

Faculty of Engineering Invites Membership Applications

Deadline FEBRUARY 28
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Biochemical Engineering: An Interface

One of the main targets that influence the transition between benign and metastatic cancer are changes in enzymes involved in cell-surface glycosylation. In the biochemistry lab of Dr. Kelley Moremen, post-doctoral and graduate researchers are working to design inhibitors to influence the maturation of cell-surface carbohydrates so that a tumor will not be able to make that advance. Whatever the degree of success, their work ushers in a new era at UGA, a synthesis of biochemistry, biological sciences and engineering, of expanded research and instruction capabilities in biochemical engineering.

Generating material for the structural work, inhibitor design and potential drug development involves recombinant enzyme expression. "We want to be able to make large quantities of enzymes for drug screening purposes. This requires an optimized fermentation process where parameters of growth and expression in the culture are defined," explains Dr. Moremen, Professor of Biochemistry and member of the Faculty of Engineering. Currently he employs biological engineering graduate student Narendra Tejwani in his lab for these very purposes.

The reason is a simple one. Systematic evaluation and optimization of the many parameters of fermentation are more engineering issues than the standard realm of biochemical study. Elements of optimal organism and instrumentation engineering are commonly not addressed in biochemistry. But these needs are providing an interface that will allow both disciplines to move forward.

With the approval last year of the Applied Biotechnology undergraduate degree in the CAES, UGA is continuing to find ways to make the most out of its biological science resources. Pending degree proposals in the Faculty of Engineering create a formidable array of teaching and research possibilities at both the graduate and undergraduate level. "It gives the students the



biotechnology, the genetics, everything related to the basic biology of biotechnology plus the engineering to take it to pilot or full-scale; someone who can do both is very marketable," says Tim Foutz, Professor and Undergraduate Coordinator in Biological and Agricultural Engineering.

The laboratory classroom.

But to understand the causal relationships and why this synthesis is happening just now, it is necessary to go back to the biochemistry lab. On one level, biochemists isolate genes and introduce them into organisms. Production and isolation of the gene products provide biochemical targets for drug screening and testing of therapeutic efficacy. The recombinant expression of biochemical targets (proteins, enzymes), requires engineering. In this context, biochemical engineering can be seen as laying the groundwork for future pharmaceutical breakthroughs.

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ENGINEERING CURRICULUM INTEGRATION

by
Robert C. Wicklein, Ed.D.,

I came to UGA in the fall of 1991 having just completed five years as an assistant professor at Oklahoma State University. I was fortunate to bring with me a 3-year grant from the U.S. Department of Education, which focused on the integration of curriculum in mathematics, science, and technology at the high school level, and I was eager to complete this work here at UGA. I also wanted to work to build collaborations among the faculty in the College of Education to continue this vein of multidisciplinary research. However, I quickly discovered that the walls of the academy were solid and impervious to most collaborative efforts, at least for a new assistant professor. It has been almost 12 years since those early days of 1991, and I have progressed through the ranks from assistant to associate and finally to full professor. Along the way, through the development of relationships with other faculty within my college and colleagues in other colleges and departments, the concepts of curriculum integration are closer to becoming a reality.

With the creation of the Faculty of Engineering, a new avenue has opened for curriculum integration. As a faculty member who teaches technology education in the College of Education, I have found that the Faculty of Engineering provides me with a vast new field for collaborative work. It is no accident that the National Science Foundation is funding projects that seek to integrate the instructional efforts in mathematics, science, and technology at the secondary and post-secondary levels with engineering education. The mechanism where high schools students can be better prepared and motivated to enter engineering majors at the college level has long been needed. Too often academically gifted high school students are simply never exposed to the possibilities of careers in engineering. Through the opportunities

afforded by the Faculty of Engineering here at UGA, the *NSF - Bridges for Engineering Education* grant was a perfect fit for the College of Education and the Department of Biological & Agricultural Engineering. The Faculty of Engineering encouraged and stimulated faculty from otherwise unrelated programs and departments to join together and submit a proposal that was successfully funded. Without this type of supportive system the probability of this type of collaborative effort would not have taken place. I am encouraged to be working side-by-side with colleagues from four departments and two colleges to create a metaphorical bridge from high schools to colleges of engineering.

