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Mechanical engineering technology students building cars for international competitions

APRIL 6, 2007

At first glance, it appears to be a typical scene in this car-crazy country:

A group of young people, gathered around a vehicle, tinkering with the engine, adjusting the suspension, customizing the body.

In this particular case, however, the people are not shade-tree mechanics prepping a hot rod for an evening at a rural dirt track, or a pick-up truck for an afternoon at a mud boggin'.

Instead, they are mechanical engineering technology students at Georgia Southern University, and they are building from scratch two vehicles that will be entered in a pair of international competitions sponsored by the Society of Automotive Engineers (SAE).

One group of 18 students is producing a single-seat, four-wheel, off-road recreation vehicle for the Baja competition that will be hosted by the University of Central Florida in Ocala, Fla., on April 12-15.

Some of the same people are also among a second group of 15 students that is building a single-seat, open-cockpit, open-wheel car for the Formula competition that will be held at the Ford Michigan Proving Grounds in Romeo, Mich., on May 16-20.

"These projects allow our students to validate what they have learned in the classroom," said Brian Vlcek, an associate professor in the Department of Mechanical and Electrical Engineering Technology and the faculty mentor for the Baja and Formula teams. "They get to demonstrate the ability to work as a team, and the ability to complete a project. Those are the kinds of traits that employers are looking for."

The SAE has more than 90,000 members in almost 100 countries. The organization includes engineers, business executives, educators and students who share information and exchange ideas for advancing the engineering of mobility systems.

Through its Baja and Formula competitions, the SAE challenges college students with real-world engineering projects in which teams build and eventually race their own vehicles. Each vehicle must be conceived, designed and fabricated by students without any direct involvement from faculty, professional engineers or experts from the world of Baja and Formula racing.

At Georgia Southern, one of the projects typically serves as a capstone project for seniors who are enrolled in the mechanical engineering technology program, which is housed in the Allen E. Paulson College of Science and Technology (COST). The other project is a club activity of Eagle MotorSports, an organization that is open to all of the University's students.

"The Baja and Formula projects require our students to draw upon previously learned skills from across the curriculum," Vlcek said. "In addition to teamwork and design integration, the projects encourage technical communication abilities through written reports and live presentations."

‘Ultimately, the work contributes to each student’s sense of self-confidence in their abilities as they contribute to a project with real-world authenticity and rigor.’

There is a very specific set of rules and regulations for each competition. For example, the maximum budget for each Baja vehicle is \$5,000, but teams are allowed to exceed that figure and take a proportionate point deduction in the competition. Georgia Southern’s team spent \$1,800 for last year’s event.

‘Quite a few SAE officials came by to see our car,’ Vlcek said, ‘and they could not believe a working vehicle was completed on such a tight budget.’

On the other hand, the Formula rules allow each team to spend a maximum of \$25,000 per car, although they, too, can exceed that amount and take a point deduction.

According to Vlcek, the Formula teams at some institutions are rumored to pour as much as \$60,000 into the project, a figure that includes spare parts, tools and travel. Georgia Southern’s team spends around \$4,500 each year in the Formula competition.

Most of the money for the Baja and Formula projects at Georgia Southern usually comes from fund-raising projects and donations. Eagle MotorSports generated some funds in March by co-hosting a classic car show that featured more than 50 vehicles on display in the parking lot of the local Kmart.

This year’s projects received an additional boost from the COST College Office of Undergraduate Research (COUR), which provided \$3,800 in applied research grants.

‘We’ve been fortunate to receive the support from COUR,’ Vlcek said. ‘It really cut down on the number of car washes the teams had to organize, and allowed the students to really focus on their vehicle design.’

Financial issues aside, the Baja rules also dictate that, among other things, each vehicle be able to accommodate a driver who is 6-foot-3 and 250 pounds, and that each vehicle be able to float and propel itself across a water obstacle. In addition, every Baja vehicle must be powered by a 10-horsepower lawn mower engine donated by Briggs and Stratton.

Meanwhile, teams in the Formula competition are not required to utilize the same kind of motor, but they must use a motorcycle engine that does not exceed 600 cubic centimeters in size. There are also significant restrictions on air intake, which further limits speed and power.

According to Vlcek, the Baja and Formula projects at Georgia Southern are set up to run like a small business.

‘For each project, there are groups of students that are responsible for coming up with the design of specific components, such as the frame, the braking and steering systems, the suspension system, and so on,’ Vlcek said. ‘Team members are coordinated by a team leader, who in turn reports to a student project manager.’

The process begins with the design phase. The students examine previous Georgia Southern vehicles, and they use the Internet to study successful and not so successful vehicles produced at other institutions.

‘The various team members have to communicate with each other to ensure that the different systems will work together,’ said Dustin Gaddis, a senior from Buford, Ga., and the president of Eagle MotorSports, which is producing the Formula car. ‘For example, the suspension cannot take up room needed by the drive train.’

The analysis and modeling phase is next. Hoping to maximize strength while minimizing weight, students use hand calculations and computer programs to test their prototypes.

