ChE department

The University of Alabama

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Denny Chimes, one of the most recognizable features of the UA campus, framed by a dogwood tree in full bloom.

A sunny fall weekend in Alabama conjures up images of the storied traditions of The University of Alabama (UA): the aroma of Southern barbecue fills the air; alumni and students, as well as many others, descend on campus for a three-day tailgating party; many pay homage to the past by visiting the Paul "Bear" Bryant Museum, and crowds gather at Bryant-Denny stadium to cheer on the famed Crimson Tide. When the weekend passes, the visitors return to their normal lives in Tuscaloosa (home city to UA) and elsewhere, and the excitement of the big game is replaced by activities of the 20,000 students.

Set at the southern end of the Appalachians and bordered by the Black Warrior River, UA's campus was established in 1831 and has seen many historic moments. Several buildings on campus survived the U.S. Civil War, and Governor Wallace's stand in the schoolhouse door brings to mind a more ignominious past. Today, The University of Alabama provides a breadth of educational options for a diverse student body— from liberal arts and business to law, science, and engineering.

LIVING IN WEST CENTRAL ALABAMA

Tuscaloosa's metropolitan area of 125,000 bustles with more than just University activities. About an hour's drive west of Birmingham, Tuscaloosa is nestled in a forested area dotted with numerous recreational lakes. The spring and fall seasons are especially long and pleasant, inviting the outdoor enthusiast to participate in any number of pastimes. Tuscaloosa's sister city of Northport is an active arts center that hosts the annual Kentuck festival each fall and numerous music and performing arts activities year-round. Local industries that employ our graduates include JVC America Inc., Hunt Oil Co.,

RadiciSpandex Co., Southern Heat Exchanger Corp., and Mercedes-Benz US International Inc.

The University of Alabama is central to the city of Tuscaloosa in both geography and spirit. It has an aesthetic appeal, with large grassy malls, tree-lined sidewalks, and campus buildings with stately Southern grace. Sitting on the opposite side of campus from Bryant-Denny stadium, the Chemical Engineering Department is housed in the Tom Bevill Building, one of the more recent additions to campus. It houses modern research laboratories, faculty offices, conference rooms, and interactive classrooms.

UA's Chemical Engineering Department maintains an active role in the national curriculum reform efforts, striving to balance the important core concepts at the heart of chemical engineering with changing and emerging technologies.

HISTORY AND GROWTH OF ChE AT UA

The College of Engineering at UA is the third oldest continuously operating engineering program in the country. Created in 1837, just six years after the formation of the University, the College remains an active and vital part of the University's higher education mission and solidifies the institution as the capstone for higher education in the State of Alabama. With nearly 15,000 undergraduate and 5,000 graduate students, UA is one of seven major PhD-granting institutions in Alabama. The campus is made up of eight colleges, with the College of Engineering representing about ten percent of the student population, but thirty percent of the honors students.

Established in 1910, the Chemical Engineering Department, like many others in the nation, originated out of a need for a degree that emphasized industrial aspects of chemistry. Its establishment was just one year after the inception of the American Institute of Chemical Engineers. The first UA chemical engineering degree was awarded in 1914.

During the early years, a professional degree was available to students in addition to the traditional BS and MS degrees. Then, in the early 1960s, the College of Engineering developed its PhD degree programs in response to the arrival of NASA and other research-intensive organizations in northern Alabama. The department awarded the first two PhD degrees in the College of Engineering in 1964.

Throughout the years, the changing face of the chemical industry has been reflected within UA's chemical engineering degree program. From highly practical BS and MS degree programs through the '60s and '70s, the department has evolved to keep pace with changes in industry and made sure that its ChE degree has retained relevance as student career choices have become more diverse. The mission of the Department has always been and remains to educate young professionals as translators of fundamental knowledge into viable solutions to problems that are technically, environmentally, sociologically, economically, and globally significant.

