William S. Kisaalita
Professor, Department of Biological & Agricultural Engineering
Member, Faculty of Engineering

Ph.D. 1987 University of British Columbia, Chemical Engineering
M.A.S. 1982 University of British Columbia, Bioresource Engineering
B.S. 1978 Makerere University, Mechanical Engineering

b. Current workload for typical semester, including specific courses actually taught

ENGR 8980 Tissue Engineering for Drug Discovery
Fall 2007, 2009

ENGR 8950 Graduate Seminar

ENGR 4920 Engineering Design Project
Spring 1992 - 2008

ENGR 3720 Engineering Physiology

c. Scholarship and publication record for past five years


Yoder MF, Kisaalita WS. Fluorescence of pyoverdin in response to iron and other common well water metals. *J. of Environmental Science and Health Part A* 41:1-2, 2006


d. Professional activity

American Society for Engineering Education
American Chemical Society
American Association for Advancement of Science
Society for Biomolecular Sciences
American Society for Agricultural and Biological Engineering

e. Expected responsibilities in this program

Teach graduate level courses
Serve as major professor for M.S. and Ph.D. students
Serve on advisory committees for M.S. and Ph.D. students

a. Name, rank, academic discipline, institutions attended, degrees earned

Peter Kner
Assistant Professor, Department of Biological & Agricultural Engineering
Member, Faculty of Engineering

Ph.D. 1998 University of California, Berkeley, Physics
B.S. 1991 Massachusetts Institute of Technology, Physics
B.S. 1991 Massachusetts Institute of Technology, Electrical Engineering

b. Current workload for typical semester, including specific courses actually taught

ENGR 4230 Sensors and Transducers

Fall 2009 (1 sections)

ENGR 1140 Computational Engineering Methods
c. **Scholarship and publication record for past five years**


P. Kner, B. B. Chhun, E. R. Griffis, L. Winoto, L. Shao, and M. G. L. Gustafsson, Live TIRF microscopy at 100nm resolution through structured illumination, *SPIE Photonics West*, San Jose, CA, January 2009


d. **Professional activity**

SPIE (Society of Photonics Engineers)
IEEE (Institute of Electrical Engineers)
f. **Expected responsibilities in this program**

Teach undergraduate and graduate level courses  
Sit on graduate committees and serve as major professor for M.S. and Ph.D. students

d. **Name, rank, academic discipline, institutions attended, degrees earned**

Kyle J. Johnsen  
Asst. Professor, Faculty of Engineering  
Ph.D. 2008, University of Florida, Computer Engineering  
B.S. 2003, University of Florida, Computer Engineering

e. **Current workload for typical semester, including specific courses actually taught**

**ENGR 1140 Computational Engineering Methods**

- Spring 2009  
- Fall 2009 (2 sections)  
- Spring 2010

**ENGR 4920 Senior Design**

- Spring 2009 (The Data Analyzing Wireless Glove)

**CSCI 6930 Virtual Reality**

- Spring 2010

c. **Scholarship and publication record for past five years**


B. Rossen, K. Johnsen, A. Deladisma, D. S. Lind, and B. Lok Virtual Humans Elicit Skin-Tone Bias Consistent with Real-World Skin-Tone Biases. Proceedings of Intelligent Virtual Agents, 2008


d. Professional activity

Member
IEEE
ACM
Formal Proposal for M.S. in Engineering

Program Committee
IEEE Virtual Reality 2010
ACM Virtual Reality Software and Technology 2009
International Symposium on Mixed and Augmented Reality 2009

e. Expected responsibilities in this program

Teach undergraduate and graduate level courses
Sit on graduate committees and serve as major professor for M.S. and Ph.D. students

a. Name, rank, academic discipline, institutions attended, degrees earned

Ke Li
Assistant Professor, Faculty of Engineering

Ph.D. 2003 Michigan Technological University, Environmental Engineering
M.S. 1998 Chinese Academy of Sciences, Environmental Chemistry
B.S. 1995 Tsinghua University, Environmental Engineering

b. Current workload for typical semester, including specific courses actually taught

ENVE 4550 Environmental Life Cycle Analysis
Spring 2010

ENVE 4620 Sustainable Design in Urban Systems
Fall 2010

c. Scholarship and publication record for past five years


Ke Li; P. Zhang; J. C. Crittenden; R. Kahhat; Y. Choi; D. Gerrity; H. Fernando; S. Guhathakurta; A. Sawhney; P. Torrens, 2009 Regional Futures 2100 (RF2100): A holistic framework for evaluating urban sustainability, in *Visualizing sustainable planning models*, Springer, Heidelberg.


