Lawrence Tech
THEORY AND PRACTICE 1932

INNOVATION

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Fabulous Fiber

How Lawrence Tech researchers are saving lives and cutting costs

Lawrence Tech INNOVATION

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On the cover: Engineering students at Lawrence Tech can participate in ground-breaking research on carbon fiber reinforced polymer (CFRP) materials conducted at the Center for Innovative Materials Research (CIMR). Here, civil engineering students Mena Eskander Bebawy and Chenglin Wu prepare a bridge beam for an ongoing research project that has demonstrated the advantage of replacing steel with CFRP in concrete highway bridge construction.

From the **Dean**

You hold in your hands the inaugural issue of *Lawrence Tech Innovation*, which details many of the exciting advancements and projects of the College of Engineering.

Lawrence Tech's College of Engineering, 75 years young this academic year, has always been forward thinking. We have been a college that celebrates inquiry and achievement, and one in which each student is important and valued. Our aim at Lawrence Tech is to prepare our graduates to be outstanding professionals characterized by integrity, social responsibility, and a global perspective.

As we look ahead, we realize that strong forces of change, rapidly evolving new technologies, and globalization are driving major changes in the role of the engineer working within a globally-integrated business environment. Today's businesses require new skills and competencies to address those challenges.

Lawrence Tech is committed to assuring that new generations of engineers and technologists enter the world of work prepared and dedicated to serving their employers, professions, communities, and society. To this end, we have assembled a team of caring, accomplished faculty; created well-equipped facilities; and have sought to develop applied research and other opportunities that meld the "theory and practice" approach to education that has for so long distinguished the Lawrence Tech educational experience.

Having come on board as dean earlier this year, I was amazed to see the range of activities and interests of our students and faculty. This new magazine helps us share that excitement with you, and provides some examples of our engagement with our constituencies. I hope you will join with us as we work to create the future. I look forward to seeing you on the campus.

Sincerely,

Devdas Shetty

Devdas Shetty, PhD, PE
Dean, College of Engineering

Opened in 2006, the Center for Innovative Materials Research (CIMR) will have four major research capabilities by the end of this year. The facility can test bridge components up to 100 feet long. A fire chamber can provide tests in temperatures up to 2,300 degrees Fahrenheit, while nanotechnology equipment can test the tensile strength of nanotubes. An environmental/loading chamber to be completed later this year will simulate a wide range of climatic conditions.

Fabulous Fiber

At Lawrence Tech's pioneering Center for Innovative Materials Research, advanced composites containing fiber are being developed for everything from highway bridges to army tanks

Nabil Grace

On the road. In the home. At the workplace. On the battlefield. Saving lives and reducing injuries is the ultimate goal of faculty and student researchers in the College of Engineering at Lawrence Technological University.

And it all starts with a simple substance – fiber.

Nabil Grace, chair of the Department of Civil Engineering at Lawrence Tech, has devoted the past 20 years to developing advanced composites, fabrics and plates that consist of various types of fibers oriented in different directions with various ratios – such as carbon, aramid, or glass – mixed with polymer resin. The resultant structural components material is much stronger than steel but just one-fifth the weight.

In 2004, Grace was awarded a U.S. patent for hybrid ductile fabric based on his research, funded by the National Science Foundation, into hybrid carbon/glass-fiber reinforced polymer (C/GFRP). A year later, he secured a major new source of funding when the U.S. Army recognized that his research has tremendous potential for military as well as civilian applications.

Today, Grace and his research teams are studying the use of carbon fiber reinforced polymer (CFRP) materials in everything from concrete highway bridges to army tanks at Lawrence Tech's Center for Innovative Materials Research (CIMR), constructed in 2006 as part of an $11 million cooperative research agreement with the Army Research Laboratory.

Bridge to the Future

Bridges are the focal point of much of the current research at Lawrence Tech. Grace's studies have revealed that concrete bridges could last as long as 100 years – double their current life span – if innovative design coupled with CFRP reinforcements and prestressing strands are deployed in new construction or upgrading existing deficient infrastructure.

"Today we use steel rods, or what is called rebar or epoxy-coated strands, when building bridges," Grace explains. "In a harsh environment, the rebar and strands experience significant corrosion and the concrete begins to crumble after about 15 years. This is a common problem among conventionally reinforced and prestressed concrete bridges. If we replace that with something that's not going to corrode, coupled with an innovative design approach, the problems disappear."

Before concrete is poured into forms for bridge beams to be tested at CIMR, Lawrence Tech students must check the tags on the sensors used to record load measurements. Pictured are (L-R) Joseph Hanson, Cheng-lin Wu, Delali Noamesi, project manager Tony Magnan, Prasadu Penjendra, Mheb Labib and Eslam Soliman.

In the short run, CFRP costs as much as five times more than steel. But over the long run, it is far less expensive when the overall life cost cycle of a bridge is calculated to reflect maintenance and reconstruction, not to mention those irksome detours for motorists while repairs are being made. Further, CFRP costs represent only a small portion of the total cost of a bridge, thus the use of CFRP does not increase the total cost by a factor of five.

Those dollar costs can be calculated. (A recent life cycle cost analysis suggested that a conventional bridge with its planned maintenance is about three times the cost of a CFRP-reinforced bridge).

> "The resultant structural component material is much stronger than steel but just one-fifth the weight."

The Maine Department of Transportation, the Federal Highway Administration, and design firm Figg Bridge Engineers Inc. selected Lawrence Tech's University Distinguished Professor Nabil Grace to assist them in selectively using carbon fiber composite cables for demonstration testing in a new cable-stayed bridge near Bangor. Maine, federal, and private design engineers engaged Lawrence Tech because it was the only source of significant research on the use of carbon-fiber-composite cables in bridges.

What cannot be calculated, but is even more significant, is the potential savings in human lives. Recent history provides a chilling example. On Aug. 1, 2007, the I-35W bridge over the Mississippi River in Minneapolis collapsed during the evening rush hour, plunging dozens of cars into the water. Thirteen people died and more than 100 were injured.

While a disaster of that magnitude is rare, the Minnesota collapse dramatizes the need for safer, long-lasting, and better maintained bridges. "For a tragedy like this to happen in the United States is terrible," Grace maintains. "It says we are way behind. We need to be more innovative and look for materials that last longer and wear better."