UA chemical engineering graduates of 2003 stand along the stately stairs of the President's Mansion, one of a handful of buildings at UA to have survived the Civil War.

Today, UA's chemical engineering department comprises 230 undergraduate and 30 graduate students, along with a full-time staff of 18, including 12 professors. The program offers BS (since 1910), MS (since 1910), and PhD (since 1964) degrees

and annually graduates more than 40 undergraduates and eight graduate students.

UA students find employment in all areas of industry, from fine chemicals and consumer products to polymers and petrochemicals, or they pursue advanced study in graduate school, medical/dental school, or law school. Many undergraduates opt for minors or departmental certificates in areas such as business or environmental engineering. With more than thirty percent of its students graduating with honors, chemical engineering is a leader in the College and University for its diversity (more than forty percent women and fifteen percent minorities), its leadership, and its quest for excellence.

As one astute alumnus observed during a campus visit, although the Department's image has been transformed throughout the years, "the fundamental parts that made a chemical engineer in the 1960s remain as important for the chemical engineer in the new millennium." While this assessment shows the continued strength of a core chemical engineering degree, the Chemical Engineering Department continues to evolve to accommodate the new technologies that are just becoming visible on the horizon.

ChE FACULTY

There are currently 12 full-time, tenured, or tenure-track faculty in the Department. They include four full professors, three associate professors, and five assistant professors. Griffin serves as the Southeastern NIGEC Director and the State of Alabama EPSCoR Director. All faculty members are fully engaged in the instructional and research programs at the undergraduate and graduate levels. Collectively, the department has averaged more than $2 million of externally funded awards over the last five years, resulting in a top-35 ranking for expenditures for chemical engineering research as compiled by NSF for the last three years (1999-2001). In addition, ASEE has consistently ranked the department among the top 50 chemical engineering BS-degree-granting institutions.

UNDERGRADUATE PROGRAMS

From a student's perspective, the Chemical Engineering Department offers several unique opportunities. Undergraduates get to know all of their professors during their four years on campus. As freshmen, the students take a one-hour introduction to chemical engineering course that focuses on informing students about career options, preparing them for problem solving, and building the camaraderie that grows between students during their time on campus. The AIChE student chapter actively involves the students in its meetings and outreach activities.

Chemical Engineering Faculty
at The University of Alabama

Gary C. April, Department Head
University Research Professor
Ph.D., Louisiana State University, 1969
large system modeling • biomass conversion

David W. Arnold
Professsor, Undergraduate Coordinator
Ph.D., Purdue University 1980
coal-water fuels • soil remediation

Christopher S. Brazel
Assistant Professor
Ph.D., Purdue University 1997
molecular design of polymer systems • drug delivery

Eric Carlson
Associate Profesor
Ph.D., University of Wyoming, 1986
numerical modeling of permeable media

Peter E. Clark
Associate Professor
Ph.D., Oklahoma State University, 1972
rheology of non-Newtonian fluids

Robert A. Griffin
Cudworth Professor; Director, Environmental Inst.
Ph.D., Utah State University, 1973
environmental • soil remediation

Duane T. Johnson
Assistant Professor
Ph.D., University of Florida, 1997
interfacial phenomena • magnetic dispersion technology • nonlinear dynamics

Tonya M. Klein
Assistant Professor
Ph.D., North Carolina State University, 1999
chemical vapor deposition for electronics