As I share this story with my colleagues from other universities they are surprised and impressed that UGA faculty have a system in place that supports and stimulates the actual collaboration between colleges and departments. A fellow professor from Virginia Tech said to me, “We can’t collaborate here because we don’t even talk with each other.” Thanks to the vision of administrators and faculty leaders who

“The mechanism where high schools students can be better prepared and motivated to enter engineering majors at the college level has long been needed.”

worked to create the Faculty of Engineering at UGA, we have made the beginning steps that cross the borders of our self imposed academic boundaries. The impacts that we can make together are yet to be determined. Thank you for supporting my membership in the Faculty of Engineering and I look forward to meeting and knowing many more of my university colleagues. Best wishes.

Robert Wicklein is a Professor and Graduate Coordinator in the College of Education – Department of Occupational Studies

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“Biochemical engineering education and research will lead in developing advanced technologies to enhance the welfare and sustainable quality of life of humankind,” says Dale Threadgill, Director of the Faculty of Engineering. Indeed, long term societal needs in healthcare, pollution prevention and renewable energy require the development of new and unique products and processes for technologies, prime among them bio-manufacturing and bio-resource utilization.

UGA Engineering Professor James Kastner, who came from a chemical engineering background, sees great flexibility in chemical engineering while sensing its limitations. “The traditional chemical engineering curriculum is limited for students who want to make that transition to the biological areas; the biochemical engineering degree program could present the opportunity for dual degrees in a variety of disciplines to tailor a student’s technical electives,” Kastner says.

Research from the Engineering Workforce Commission (www.aaes.org) indicates that enrollment in chemical engineering curricula was down 12.1% in 2001 from 2000. The growth of bio-engineering and biomedical engineering has been attributed to this decline¹, with some schools addressing the issue with departmental name additions like ‘biomolecular’ to traditional chemical engineering or offering students the freedom to branch out into other related areas of emphasis. This is anecdotal evidence of the more fundamental shifts occurring with UGA Engineering, which has the flexibility to evolve with the new directions in biochemical engineering and the institutional expertise to make the changes responsive and enduring.

¹Rita D’Aquino “ChE Enrollment Drops - Is Biotech To Blame?” *Chemical Engineering Progress*, Vol. 98, No. 11 (November 2002), p.12



FACULTY PROFILES

Building an eight-acre artificial wetland is one strategy to help a textile company cope with aquatic toxicity in their effluents. But determining what happens when this effluent is discharged into such a swamp requires the consultation of an academic team with extensive knowledge in the many aspects of this snapshot to assess its effectiveness. Dr. Ian Hardin, Department Head of Textiles, Merchandising & Interiors, engages the experts at the forest service and UGA engineers to comprise such a team, fulfill research goals and instruct tomorrow's textile scientists.



Ian Hardin

“Using analytical chemistry we look for BOD, COD, phosphorus and nitrates to find out what happens to the chemical soup they put into their effluent,” Hardin says.

The Textile, Merchandising & Interiors department is very closely tied to its sister industries. “At the graduate level we work in chemical modification of textile materials and analysis and testing of textiles,” he explains, adding that much of this work and innovation has direct industry application that often occurs contemporaneously.

One example is working with enzymes as a replacement for traditional chemical processes in the textile industry. Hardin currently oversees two projects in North Georgia to help recover waste water to reuse. “Cutting down on the color in the waste water helps save on the beginning chemicals, because you can reuse them,” he says. With industrial support from a Danish enzyme maker and the open, collaborative atmosphere at UGA, Hardin is poised to witness further inroads in the enzymatic approach to treating textiles.