Government statistics tell a stark story. It is estimated that 150,000 of the 600,000 bridges in the United States – one in four – are in need of replacement. In Michigan, which has 10,887 bridges, the Federal Highway Administration estimates that 1,746 are structurally deficient and 1,309 are functionally obsolete. Much of the damage is the result of corrosion caused by salt and other chemicals.

With figures like that in mind, Grace and his research staff teamed with the Michigan Department of Transportation (MDOT) to obtain a $900,000 award from the Michigan Economic Development Corporation (MEDC) to research the use of CFRP in the construction of box beam bridges. Lawrence Tech is the only school in Michigan doing such research.

The carbon fiber design approach developed by Grace and designed by Hubble, Roth & Clark Consulting Engineers (HRC) of Bloomfield Hills, Mich., has already been adopted for the Bridge

> "The $8 million Bridge Street span was the first highway bridge built on Grace's research"

Street Bridge in Southfield, which spans a tributary of the Rouge River and carries traffic to an industrial park northwest of Detroit. This research/design approach was sponsored by the National Science Foundation for a number of years. In this deployment project, the City of Southfield used traditional, steel-reinforced concrete for one span and an innovative CFRP-prestressed concrete Double-T design for a parallel span.

During construction and in collaboration with HRC, a complex system of instrumentation and monitoring devices was embedded in the structural elements of both bridges. A five-year monitoring program, including load tests on both spans, was completed in December 2006, and recent additional funding from MDOT and the City of Southfield will enable monitoring to continue for another decade. The data collected will be made available to researchers, design engineers, federal and state transportation authorities, and the National Science Foundation.

The $8 million Bridge Street span was the first highway bridge built based on Grace's research. The project design and research team won the Precast/Prestressed Concrete Institute's Harry H. Edwards Industry Advancement Award. The American Consulting Engineers Council of Michigan and the Michigan Society of Professional Engineers awarded the engineering design and research team the Eminent Conceptor Award – the highest award for engineering excellence for outstanding achievement for an engineering or surveying project.

Going forward, the City of Southfield also plans to use CFRP reinforcements in place of steel on the Beech Road Bridge it is building next year, and MDOT plans to build three new bridges made of the material over the Southfield Freeway (M-39) in 2010.

U.S. Sen. Carl Levin, D-Mich., chairman of the Senate Armed Services Committee, visits Lawrence Tech and speaks with students to learn about the CIMR's research into carbon fiber reinforced polymers and other advanced materials for both civilian and military applications.

Beyond Civil Engineering

It is anticipated that this innovative structural system and study of its behavior will result in aggressive future deployment of advanced CFRP and hybrid combinations of various fiber composites in many more applications in and beyond civil engineering; in fact, this technology is already used in the automotive and aerospace industries.

For example, the composite structural elements developed by Grace are also capable of trimming the weight of components in automotive or tank applications, thereby lowering fuel costs and improving maneuverability. In public structures, such as high-rise and critical buildings like embassies, the use of composites could increase strength and reduce vulnerability to weather-related corrosion – and possibly even terrorist attacks.

In 2005, the U.S. Army, recognizing the potential for military applications, took note of Grace's research. This led to a five-year, $11-million agreement that included funding for the design and construction of the Center for Innovative Materials Research (CIMR). The $3.2 million, 7,200-square-foot full-scale testing facility opened in 2006 and features a 30-foot clearance height and a 25-ton crane to accommodate the testing of full-scale structural components, such as portable battlefield bridges up to 100 feet long.

At CIMR, researchers can test structures subjected to static, repeated, and impact loads of up to 1 million pounds using a 160 GPM closed-loop hydraulic system, and a high-temperature fire/loading chamber (up to 2,300 degrees Fahrenheit with repeated and impact loading capabilities of 125,000 pounds). This makes it possible to investigate how conditions similar to those of the 9/11 terrorist attacks on the World Trade Center affect the critical structural components of buildings and other structures.

CIMR is unique; there is no other laboratory in the United States where combinations of these types of tests could be carried out simultaneously. Current projects now in progress include:

• Developing and testing new carbon fiber materials for use in lightweight body armor, lightweight military vehicle applications, and impact mitigation.

• Developing and testing materials that strengthen and prolong the life of critical structures, including buildings, bridges, military complexes, and airports.

The U.S. Army has turned to Lawrence Tech to conduct a number of tests on components used on High Mobility Multipurpose Wheeled Vehicles, known as Humvees. Later this year, an environmental/loading chamber will begin testing equipment under both repeated and static loads in climatic conditions representing those from Iraq to Antarctica.

• Developing vehicle armor protection for U.S. military applications.

Last year, Lawrence Tech enhanced its reputation even further by securing a $1 million federal appropriation to build an environmental/loading chamber for testing vehicle components for military uses. This latest addition to CIMR is scheduled to be completed this summer.

The environmental/loading chamber, made of insulated ceramic blocks, will be 20 feet long, 12 feet wide, and 12 feet high. It will sit on an insulated floor, surrounded with a heavy steel testing superstructure to hold a large-size actuator, a device built into the roof of the chamber and capable of delivering impact blows with up to 150,000 pounds of force on components being tested. The environmental/loading chamber will replicate the impact of both repeated and static loads in simulated climatic conditions ranging from Iraq to Antarctica.

Thanks to these cutting-edge learning, research, and testing facilities at Lawrence Tech, undergraduate and graduate students alike play important roles on teams that are addressing complex and challenging engineering problems. Even some first-year students are actively involved on these projects, gaining exposure to these state-of-the-art facilities and sharpening their competitive edge.

Grants Galore

Since his arrival at Lawrence Tech from the private sector 20 years ago, Nabil Grace has won more than 20 grants and contracts totaling more than $13 million with his proposals for innovative research.

The grant money has supported ongoing improvement of facilities and equipment, leading to bigger and more innovative research projects. State-of-the-art facilities attract energetic faculty members and more qualified students, who are in great demand when they enter the job market.

These graduates are well prepared for professional careers or advanced study because the combination of Lawrence Tech's facilities, faculty, and ongoing challenging research projects provide a dynamic learning environment and serious interaction between faculty members and their students. Students gain both a strong educational foundation and practical experience with a leadership approach outside the classroom.

"Schools must have outstanding professors and good students in order to grow. We have been able to attract both at Lawrence Tech with innovative projects that win the support of grants," Grace says. "It has to be a continuous process. You can never stop innovating if you want to continue to grow and improve."

A native of Egypt who earned his bachelor's degree in civil engineering at Cairo University, Grace came to the United States by way of the University of Windsor (Ontario), where he earned his master's degree in 1981 and his PhD in 1986.