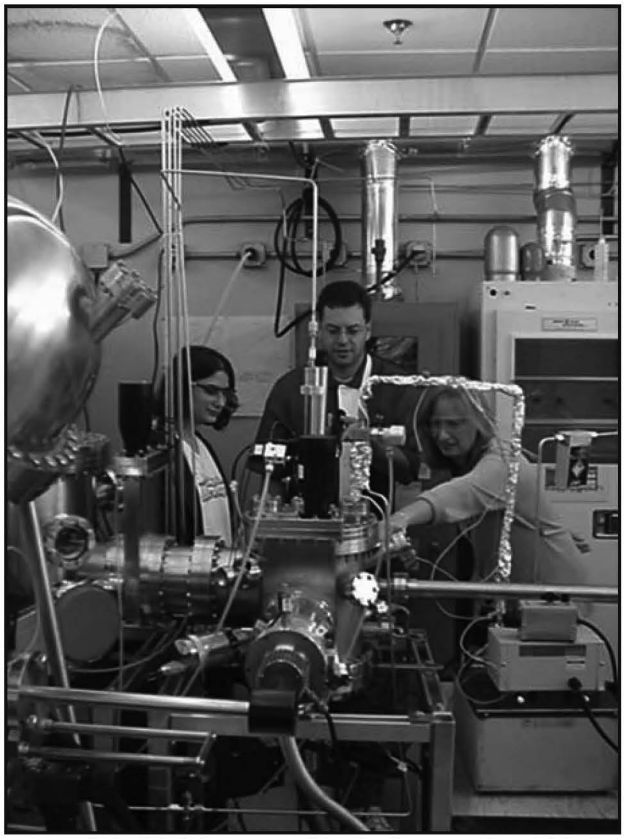
Alan M. Lane
Professor
Ph.D., University of Massachusetts, 1984
catalysis • colloids

Stephen M.C. Ritchie
Assistant Professor
Ph.D., University of Kentucky, 2001
advanced membrane structures for environmental separations

C. Heath Turner
Assistant Professor
Ph.D., North Carolina State University, 2002
chemical reaction simulations

Mark L. Weaver
Adjunct Associate Professor
Ph.D., University of Florida, 1995
microstructural characterization and tribology of bulk and thin films

John M. Wiest
Associate Professor
Ph.D., University of Wisconsin, 1986
molecular rheology • transport phenomena



Dr. Klein (right) runs a chemical vapor deposition experiment with researchers in her laboratory.

Dr. Lane (also known as the blues guitarist Doobie 'Doghouse' Wilson) gets his class involved in the Reynolds' Rap.

The students form the heart of the department, and their enthusiasm for UA chemical engineering shows at times such as E-Day, where the students take the lead role in preparing tours, demonstrations, and discussions for prospective engineering students from high schools across Alabama. The AIChE group also has a tradition of hosting a friendly picnic with the AIChE student chapter from one of our rival schools, Mississippi State.

As students progress through the curriculum, they can take advantage of numerous educational opportunities. Nearly thirty percent of the students are involved in cooperative education. Involvement in undergraduate research has increased significantly in the past five years, with more than one-third of the students working in a chemical engineering research lab.

The chemical engineering curriculum is centered around the traditional chemical engineering courses in material and energy balances, thermodynamics, and reaction and transport phenomena. The students also take advanced elective courses, two of which are technical—an advanced chemistry and an advanced chemical engineering course. The availability of engineering electives in chemical engineering has increased substantially with the influx of new assistant professors in the past five years. Four new junior/senior/graduate student electives have been taught for the first time at UA since 2000. Two additional electives can be selected from nearly anything offered on campus; students simply have to justify their selection by describing how the course will aid their careers. With the wide availability of courses at UA, many choose to fill these electives with business classes, biology courses, foreign languages, environmental engineering classes, or undergraduate research.

Summer Lab

One of the unique educational experiences at UA comes in the early summer after completion of the junior year. "Summer lab" is a five-credit-hour course that is perhaps the most intense unit operations laboratory in the country. Lab is in session from 8 a.m. to 5 p.m., Monday through Saturday, for five weeks. It is taught in May to early June each year to avoid scheduling conflicts and distractions for the students. If you were to ask an undergraduate about summer lab, you would likely get one of two answers: "It's scary, the time commitment is overwhelming," or "It was the most significant event during my time at UA." The first statement represents what summer lab looks like to the freshmen, sophomores, and juniors, while the attitude shifts as seniors realize that the intense working environment not only pulls together the theory they have learned in other chemical engineering courses, but also prepares them for their careers.