Melissa R. McHale, Nancy B. Grimm, Lawrence A. Baker, Brenda A. Koerner, Ke Li, and Sharon J. Hall, 2009 Impacts of urbanization on regional and global carbon cycling: a complete carbon budget of Phoenix metropolitan region as a case study, the *94th ESA Annual Meeting, Albuquerque, New Mexico, Aug 2-7.*


Daisuke, M., K. Li, J. Crittenden, P. Westerhoff, 2008 Development of Group Contribution Method (GCM) for Hydroxyl Radical (HO•) Reaction Rate Constants in the aqueous phase, *the 14th International Conference on Advanced Oxidation Technologies in San Diego, CA, Sept. 22.*


Minakata, D.; Crittenden, J.C.; Li, K. 2007 Evaluation and design Advanced Oxidation Processes (AOPs). 1. UV/H₂O₂ processes for methyl tert-butyl ether (MtBE) and tertiary butyl alcohol (tBA) removal from drinking water source: effect of pretreatment options and light source. 2. Mitigation of bromate during ozonation –kinetic study -. Water Quality Technology Conference Workshops Sun 5 Advanced Oxidation Technologies in Water. Nov. 4th, Charlotte, NC.


Li, K. 2004 UV/H₂O₂ Process From Design Aid to Mechanism Study, invited Pre-conference Workshop of the Tenth International Conference on Advanced Oxidation Technologies for Water and Air Remediation, Oct. 24-28, San Diego, CA.

d. **Professional activity**

American Environmental Engineering and Science Professors
American Chemical Society
Water Environment Federation
American Water Works Association

e. **Expected responsibilities in this program**

Teach undergraduate and graduate level courses
Sit on graduate committees and serve as major professor for M.S. and Ph.D. students

<table>
<thead>
<tr>
<th>a. <strong>Name, rank, academic discipline, institutions attended, degrees earned</strong></th>
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<tr>
<td>Jason Locklin</td>
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<tr>
<td>Assistant Professor, Department of Chemistry and Faculty of Engineering</td>
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<tr>
<td>Ph.D. 2004 University of Houston, Chemistry</td>
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<td>B.S. 1999 Millsaps College, Chemistry</td>
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<table>
<thead>
<tr>
<th>b. <strong>Current workload for typical semester, including specific courses actually taught</strong></th>
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<tr>
<td><strong>ENGG 4165/6615; CHEM 4615/6615 Soft Materials</strong></td>
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<td>Fall 2007, 2008, 2009</td>
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<tr>
<td><strong>CHEM 8390 Principles of Polymerization</strong></td>
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<td>Spring 2008</td>
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<tr>
<td><strong>CHEM 2212 Organic Chemistry II</strong></td>
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<td>Spring 2009, 2010</td>
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</table>

c. **Scholarship and publication record for past three years**


d. Professional activity

American Chemical Society
Materials Research Society
The Fiber Society

e. Expected responsibilities in this program
Teach undergraduate and graduate level courses
Sit on graduate committees and serve as major professor for M.S. and Ph.D. students

a. **Name, rank, academic discipline, institutions attended, degrees earned**

Leidong Mao
Asst. Professor, Faculty of Engineering

Ph.D. 2008 Yale University, Electrical Engineering
B.S. 2001 Fudan University, Materials Science

b. **Current workload for typical semester, including specific courses actually taught**

**CSEE 2220 FUNDAMENTALS OF LOGIC DESIGN**
Fall 2008, 2009

**ENGR 8310 MEMS DESIGN**
Spring 2009

**FRES 1020 FRESHMAN SEMINAR**
Fall 2009

c. **Scholarship and publication record for past five years**


d. **Professional activity**

Institute of Electrical and Electronics Engineers
American Society for Mechanical Engineers
American Chemical Society

e. **Expected responsibilities in this program**

Teach undergraduate and graduate level courses
Sit on graduate committees and serve as major professor for M.S. and Ph.D. students