During four years as a group leader at Giffels Associates Inc., an architectural engineering firm in Southfield, Grace gained a greater appreciation for the ability of private enterprise to solve problems quickly. He also learned there is no substitute for experience in the field.

When he came to Lawrence Tech, he wanted to replicate both the problem-solving approach and practical experience that he experienced in the private sector. That required getting students out of the classroom and into testing facilities where they can see how theoretical solutions stand up when put to the test.

Lawrence Tech's administrators were receptive to his ideas, but the University didn't have the financial resources of a large public university. Consequently, Grace created a business model to generate the financial support needed to implement his educational vision.

Grace started his quest for funding with the National Science Foundation. Since 1988, he has won more than a dozen NSF grants totaling more than $3 million. These and other grants from MDOT, Ohio-DOT, NYDOT, Maine-DOT, US-DOT, MEDC, and industry partnerships helped pay to fit out a high-bay Structural Testing Center and additional testing equipment and significant space for research.

Current research projects at the Center for Innovative Materials Research are supported by a variety of grants that Grace has attracted with innovative proposals, including:

- Michigan 21st Century Fund, Michigan Economic Development Corp. (2006-11), $899,996.
- Michigan Department of Transportation (2006-09), $168,000.
- U.S. Department of Defense (2006-11), $1 million.
- U.S. Department of Transportation (2006-11), $1.17 million.
- National Science Foundation (2005-09), $400,000.

Tower of Power

From fuel cells to wind turbines, Lawrence Tech's state-of-the-art Alternative Energy Engineering Laboratory gives students the opportunity to study a wide range of emerging energy technologies

There is a lot of talk about new energy sources these days, but the fact of the matter is that traditional energy sources, such as fossil fuels, still account for over 94 percent of the energy used in the United States.

At Lawrence Tech, the emphasis is on action – not talk – when it comes to alternative energy technologies. The College of Engineering has developed curricula that give students the opportunity to study a broad array of emerging energy-related topics, or to focus in specific areas of energy engineering, all with practical applications in real-world settings.

Michigan Gov. Jennifer Granholm got a quick lesson in how to use CATIA V5 software when she visited the Alternative Energy Engineering Laboratory in February. The governor visited campus to learn about alternative energy initiatives at Lawrence Tech, which she views as key to diversifying Michigan's economy.

Associate Professor Robert Fletcher, left, demonstrates some of the equipment he has assembled in Lawrence Tech's Alternative Energy Engineering Laboratory. Students gain hands-on experience related to solar energy, wind turbines, fuel cells and other applications.

The University augments its academic curricula with cutting-edge research at its Alternative Energy Engineering Laboratory. This state-of-the-art lab, which opened in 2005, enables students to participate in hands-on learning, specifically in the fields of energy conservation, solar energy, wind turbines, and fuel cells.

Diversity is the key to the success of Lawrence Tech's approach to alternative energy education and research, explains Robert W. Fletcher, associate professor of mechanical engineering and director of Lawrence Tech's Alternative Energy Engineering program.

"The best way to proceed to meet future energy needs is not to lock into one single technology or one single energy source," Fletcher notes. "At Lawrence Tech, our College of Engineering faculty and students are studying a diverse array of energy sources. That diversity prevents us from getting hooked on any one system, like fossil fuels."

Since much of the work in alternative energy is still in its early phases, Fletcher notes, it's too soon to say for certain which of the various technologies will become future champions and which will fall by the wayside.

Robert W. Fletcher

"We are trying to give our students a career, not just a niche of knowledge," he adds. "We need to expose them to all of these different technologies at some level. If they want to zero in and focus on one

Fuel Cell Research

The U.S. Army is deeply interested in how various types of fuel cells operate under different environmental conditions. Faculty and student researchers at Lawrence Tech's Alternative Energy Engineering Laboratory are providing some of the answers.

Under a contract with the Army's Tank Automotive Research, Development and Engineering Center (TARDEC), Lawrence Tech is conducting reliability and durability tests on PEM (proton exchange member) fuel cells. To date, the study has logged more than 2,000 hours of test time on these fuel cells.

"In effect, Lawrence Tech is serving as an early studier or evaluator for the Army," explains Robert Fletcher, director of the school's Alternative Energy Engineering program. "We basically run the tests and say to the Army, 'If you do this you will see this result. If you do the other thing, you will see these other results.' It gives them a preliminary assessment of what to expect with these devices."

Six students are now working on the project at the University's well-equipped Alternative Energy Engineering Laboratory. The facility features several solar PV technologies and solar hot water heating systems, some of which were built by students.

"The Army likes it because we can do the testing for them at a fraction of the cost, so it saves them money and often a lot of time," Fletcher adds.

Lawrence Tech students Jacob Bushon, Yajnanarayana Somayali, and Mike Samaroo examine results from a test on fuel cells, a long-term research project conducted in the Alternative Energy Engineering Laboratory for the U.S. Army.

> Ultimately, the goal of this effort is to give students the education they need to secure a productive career

Since 2005, Lawrence Tech's Alternative Energy Engineering Laboratory has collected data from a 10 Kw system of photovoltaic panels on the Engineering Building roof. Students designed and built the solar energy demonstration system that generates enough electricity to power a large home, thanks to a grant from the Michigan Department of Labor and Economic Growth.

area, they can do that. But it's important that we give them the breadth as well as the depth of knowledge, and that makes us unique when compared with other schools."

Ultimately, the goal of this effort is to give students the education they need to secure productive careers as working energy engineers, as well as the theoretical foundation needed to pursue advanced engineering degrees or undertake research in the emerging alternative and renewable energy field.

"We are preparing students for jobs five, 10, 15 years down the road – for jobs that don't even exist yet," Fletcher points out. "That's a fundamental cornerstone in our whole approach of what we're doing here. We're trying to stay away from 'fad of the week' and instead give our students the fundamental skills that can carry them into a career. The students are in tune with this. They see this as the future, and they're excited to be a part of it."

Energy Engineering

Lawrence Tech now offers an undergraduate minor concentration in energy engineering designed to provide students with a better understanding of alternative and renewable energy sources, traditional fossil fuels, nuclear energy, energy management, and conservation. The courses are also offered to practicing engineers as a certificate program.

Core courses for the minor cover alternative energy fundamentals, applied thermodynamics, and energy resources and technologies. Students can choose from 14 electives covering topics such as energy and environmental management, solar and wind power generation, fuel cells, elements of nuclear engineering, power plant engineering, and biomass energy sources.