‘Computer simulations are run to see how each system will react under certain driving conditions,’ Gaddis said.

In addition, prototype frames are often built out of PVC pipe and duct tape to test for driver fit and comfort, and scale models are generated to ensure integration between the various components.

Next comes the redesign phase, where flaws in the original design are corrected.

‘If we discover the original design doesn’t meet certain goals if the frame isn’t stiff enough, for example, or if the suspension geometry changes too much as the wheels move up and down we change things until we get the desired results from the analysis software,’ Gaddis said.

Once the redesign is complete, the actual fabrication process begins in the shop of the Science and Technology Building.

‘About half of each vehicle is built from scratch, and half from off-the-shelf components,’ Vlcek said. ‘We don’t build our own shock absorbers when we can buy them better and cheaper.’

Significant parts of each vehicle are fabricated by the students, though.

‘We are building the frame, suspension arms, intake manifold, exhaust manifold, pedals and all the brackets used to hold everything together, just to name a few things,’ Gaddis said of the Formula car.

Georgia Southern’s Formula car is 96 inches long and 60 inches wide. Weighing approximately 500 pounds, it features a 600 cc Suzuki GSX-R engine that produces 100 horsepower and will allow the vehicle to go from zero to 60 mph in 3.8 seconds.

The University’s Baja vehicle is 92 inches long and 50 inches wide. It weighs around 420 pounds and will have a top speed of close to 30 mph.

‘The process usually goes right down to the wire, so we are fortunate to have a day or two to test the vehicles before we have to leave for the competitions,’ Vlcek said. ‘We drive them around campus and try to run over a lot of curbs to test the suspension. Also, the Baja car takes a swim in the pond in front of the College of Education Building.’

All entries in both the Baja and the Formula competitions are judged on a variety of criteria, including design and cost. Every vehicle has to be accompanied by a written report that details the design process and the production costs.

'The vehicles must pass a grueling safety test, and I typically consider it a major accomplishment just to get through that phase,' Vlcek said. 'It's not uncommon for a team to have 10 or 15 problems with its vehicle. You usually have 24 hours to get the problems corrected.'

If and when they get past the safety inspection, the cars are subjected to further scrutiny. The Baja vehicles are tested for acceleration and traction, and they must negotiate a challenge course filled with obstacles such as rocks, sand and logs. The Formula cars are tested for acceleration and fuel economy, and they are driven on an autocross track that evaluates their maneuverability.

Seventy-five teams from across the United States, Canada and Mexico have signed up for the Baja competition. The Formula competition is expected to attract 130 teams from a dozen countries, including Australia, Brazil, Japan and the United Kingdom.

Regardless of how Georgia Southern's vehicles fare in Florida and Michigan, the projects have already proven to be an invaluable experience for the students.

'Even though it is a lot of work, there are lots of rewards,' Gaddis said. 'You get the chance to apply concepts learned in the classroom to a real-world situation, and you also learn a lot of things you don't learn in a classroom.'

'Finally, when it comes time to graduate, being a part of a project like this is a great thing to talk about with potential employers.'

Student research is focus of April 20 Phi Kappa Phi Symposium

APRIL 6, 2007

Thirty Georgia Southern students will present their yearlong research projects at the University's annual Phi Kappa Phi Research Symposium on Friday, April 20. The event, which includes both presentations and a poster session, begins at 8:30 a.m. in Room 3301 of the College of Information Technology Building and concludes at 2:30 p.m. Both the University community and the public are invited to attend.

The symposium committee has approved 19 research projects with topics that vary from 'In Defense of the Peripheries: The Genesis, Resolution, and Impact of the *Darby Case*' to 'A Qualitative Analysis of Dating Practices and the Shift over Time' to 'A Molecular Modeling Study of the Aluminum Chloride-Promoted Reduction of Benzylidene Acetals.' The students' research presentations will begin at 9:45 a.m. and continue until 1:15 p.m.

The symposium committee has also approved 11 research projects for poster sessions. From 1:00 to 2:30 p.m., students will display posters and be available to discuss their research in Room 3301. A list of presentations and posters is below.

Phi Kappa Phi is the oldest and largest collegiate honor society dedicated to the recognition and promotion of academic excellence in all disciplines. Since its founding in 1897, more than 1 million

members have been initiated. Phi Kappa Phi has chapters on nearly 300 select colleges and universities in North America and the Philippines.