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a. **Name, rank, academic discipline, institutions attended, degrees earned**

Sudhagar Mani
Asst. Professor, Biochemical Engineering Program, Faculty of Engineering
Asst. Professor, Department of Biological & Agricultural Engineering

Ph.D. 2005 University of British Columbia, Chemical Engineering
M.S. 2000 Indian Institute of Technology (IIT) Kharagpur – Food Engineering
B.E. 1998 Tamil Nadu Agricultural University, Agricultural Engineering

b. **Current workload for typical semester, including specific courses actually taught**

**ENGR 3140 Engineering Thermodynamics**
Fall 2007, 2008, 2009

**ENGR 3540 Physical Unit Operations**
Spring 2008, 2009

**ENGR 8520 Biomass Feedstock Engineering**
Spring 2008, 2009

**ENGR 8980 Process Modeling & Heterogeneous Catalysis**
Spring 2009
c. Scholarship and publication record for past five years


d. Professional activity

American Society of Agricultural & Biological Engineering (ASABE)
(1) Chair, Georgia Section of ASABE (2009-2010)
(2) Vice Chair, FPE 709 Technical Committee
(3) Member, T-11 Energy Committee
(4) Sub-task chair – Solid Fuels Standards development

American Institute of Chemical Engineers (AIChE)
Society for Industrial Microbiology (SIM)
Institute for Biological Engineers (IBE)
International Standards Organization (ISO)
   (1) Task leader for working group 4 & 5 – Solid Biofuels Standard.

e. Expected responsibilities in this program

Teach undergraduate and graduate level courses
Sit on engineering graduate committees, serve in the Engineering Graduate Students Selection Committee and serve as major professor for M.S. and Ph.D. students

a. Name, rank, academic discipline, institutions attended, degrees earned

Zhengwei Pan
Asst. Professor, Faculty of Engineering & Department of Physics and Astronomy

Ph.D. 1997 Northwestern Polytechnic University, China, Mater. Sci. & Eng.
M.S. 1993 Shandong University of Technology, China, Mater. Sci. & Eng.
B.S. 1990 Shandong University of Technology, China, Mater. Sci. & Eng.

b. Current workload for typical semester, including specific courses actually taught
Scholarship and Publication Record for Past Five Years


d. **Professional activity**

Materials Research Society  
American Chemical Society  
TMS  

e. **Expected responsibilities in this program**

Teach undergraduate and graduate level courses  
Sit on graduate committees and serve as major professor for M.S. and Ph.D. students  

---

a. **Name, rank, academic discipline, institutions attended, degrees earned**

John R. Schramski  
Asst. Professor, Environmental Engineering, Faculty of Engineering  

Ph.D.  2006  University of Georgia, Ecology  
M.S.  1993  University of Cincinnati, Mechanical Engineering  
B.S.  1989  University of Florida, Mechanical Engineering  

b. **Current workload for typical semester, including specific courses actually taught**

**ENGR 3160 Fluid Mechanics**  
Fall 1999  
Spring 1999  
Fall 2000  

**ENGR 4300 Mechanical Systems II**  
Spring 2008  

**ENVE 3210 Energy I**  
Fall 2009  
Fall 2010 (scheduled)  

**ENVE 3220 Energy II**  
Spring 2010 (scheduled)  

**ENVE 4230 Ecosystem Energetics**  
Fall 2010 (scheduled)
c. Scholarship and publication record for past five years


d. **Professional activity**

International Society of Ecological Modellers  
Georgia Professional Engineer, License #021404

e. **Expected responsibilities in this program**

Teach undergraduate and graduate level courses  
Sit on graduate committees and serve as major professor for M.S. and Ph.D. students

a. **Name, rank, academic discipline, institutions attended, degrees earned**

Andrew T. Sornborger  
Assoc. Professor, Faculty of Engineering, Department of Mathematics  
Ph.D. 1995 Brown University, Physics  
B.S. 1985 Dartmouth College, Computational Linguistics

b. **Current workload for typical semester, including specific courses actually taught**