"By optimizing energy utilization, engineers will improve their companies' bottom lines and provide a competitive advantage," says Gregory Feierfiel, interim chair of the Department of Mechanical Engineering. "In addition, development of renewable energy sources will benefit future generations."

Field trips taken by Lawrence Tech engineering students help them see how energy technologies they study in the classroom and labs perform when implemented in the real world.

Taubman Center a Living Laboratory

The A. Alfred Taubman Student Services Center at Lawrence Tech, which opened in 2006, was built to the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) standards. Efforts were taken to assure it is a "living laboratory" of sustainable design and engineering.

The building's various components give students an up-close view of real-world applications of sustainable design and engineering. Many of the heating, ventilation and air conditioning controls and mechanisms are visible for study by students, and the concrete flooring tiles throughout the building are elevated 18 inches, making all wiring and piping easily accessible by lifting panels of the completely modular floor.

The most complex and sustainable aspect of the Taubman Center is hidden from view – a field of 88 geothermal wells sunk 300 feet through five geological layers under the campus quad. A system of polyethylene tubing, pumps, heat pumps and fans connected to the wells utilizes water to heat and cool the building, which has no boiler, furnace, or even a gas meter.

Lighting in the Taubman Center is controlled by sensors and astronomically synchronized timers that adjust three times a day to accommodate seasonal lighting needs. And more than 60 percent of the roof – 10,000 square feet – is covered with vegetation, creating a living "green roof" used in a major stormwater research project (see page 12).

Receiving silver certification by the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program, Lawrence Tech's Taubman Student Services Center addresses criteria of sustainable site development and construction, water and energy efficiency, recycled materials selection, and indoor environmental quality, and serves as a "living laboratory" for student investigation of such issues.

Hydrogen Technology Park Pioneers the Future

Lawrence Tech is the educational partner for the DTE Energy Hydrogen Park in Southfield, the first and largest hydrogen technology park of its type in the world. It was developed with support from the U.S. Department of Energy. Lawrence Tech faculty and students have helped research the use of hydrogen for both electricity and transportation fuel.

Lawrence Tech is a partner in a project that could help lay the foundation for one of the biggest transitions for the U.S. economy in the past 150 years – the transition from traditional fossil fuel-based technologies to hydrogen power.

The research is being done at the DTE Energy Hydrogen Technology Park, launched in 2004 at a site in the city of Southfield not far from the Lawrence Tech campus.

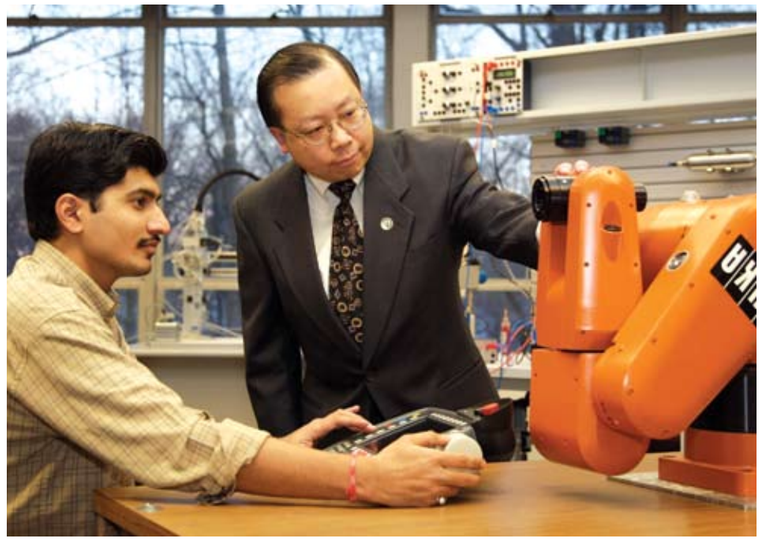
The facility converts electricity from solar power panels at the site and from methane at a municipal solid waste plant off-site to make hydrogen from water. Once produced, the hydrogen is compressed for storage and used either in the stationary fuel cells for the production of grid-quality electricity, or to refuel hydrogen-powered vehicles from an advanced hydrogen-dispensing station designed to accommodate such vehicles.

The park is equally funded by the U.S. Department of Energy's State Energy Program and DTE Energy, a Detroit-based utility company with 2.2 million electric customers in Southeast Michigan and another 1.3 million natural gas customers across the state. It is one of only three federally funded demonstration projects of this kind in the country.

In addition to Lawrence Tech, other partners in the DTE Energy Hydrogen Technology Park include Chrysler LLC, BP, and Sandia National Laboratories. Lawrence Tech's Robert Fletcher, director of the Alternative Energy Engineering program, and his students provided startup and trouble-shooting support during the initial launch of the park; now they are assessing the reliability and durability of the park's equipment.

To the Second **Power**

Lawrence Tech is unique among American universities in offering a full master's degree program in mechatronics



Associate Professor Kingman Yee and a student work with a teaching control panel for the KR3 robot, which has been provided by KUKA Robotics Corp. on a five-year consignment to the Mechatronics Laboratory.

A convoy of 20 Army trucks is traveling along a road that snakes through a mountain pass in Afghanistan. Except for the lead vehicle, all the truck cabs are empty. The other unmanned vehicles respond automatically to the road conditions and commands from the first vehicle.

This scenario dramatizes the type of project that students are exploring in the new Master of Science in Mechatronic Systems Engineering (MSMSE) degree program at Lawrence Tech.

In the Army convoy scenario, the mechanical engineering involved in operating a vehicle must be combined with the programming of electrical and computing engineering, math, and computer science. It's a good example of mechatronics in action.

Mechatronics – the word itself is a combination of "mechanics" and "electronics" – employs a unique approach that cuts across multiple academic disciplines. An engineer skilled in mechatronics can create a seamless and unified system for a specific project that encompasses the principles of the different disciplines involved while at the same time fulfilling the specific requirements of each.

While mechatronics degree programs are common in Europe and Asia, they remain a rarity in the United States. Other universities in this country offer mechatronics courses, and at least one has a concentration in mechatronics, but Lawrence Tech is believed to be the only one offering a full Master of Science-level degree program.

"Electrical and mechanical engineers speak different languages. So when you hire one student from our program, it means you buy one, and get another for free. You get several engineers in one," declares Vladimir Vantsevich, who first proposed to develop the program at Lawrence Tech in 2005.