Presentations at the April 20 Phi Kappa Phi Symposium at Georgia Southern University:

Primitive Na⁺ / H⁺ Exchangers in Fish

Author: Amanda M. Fischer – Faculty Mentor: Dr. J.B. Claiborne

Distribution of Grunt and Snapper Populations in a Mangrove Atoll at Multiple Scales of Habitat

Author: Perry Hampton Harbin -Faculty Mentor: Dr. Bret S. Danilowicz

A Molecular Modeling Study of the Aluminum Chloride-Promoted Reduction of Benzylidene Acetals

Author: Javoris Hollingsworth (McNair Scholar) -Faculty Mentor: Dr. K.T. Welch

Simulation and Analysis of a Clinical Trial

Authors: Changlu Liu – Faculty Mentor: Dr. Karl E. Peace, Shrikrishna Shroff, Jiehui Zhu

Case Study: Starbucks `Corporate Social Responsibility

Author: Monica Galvan Burgueno – Faculty Mentor: Dr. Pamela Bourland-Davis

Genocide and Semantics: Projection as a Reflection

Author: Rebekah R. Lovell – Faculty Mentor: Dr. Chris B. Geyerman

A Qualitative Analysis of Dating Practices and the Shift over Time

Author: Christy Curry -Faculty Mentor: Dr. Beverly Graham

Primetime Desperate Housewives Compared to Daytime Soap Opera

Author: Rachel Sampson – Faculty Mentor: Dr. Beverly Graham

Theoretical Dynamics of Competing Values: European Integration and Turkish Accession

Authors: Danielle L. Smith – Faculty Mentor: Dr. Charles Crouch, Maureen E. Wilson

In Defense of the Peripheries: The Genesis, Resolution, and Impact of the *Darby Case*

Author: Stephen M. Smith – Faculty Mentor: Dr. Jonathan O'Neill

Art of the World War II Era and Holocaust

Author: Maggie P. – Faculty Mentor: Dr. Julie McGuire

The Great Debate: An Analysis of Judicial Campaigns and Judiciary Independence

Author: Ashley L. Scruggs (McNair Scholar) – Faculty Mentor: Dr. Rebecca Davis

Anxiety on the Strip: An Examination of Predictors of Precompetitive State Anxiety in Epee Fencers

Author: Elizabeth Athanas – Faculty Mentor: Dr. Johnathan N. Metzler

Perceived Job Satisfaction, Job Stress and its Effect on Health: A Pilot Study of Women in the Workplace

Author: Jenna N. Pinkston (McNair Scholar) – Faculty Mentor: Dr. Joanne Chopak-Foss

Understanding the Career-ending Injury: A Phenomenological Analysis

Author: Christina Rapp – Faculty Mentor: Dr. Daniel R. Czech

An Examination of the Experience of Music in Sport among NCAA Division I Athletes: An Existential Phenomenological Investigation

Author: Lacey M. Sorenson – Faculty Mentors: Dr. Daniel R. Czech, Dr. Jim Klein, Dr. Tony Lachowetz

WebCt Changing GSU

Authors: Jo-El Rowell – Faculty Mentor: Dr. Joseph Barjis, Sidney Parker Newton, Michael Hamilton, Nick Brown, Jeff Martin

Comparison of Anticipation Times among College Students when Provided Optimistic, Pessimistic, and Neutral Feedback

Authors: Christina Rapp – Faculty Mentor: Dr. Daniel R. Czech, Marlena Kincaid, Gina Sterchi, Dana Jones, Courtney Jennings, Justin Smith, Erik Wilder

The Experience of Preshot Routines among Professional Golfers: An Existential Phenomenological Investigation

Author: Allison K. Yancey – Faculty Mentor: Dr. Daniel R. Czech, Dr. Barry Joyner, Dr. Drew Zwald

1:00-2:30 PM: Poster Sessions – IT 3301

Exploration of Raman Spectroscopy

Author: Thomas Anderson – Faculty Mentor: Dr. James M. LoBue

A Preliminary Examination of Coaches' Perceptions and Experiences of Spirituality in Sport: A Mixed Methodological Study

Author: Erin S. Bullett – Faculty Mentor: Dr. Daniel R. Czech

Health Behaviors and Cancer Screening Knowledge in Six Georgia Counties: A Pilot Investigation

Author: Kelley G. Chester – Faculty Mentors: Dr. Gerald Ledlow, Dr. Laura H. Gunn

Genome Sequence of NHE2A in the Long Horned Sculpin

Author: Catherine Hall – Faculty Mentor: Dr. J.B. Claiborne, Dr. Andrew Diamanduros

Modeling the Dynamics of Mixtures of Bose-Einstein Condensates

Authors: Laura Halmo – Faculty Mentor: Dr. Mark Edwards, Charles Holcombe

The Octagon: A Qualitative Study of the UFC

Author: Matthew Harpold – Faculty Mentor: Dr. Daniel R. Czech

Rh Glycoproteins

Authors: Jamie E. Phillips – Faculty Mentor: Dr. J.B. Claiborne

Response Time Differences within the Game of Soccer: An Applied Intervention Investigation

Author: John Scott – Faculty Mentor: Dr. Daniel R. Czech

Synthesis of PNPg

Author: Derick J. Sharpe – Faculty Mentor: Dr. Michael O. Hurst

Optimism-Pessimism and Achievement Motivation Levels in Youth Tennis Players: A Cross Cultural Study

Author: Eleanor Shearman – Faculty Mentor: Dr. Daniel R. Czech

Analyzing the Assessment of Optimism in Sport

Author: Samuel J. Whalen – Faculty Mentor: Dr. Jonathan N. Metzler