With an interest in computer systems and artificial intelligence that dovetails with real world issues, UGA Engineering Professor Takoi Hamrita makes the most of her exposure to Georgia's industries with the latest in new technology. Her well-publicized research in biotelemetry focused on improving the poultry housing environment through physiological feedback, while some of her activity in the classroom features a design-based approach for teaching microcontrollers.

Alongside this devotion to her research and students, Dr. Hamrita has also discovered a parallel academic universe where she can address two more subjects about which she feels passionately: the scholarship of teaching and her native Tunisia. Awarded a major U.S. State Department grant in fall 2002, she is leading a UGA delegation in establishing a partnership with the University System of Tunisia to train faculty and administrators. “It's my interest in pedagogy and higher education that drove me in this direction,” she explains.



Takoi Hamrita

On a recent trip to Tunisia as part of the project, Hamrita was part UGA ambassador, part project director, but always able to strike a balance with her origins as an engineer. “I used it (engineering) as an opportunity to speak about who we are as an engineering faculty and the breadth of things we do here at UGA with an interdisciplinary approach,” she says. “The Faculty of Engineering is the perfect vehicle for working on international issues in higher education and building bridges.”

Expertise is often a successor to inquiry, but in more and more cases UGA researchers are broadening their own areas of interest by exposure to new developments in technology. Bill Dennis brings his work as an experimental physicist to the fjord of bio-science and engineering through an interest in nano-scale systems that has only increased as this new science has evolved.

“The underlying theme of my research is using lasers to study dynamic processes in matter, including systems like phosphors, organic polymers, laser crystals and now proteins,” Dr. Dennis says. His interest as a physicist in nano-scale systems has grown with his own research into the optical properties of proteins, driven by developments in nanotechnology.

“Part of the function of this particular, green-flourescent protein, is built on its nano-scale size. A chromophore is very efficient at absorbing and emitting light and the optical properties of that chromophore can be used as a probe for the rest of the protein,” he says, explaining the work as using ultra-fast lasers to try and understand more about the physics of the protein.



Bill Dennis

Dennis is using his research on non-linear optical properties of green fluorescent proteins to collaborate with Dr. Cory Momany of Pharmaceutical and Biomedical Sciences to identify self-assembled arrays in living organisms. Additionally he is working with Oglethorpe County High School student Mike Kwon as the two study the optical properties of sculptured nanostructures grown by Dr. Yiping Zhao of UGA Physics.

NEW ENGINEERING FACULTY

The Faculty of Engineering welcomes new faculty members from Fall 2002.

Engineering members

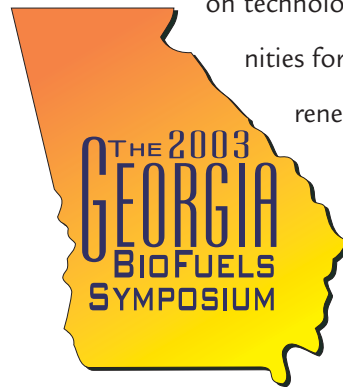
David Gattie - *Bio & Ag Engineering*
 Jim Kastner - *Bio & Ag Engineering*
 Edward Law - *Bio & Ag Engineering*
 David Radcliffe - *Crop & Soil Sciences*

Affiliate Members

Robert Wicklein - *Occupational Studies*
 Timothy Davies - *Biochemistry & Molecular Biology*
 Kelley Moremen - *Biochemistry & Molecular Biology*
 Dan Fowler - *Energy Services (Jefferson Energy Cooperative)*

These faculty and professionals join the current roster of 54 engineering and 33 affiliate members.

The UGA Engineering Outreach Service and the Faculty of Engineering present two symposia and workshops on renewable bioproducts: The 2003 Georgia Biofuels Symposium and the Forest Products and Agriculture/Biomass Symposium and Workshop. Presentations and discussions will focus on technologies, economic incentives, and funding opportunities for new ideas on the use of bioresources for renewable energy in Georgia.



Forest Products and Agriculture/Biomass Symposium & Workshop

FEBRUARY 18-19, 2003

FEBRUARY 20, 2003

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