Vantsevich is a professor in the Department of Mechanical Engineering and director of the MSMSE program, who earned his doctorate in ground vehicle engineering from the Belarusian Polytechnic Institute in his native Belarus. He had almost 30 years of experience in designing driveline systems of multi-wheel drive vehicles and automatic control of vehicle dynamics and performance before joining the Lawrence Tech faculty in 2001.

Five students enrolled when the program was launched in 2006; today, just a year and a half later, the roster has grown to 34 students.

Jason Spina was one of the first students to enroll in the MSMSE program at Lawrence Tech, after receiving his undergraduate degree at Michigan Technological University. He's pursuing his master's degree while working full-time at General Dynamics Land Systems in Sterling Heights, where the next generation of Army tanks is being created.

"It's been challenging, but it's been very rewarding," says Spina. "Dr. Vansevich has put together a great program with advanced laboratory facilities and a terrific cast of instructors. They each have their own area of expertise and their own teaching style, but they really get through to the students, especially because the class sizes are so small. You can't imagine the personal attention you get."

After graduation next fall, the 30-year-old Grosse Pointe Woods resident plans to apply what he's learned in the mechatronic systems engineering program to his position at General Dynamics Land Systems, where he has worked for the past four and a half years. "Eventually I'd like to get an MBA and then use my engineering and business background to become my own boss," he adds.

Mechatronics graduates will have a wide choice of opportunities in such areas as aviation, space, industrial robotics, and military transportation, in addition to the auto industry. Graduates will also be able to apply their knowledge to fields as varied as autonomous vehicle engineering and defense systems, biomedical engineering, material processing, media communications, and many others.

As the program continues to grow and produce its first crop of students, Lawrence Tech's experience will likely serve as a model for other institutions, says Vantsevich.

Vantsevich's extensive contacts have opened up opportunities for collaboration with European universities and companies that have been working in the field for years, including Festo Corp., Kistler Instrument AG, Loughborough University, and the University of Applied Sciences of Western Switzerland.

The program also has benefited from an International Industry Advisory Board of more than 20 engineers and executives who provide the perspective of industry, professional societies, and government agencies, such as the U.S. Army's Research Development and Engineering Command's Tank Automotive Research, Development and Engineering Center (TARDEC, Intelligent Systems) in Warren, Mich. The Big Three U.S. automakers are represented on the board, along with Toyota Technical Center USA Inc., Johnson Controls Inc., Eaton Corp., Robert Bosch Corp., KUKA Robotics, National Instruments, dSPACE, MathWorks, and MSC Software Corp.

A big asset for the MSMSE program is Lawrence Tech's 4x4 Vehicle Chassis Dynamometer, which was developed in the Department of Mechanical Engineering. This unique machine allows controlling all four wheels individually, a feature that enables engine power distribution to be applied independently to each wheel, which in turn makes it possible to incorporate a much broader range of testing scenarios. Professors Vladimir Vantsevich and Suresh Bansal, pictured here, use the equipment to research vehicle mechatronic and autonomous systems and teach test-instrumentation and measurement systems.

With a Little Help From Our Friends

When Vladimir Vantsevich started the pioneering academic program in mechatronics at Lawrence Tech, financial contributions and cooperative support from the private sector were key to getting the program off the ground.

The Mechatronic Systems Laboratory, which opened in 2007, features equipment and software valued at $470,000 that was contributed by Bosch, dSPACE, Eaton, Festo, Kistler Instrument, KUKA Robotics, and National Instruments. Chrysler contributed nearly $50,000 for academic support programs and also donated hardware. In addition, guest lecturers from the industry and TARDEC (Intelligent Systems) teach in the mechatronics program.

This extraordinary level of support is a classic win-win situation for Lawrence Tech's College of Engineering and its industry supporters. Students gain insights into how to design equipment, which is normally proprietary information rarely shared outside a company. In return, companies get exposure for products with both practicing and future engineers, and often gain access to valuable research data that can be used to help improve or develop new products and processes.

Vladimir Vantsevich

The 10,000-square-foot living "green" roof on Lawrence Tech's Taubman Student Services Center consists of layers of insulation, roof membrane, drainage fabric, and a granular soil composition that supports nine different species of sedum. About nine inches thick, the roof offers more effective insulation than traditional roofs and expands and contracts with seasonal changes

Let It Rain

Green is the color of choice in a groundbreaking storm water research and education project at Lawrence Tech focusing on 'rain gardens' and 'green roofs'

As a youngster Laura Hallam was a whiz at math and science, so it probably came as no surprise when she chose to pursue a career in civil engineering at Lawrence Tech. "It's a good field for me," she says, "because it lets me use both skills."

The 24-year-old graduate student from Monroe is currently putting those skills to good use on a cutting-edge storm water research and education project that could have a significant impact on water quality and wildlife habitats in urban areas.

Working with two other graduate students, Hallam designed and constructed two bio-retention cells – or "rain gardens" – on the school's Southfield campus. The cells are equipped with soil moisture sensors, temperature sensors, a rain gauge, a flow meter, and a water quality sampler.

Funded with a federal grant, the project exemplifies the University's 75-year commitment to teaching both theory and practice. Hallam, who also received her undergraduate degree at Lawrence Tech, will incorporate the results into her master's thesis on bio-retention cells. Her future plans include studying abroad, presenting her research at an international conference, and pursuing her PhD in water resources.

A bio-retention cell or rain garden is basically a shallow swale, excavated down about three feet and then backfilled with a planting mixture of sand and compost. The garden is then planted with deep-rooted native plants. This eco-mixture essentially acts as a filtration system for storm water. Because the plants soak up much of the water, there is less runoff into the storm sewer system – and the water that does escape is both cleaner and cooler.

The Rouge River tributary adjacent to the Engineering Building was a good place to demonstrate equipment that measures the effect of "scour" erosion. Assistant Professor Hiroshan Hettiarachchi (L) and Associate Professor Don Carpenter (R) have received a Michigan Department of Transportation grant to improve the ability to predict the effect of such scouring on bridges.

A related but more expansive project is also under way at Lawrence Tech, this one involving green roofs. Green roofs provide a similar function as rain gardens (control and clean storm water) except, as the name implies, they are constructed on top of buildings. Lawrence Tech's green roof is on top of the Taubman Student Services Center, which has earned Leadership in Energy and Environmental Design (LEED) silver certification. The green roof is literally a living roof with plants in a soil mixture to catch and treat storm water. On an asphalt roof, for example, 95 to 100 percent of the rain runs right off the roof and into the storm drain, and the water is both hot and polluted. In contrast, on a green roof, only about half that much water runs into the storm drain, and the water is both cooler and cleaner because it has been filtered by the plants and planting medium.