**MATH2250 Calculus for Engineers and Scientists, Part I**  
Fall 2004, 2008  

**MATH2260 Calculus for Engineers and Scientists, Part II**  
Spring 2005, 2006  

**MATH2700 Ordinary Differential Equations**  
Spring 2004, 2009  

**MATH3500 Linear Algebra**  
Spring 2008  

**MATH4700/6700 Qualitative Differential Equations**  
Fall 2006  

**MATH4500/6500 Numerical Analysis**  
Spring 2007  

**MATH4780/6780 Mathematical Biology**  
Spring 2007  

**MATH4900 Transforms, Topics in Mathematics**  
Fall 2009  

**MATH8850 VIGRE Cardiac Physiology Group**  
Fall 2004, 2005  

**ENGR4980 Undergraduate Independent Study**  
Fall 2005 Blake Windsor, Mouse Brain Imaging  
Fall 2005 Amit Salkar, Mouse Brain Imaging  

**ENGR6930 Experimental Methods for Engineers**  
Spring 2004, 2006  

**ENGR8980 Special Topics in Engineering, Mathematical Physiology**  
Spring 2005  

**ENGR8980 Graduate Independent Study**  
Fall 2005 Prince Odame, Multivariate Imaging Data Analysis  
Fall 2008 Judith Navick, Multivariate Statistical Analysis
c. **Scholarship and publication record for past five years (reverse chronological order)**


d. **Professional activity**

Society for Neuroscience
Society of Industrial and Applied Mathematicians
American Mathematical Society

e. Expected responsibilities in this program

Teach undergraduate and graduate level courses
Sit on graduate committees and serve as major professor for M.S. and Ph.D. students

a. Name, rank, academic discipline, institutions attended, degrees earned

Ernest W. Tollner
Professor, Department of Biological & Agricultural Engineering
Member, Faculty of Engineering

Ph.D. 1980 Auburn University, Bio Systems Engineering
MSAE 1974 University of Kentucky, Agricultural Engineering
BSAE 1972 University of Kentucky, Agricultural Engineering

b. Current workload for typical semester, including specific courses actually taught

ENGR 3420 Soil Mechanics
Every Spring

ENGR 3440 Water Management
Every Spring

ENGR 4210/6210 Linear Systems
Every Fall

ENGR 4920 Senior Design
Spring 2001-Present

ECOL 8710 Environmental Law Practicum
Spring 2008

ENGR 8750 Advanced Heat Transfer
Spring 2008, 2009

c. Scholarship and publication record for past five years


van Donk, SJ; Tollner, EW; Steiner, JL, Soil temperature under a dormant bermudagrass mulch: Simulation and measurement. Transactions of the ASAE, 47 (1): 91-98 JAN-FEB 2004.


d. Professional activity

American Society for Engineering Education
American Society of Agric. and Biol. Engineers
Publication director
Co-chair of International Water Quality Conference (Chile, 2009, Costa Rica, 2010).
Contributor to the Fundamentals of Engineering Exam development
Contributor to the Agricultural PE exam development
Operating Engineer, UGA BAE-Physical Plant Composting yard

e. Expected responsibilities in this program

Teach undergraduate and graduate level courses
Sit on graduate committees and serve as major professor for M.S. and Ph.D. students
Currently serving as FE Graduate Coordinator

a. Name, rank, academic discipline, institutions attended, degrees earned

Joachim Walther
Asst. Professor, Faculty of Engineering

Ph.D. 2008 University of Queensland (Australia), Engineering Education
Dipl.-Ing. 1998 University of Darmstadt (Germany), Mechanical Engineering

b. Current workload for typical semester, including specific courses actually taught

ENGR 1010 Synthesis and Design Studio
Fall 2009

ENGR 1020 Synthesis and Design Studio
Spring 2010

ENGR 2010 Synthesis and Design Studio
Spring 2010

c. Scholarship and publication record for past five years


d. **Professional activity**

American Society for Engineering Education

e. **Expected responsibilities in this program**

Teach undergraduate and graduate level courses
Sit on graduate committees and serve as major professor for M.S. and Ph.D. students