By working in teams of three-to-five students, the students gain valuable experience with team dynamics while they work on five different experiments led by three to four professors. The experiments change from year to year. Teams receive short assignments composed of one-paragraph statements at the first lab meeting on the first Saturday. After an extensive safety review, they are released to write proposals, determine equipment to be used, and perform preliminary work. The students must prepare a proposal that is approved by the faculty for each experiment, followed by two days to build and run the experi-

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ment, to compile and submit a technical report, and to present their results.

During the work, each group meets with the instructor to discuss experimental strategies and give progress reports. These meetings are designed to simulate an industrial setting; they are informal and may last as long as two hours. Team members answer questions on all aspects of the experiment at the proposal meeting. The challenge to create an acceptable proposal rests on the team and often requires several drafts. Great emphasis is placed on the proposal so the students understand what they are doing in lab and can get meaningful results. The instructors are heavily involved in supervision of the experiments.

The Tom Bevill building, home to chemical engineering at UA.

<u>Undergraduate Honors Program</u>

A relative newcomer to the undergraduate curriculum is an honors program specifically for chemical engineering students. The requirements to join it match that of the University Honors College, and the courses carry through the junior and senior year. This curriculum requires a total of twelve hours of honors classes, with at least six hours in chemical engineering. Honors forum classes are taught at two levels: sophomore level (beginning of ChE curriculum) and junior/senior level. The forum subject rotates from semester to semester, with different instructors delving into recent developments in chemical engineering, such as "Engineering the Hydrogen Economy" and "Bionanotechnology." The honors co-op and internship program allows advanced students to work with industrial mentors and to earn honors credit upon presenting project findings to faculty. Industrial recruiters have shown marked enthusiasm about the honors co-op program, and we will learn more as UA's chemical engineering honors program matures.

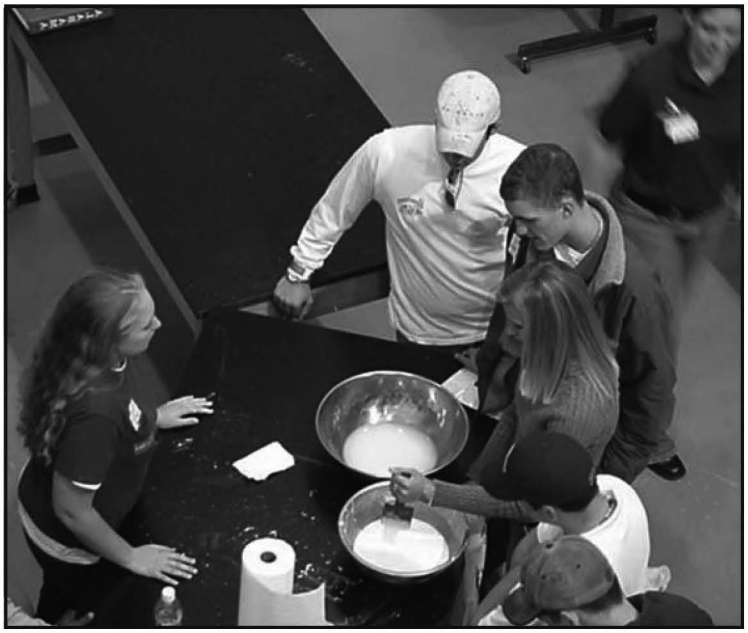
GRADUATE EDUCATION AND RESEARCH

The department has offered graduate degrees in chemical engineering since 1914. The emphasis has shifted over the last decade from masters to doctoral degrees. This has been accompanied by an increase in externally funded research from just under $1 million to more than $3 million in 2003. The laboratories and graduate student offices were custom designed by the faculty when the building was constructed in 1994.