The research at Lawrence Tech consists of comparing three full-scale roofs subjected to actual rainfall events – the green roof, a rock-ballasted roof, and a traditional black asphalt roof. Equipment similar to that used to measure the performance of the rain garden measures water quality, quantity, and temperature as well as pollutant levels of the roof-top storm water run-off. This information will then be used to determine the performance of each roof type and the effectiveness of the green roof at retaining and cleansing storm water runoff.

> "The project exemplifies the University's 75-year commitment to teaching both theory and practice"

Long-rooted grasses and trees are part of a bioswale system that prevents 60 percent of the rainwater that falls on the Taubman Center's green roof and the adjacent campus quadrangle from running into the Rouge River. The vegetation naturally purifies the water by filtering out pollutants commonly found in snow and rain runoff.

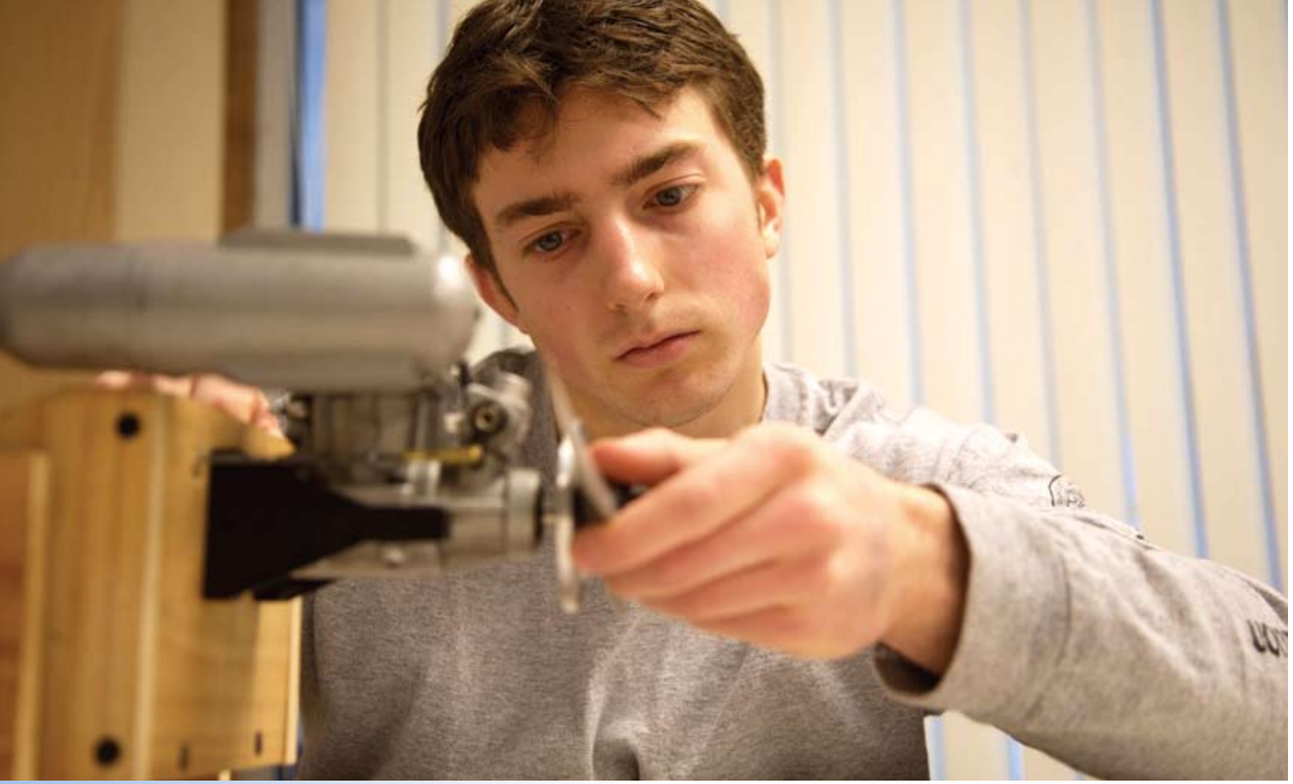
"The green roof research is incredibly important," explains Donald Carpenter, associate professor of civil engineering. "Only a few other institutions of higher education have full-scale green roofs on their campus and even fewer are actually monitoring their performance."

Green roofs have been used in Germany for more than 20 years and in the United States for over a decade. Many communities, however, are reluctant to embrace the concept because there has been little published data on their performance and cost-effectiveness, especially in this country. That's one of the reasons why the research at Lawrence Tech is so critical.

Lawrence Tech is an ideal site for bio-retention research because it is located in the heart of the Detroit metropolitan area. Storm water runoff in major urban areas like Detroit can lead to a number of problems, including flooding and deterioration of streams and rivers due to pollutants, erosion, and instability. Ultimately, these issues have an impact on the quality of drinking water and wildlife habitat.

In addition, two tributaries of the Rouge River run through Lawrence Tech's campus, placing the University at the heart of the Great Lakes watershed. The Great Lakes contain 20 percent of the world's surface freshwater, supply drinking water to 42 million people, and play a critical role in the region's economy. Because most lakes and rivers in the region discharge into the Great Lakes, increasing urbanization exacerbates the problems caused by polluted runoff in the ecosystem. Lawrence Tech is committed to helping the region restore the Great Lakes watershed through research and education.

For example, the storm water detention pond is the most commonly used method to control storm water runoff in newly developed and redeveloped urban areas. However, this approach primarily addresses only the issue of peak discharges. More recently, there has been a greater understanding, based on scientific evidence, that society needs to be concerned not only with peak discharges, but also with total flow volumes into our streams. The research now under way at Lawrence Tech will add to that body of knowledge and potentially lead to new methods of assuring a clean water supply.



Chris Jurczak, a senior majoring in mechanical engineering and physics, adjusts the prop on his team's entry for the SAE Aero Design East, one of several vehicle design and performance competitions that attract Lawrence Tech student teams each year. The Lear Enterprenuer Center can help students learn the next steps of bringing their technological solutions to market.

Meet the Real World

The Lear Entrepreneurial Center at Lawrence Tech is turning out engineers with enhanced skills in creativity, innovation, and problem-solving

At Lawrence Tech, where theory and practice go hand-in-hand, innovation and entrepreneurship are seen as the keys to maintaining a competitive edge in the increasingly global field of engineering.

Businesses need more than graduates who excel in their field. They need leaders who think in innovative ways, plan and manage projects and use technology to bring projects and products to fruition. This is the mission of the Lear Entrepreneurial Center (LEC), administered by the College of Engineering.

Students enrolled in the elective entrepreneurial program at LEC can earn a Certificate in Entrepreneurship while pursuing an engineering degree. The focus is on courses, conferences, and internships designed to foster inquiry, creativity, problem-solving skills, and innovation in the development of processes and products. The program was launched with seed money from automotive interior supplier Lear Corp.

The process begins in the sophomore year, when students participate in an internship to prepare for their capstone project. As juniors, students form their own company and run it as if it were a real private-sector business. They develop a business plan, and then design, produce, and market a technical project. As a result, they gain knowledge and understanding of the business world from a combination of academic and practical experiences that supplement their core engineering, math, and science courses.

"Right now we are expanding this program so that it complies with our strategic plan to embed entrepreneurial thinking throughout the entire campus, even beyond engineering," says Don Reimer, an adjunct professor at Lawrence Tech and president of The Small Business Strategy Group, a Southfield-based consulting firm dedicated to helping small businesses grow.

In addition to his role as associate director of the entrepreneurial program under the leadership of Greg Feierfeil, interim chairman of the Department of Mechanical Engineering, Reimer teaches a class in Corporate Entrepreneurship – one of eight courses offered through the Lear Entrepreneurial Center. Reimer also worked with Dana Clarke, president and CEO of Applied Innovation Alliance LLC, to pilot test a new course called Structured Approaches to Innovation, which features a four-step process to help students hone their problem-solving and creativity skills.

Chris McCarthy, a 22-year-old senior electrical engineering major from Rockwood, says the Structured Approaches to Innovation class taught him how to effectively present his ideas to others. "I'm more of a creative person," he says. "So there are a lot of things I already know how to do, but I found it hard to share my ideas with others and explain how I came to them."

After graduation, McCarthy would like to land a job as a project engineer in either the hybrid automotive or building systems areas. Down the road, though, he envisions starting his own electric vehicle or alternative energy construction company. His experiences at the Lear Entrepreneurial Center will serve him well in both ventures.

Alumni play an important role in the entrepreneurial program. An annual lecture series sponsored by the College of Engineering brings alumni with strong backgrounds in entrepreneurship back to campus to share their expertise and vision with students. A new initiative, dubbed "The Legends," is now under way to develop a database of alumni who will be tapped to inspire the next generation of engineers.

Lawrence Tech alumnus Richard Burns, now chief engineer of research and development for Yazaki North America Inc., was a recent visitor to campus. The 1988 electrical engineering graduate addressed a class on how to create a culture of innovation within a company.

Mission: Embed Entrepreneurialism

Lawrence Tech is one of 14 institutions in the Kern Entrepreneurial Education Network (KEEN), which supports academic programs that help undergraduate engineering students think like entrepreneurs. Professor Greg Feierfeil, interim chairman of the Mechanical Engineering Department, and Don Carpenter, associate professor in the Civil Engineering Department, hold the titles of Kern Fellow of Entrepreneurial Education.
Their mission is to develop programs that embed the concept of entrepreneurialism throughout the school's curriculum. The Lear Entrepreneurial Center, administered by the College of Engineering, is at the heart of this program. KEEN was developed by the Kern Family Foundation in conjunction with the National Collegiate Inventors and Innovators Alliance.

Gregory Feierfeil

> "Students enrolled in the elective entrepreneurial program at LEC can earn a Certificate in Entrepreneurship while pursuing an engineering degree"

Last year Lawrence Tech students Tom Castle, Blair Temple, Robert Goldsworthy, and Steve Byrd established Pet Dimensions Inc. to market their student project, dubbed the "Pooch Palace." Their model, priced at around $1,000, includes heating and air conditioning, video monitoring, and an automatic door.

Raising the Moral Bar

A Lawrence Tech professor is a principal investigator in a project aimed at helping engineering schools integrate ethics education into their curriculum

Integrity.

Donald Carpenter

Integrity is commonly promoted as a core value of institutions of higher learning, but recent cheating scandals on numerous campuses indicate that perhaps the educational process is not promoting integrity as well as it should. This is particularly problematic in engineering programs whose duty is to produce engineers who will protect the health, safety, and welfare of the public.

Startlingly, research at the national level reveals that engineering undergraduate students cheat at levels that are almost unprecedented among their peer groups – ranking second only to business students in their likelihood to cheat. This troubling statistic is the motivation for the Student Engineering Ethical Development (SEED) project funded with an $850,000 grant from the National Science Foundation.

Now in its second year, the four-year SEED project, however, reaches far beyond the basic issue of cheating, which has already been extensively studied and documented. Instead, its overriding goal is to raise the moral bar for engineering students by determining how to improve their ethical decision-making capabilities.

"Research shows that students who are more likely to cheat in high school are also more likely to cheat in college, and there is evidence showing a linkage between students who cheat in college and how they perform in the workplace. We want to break this cycle," declares Donald Carpenter, associate professor of civil engineering at Lawrence Tech and one of three principal investigators for the project.

Carpenter and his fellow PIs – one from the University of Michigan and another from California Polytechnic-San Luis Obispo – are currently traveling around the country to gather detailed information for the SEED project. In all, they plan to visit 20 engineering schools and interview 4,000 students and 150 faculty members and administrators.

Computers put a world of information at the fingertips of students and enhance the educational experience in many ways. But access to so many resources also challenges students and faculty to assure ethical use of such material.

To date, they are about midway through this part of the study. The timetable calls for the survey team to complete its site visits this year, analyze the results next year, and publish and disseminate its findings in 2010. Along the way, the study group is determined to discover not only what causes students to behave unethically, but also, more importantly, what can be done in the curriculum to promote integrity.

Current requirements for ethics education at engineering schools are vague at best. The Accreditation Board for Engineering and Technology requires that ethics education be included in undergraduate degree programs, but does not specify how much such instruction students should receive, nor how it should be taught. Lawrence Tech's College of Engineering offers one ethics course in its curriculum and integrates ethics education in additional courses in its undergraduate degree programs. Alternatively, some colleges do not offer a specific course or incorporate ethics education in their curriculum at all, offering it instead through a separate seminar series.