A hallmark of our research program is collaboration with chemists, physicists, biologists, mathematicians, and other engineers in a variety of campus-wide research centers. The Center for Materials for Information Technology (MINT) was established in 1990 in response to JVC's 1986 decision to locate a magnetic tape manufacturing facility in Tuscaloosa, as well as a large concentration of the data storage industry in the Southeast. Chemical engineering faculty (Arnold, Johnson, Klein, Lane, Weaver, Wiest) joined other faculty in science and engineering to earn an NSF Materials Research Science and Engineering Center grant in 1994 (the first ever in the Southeast) with renewals in 1998 and 2002. The emphasis is on developing new materials for high-density data storage and spintronics.

Mercedes-Benz located their only US-based production facility in Tuscaloosa in 1993, manufacturing the M-class SUV here. Honda, Hyundai, Nissan, Toyota, and the supporting industrial suppliers followed soon after, making the region a center for automobile manufacturing. UA supports this industry through the Center for Advanced Vehicle Technology, in which the multidisciplinary fuel cell research group plays a leading role. With a focus on materials, chemical engineering faculty (Lane, Wiest, Turner, Klein, Ritchie, Weaver) are developing new catalysts for hydrogen production and fuel cells.

A microelectromechanical systems (MEMS) laboratory was established in 2002. Initial work by Klein and collaborators focuses on the microfabrication of gyroscopes. They recently won an NSF grant to incorporate MEMS technology into the undergraduate program.



A sophomore demonstrates complex viscosity properties to high school students on E-Day.

A long-standing departmental emphasis on environmental research is now complemented by the university's Center for Green Manufacturing. Major projects have included waterborne magnetic inks (Lane, Arnold), biomass conversion (April), soil remediation (Arnold), and benign solvents and additives for the polymer industry (Brazel).

The mining and petroleum industries remain a vital part of the Alabama economy and are served by Carlson (subsurface modeling) and Clark (complex rheology). Clark was recently honored as a Society of Petroleum Engineers Distinguished Lecturer. He presented invited lectures throughout the U.S. during the 2002-2003 academic year.

The department is particularly proud of its NSF CAREER award recipients. Mark Weaver has been studying multilayer thermal barrier coatings since 1999, addressing the influence of thermal exposure on the interfacial microstructure. Tonya Klein began her work in the fall of 2003 on plasma-enhanced, atomic layer deposition, which is an advancement of traditional chemical vapor deposition.

Charlotte Nix runs a demonstration of environmental hazards of oil contamination for Project ROSE. The audience included high school students and their parents who were visiting the UA campus for E-Day.

The strong collaborations among chemical engineering faculty, their colleagues across campus, and the industries we serve result in a fun and exciting atmosphere in which to conduct truly cutting-edge research.

OUTREACH PROGRAMS

Among the various outreach activities of the Department, Project ROSE (Recycled Oil Saves Energy) stands out in both statewide impact and longevity. Project ROSE, under the direction of Gary April, has been running successfully for 27 years. It involves both a public awareness arm and activities to aid local communities in Alabama in collecting used motor oil for reclamation and recycle. Outreach to school groups includes environmental models to explain the effects of point source and non-point source contamination on ecosystem management. Project ROSE is run by two chemical engineering staff members: Ms. Sheri Powell and Ms. Charlotte Nix, who conduct demonstrations throughout the state. Project ROSE recently celebrated its active presence in all 67 Alabama counties.

THE FUTURE

UA's Chemical Engineering Department maintains an active role in the national curriculum reform efforts, striving to balance the important core concepts at the heart of chemical engineering with changing and emerging technologies. We are forging new relationships with the biological sciences department on campus and continue to expand our research programs through collaborations within and beyond the Tuscaloosa campus. Ultimately, our commitment to education is expressed in the opportunities afforded our students and the careers of our graduates.

ROLL TIDE ! ❐