Why is ethics education particularly critical for engineering schools? "Ethics is especially important in engineering because the lives and health of people are ultimately involved. As educators, we have a duty to make sure our graduates will become ethical professionals when they enter the workforce," says Carpenter.

The SEED project, Carpenter points out, takes the issue of academic dishonesty to a whole new level that has yet to be fully explored until now. "We are still concerned about undergraduate cheating, but we are much more interested in ethical development. That's what the SEED project is about – what we can do in the curriculum to help students make ethical decisions."

Carpenter and his colleagues have identified a number of factors they believe will lead to improved ethical behavior among students. These include:

Lawrence Tech professors like Suryaji Bhonsle (L) often provide one-on-one instruction and guidance. Faculty members who serve as mentors can help students see the critical importance of maintaining their integrity as future engineers.

• Giving students more opportunities to participate in community service programs and professional organizations.

• Establishing a curriculum that spreads ethics education across the duration of the degree program and focuses on decision-making and character development.

• Focusing on teaching students about the ramifications of failing to follow ethical codes of conduct, particularly as they relate to public health and welfare.

As part of its work to date, the SEED team has discovered that old-fashioned shame is a deterrent. In other words, students would be ashamed if their parents or peers knew they were cheating or otherwise engaged in academic dishonesty.

"So that means we need to establish respect for faculty as mentors," says Carpenter. "Faculty must show care and concern for students both as individuals and as future engineering professionals. Students will be less likely to cheat if they understand the impact of what they are learning. As educators, we must help our students see why what they are doing is important and they will then develop a stronger sense of integrity in their profession."

Carpenter and his fellow principal investigators bring to their work on the SEED project an extensive track record in exploring ethical decision-making among engineering undergraduate students. Assisting them are experts in moral development and psychometrics at the Center for the Study of Higher and Postsecondary Education at the University of Michigan.

"Our overriding goal is to identify and disseminate best practices for engineering education," Carpenter explains. "At the end of the day, we will go to universities and workshops around the United States to say, 'Here's what we found as part of our research. This is groundbreaking research with hard-core evidence. We will show how you can make a difference.'"

ACCENT ON R&D

At Lawrence Tech's Automotive Engineering Institute, students get the hands-on experience they need to become better engineers

Suresh Bansal

Lawrence Tech's College of Engineering combines innovative academic programs, cutting-edge research involving both faculty and students, and creative partnerships with business and industry to create new knowledge in the increasingly complex field of automotive engineering.

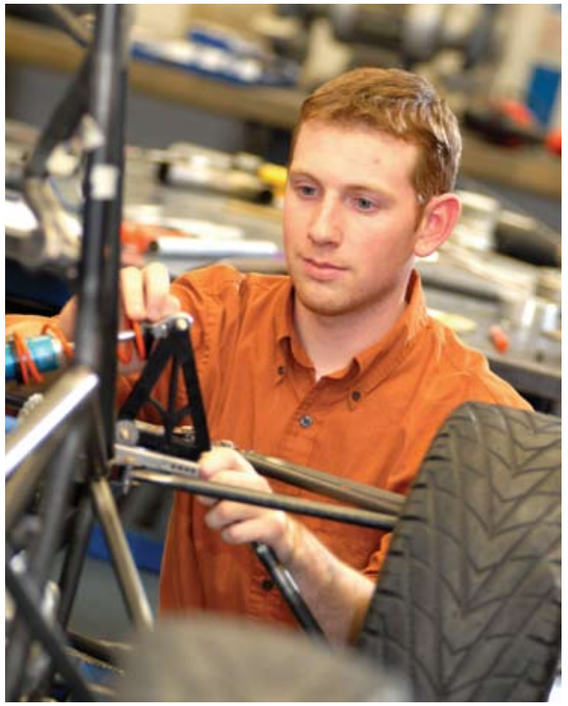
"We are located at the epicenter of automotive research and development in the United States, so we are uniquely positioned to serve the needs of this industry," says Suresh Bansal, director of the Automotive Engineering Institute (AEI) at Lawrence Tech. "We have everybody here in Southeast Michigan – the domestic Big Three; foreign companies like Toyota, Nissan and Hyundai; and the military as well."

Founded at Lawrence Tech in 2004, the AEI is an academic and applied research organization that benefits the automotive industry, engineering students, and society at large by capitalizing on the capabilities of the University and the automotive industry.

"Through the work of the AEI, our students get the hands-on experience they need to become better engineers, which positions them to help the automotive industry create better products through advanced technology," adds Bansal, who is also director of the Master of Science degree program in automotive engineering (MSAE) at Lawrence Tech.

Applied research through funded projects is at the heart of AEI's mission. One recent successful project that exemplifies AEI's mission involved the U.S. Army's High Mobility Multipurpose Wheeled Vehicle (HMMWV) – better known as the Humvee.

The Army's Tank-Automotive Research, Development and Engineering Center (TARDEC) is currently developing a hybrid electric version of the venerable Humvee, which is designed to be safer and more efficient than its predecessors in combat and reconnaissance operations in hot spots like Iraq and Afghanistan.



Engineering students at Lawrence Tech gain hands-on knowledge about the basic mechanics of automobile systems before moving on to much more sophisticated systems at the Automotive Engineering Institute.

Rigorous Testing

Lawrence Tech is using a $1 million federal appropriation to build an environmental chamber for testing vehicle components for military uses. It is housed at the University's Center for Innovative Materials Research (CIMR), which was built in 2006 with the help of the Army Research Laboratory.

Slated for completion this summer, the chamber is being built to military testing standards, which are more rigorous than industry standards. Constructed of insulated ceramic blocks, it is 12 feet long, 12 feet wide and 20 feet high and situated on an insulated foundation. The chamber has a steel superstructure holding an actuator, a device built into the roof and capable of delivering impact blows with up to 150,000 pounds of force on components being tested. The chamber will measure the impact of both repeated and static loads in simulated climatic conditions ranging from tropical to arctic.

TARDEC, the Army's research and development center in Warren, Mich., is expected to use the new test facility to measure the capabilities of ceramic-tile armor systems for mine-resistant, ambush-protected military vehicles. The chamber also could be used for civilian projects, such as testing different types of concrete, steel, wood, composites, or hybrid beams used in bridges.

Mark Schmidt, a lab technician in the Department of Mechanical Engineering, puts a Humvee through its paces on Lawrence Tech's four-wheel-drive chassis dynamometer as part of a research project for TARDEC.

In order to improve what the military calls the Technology Readiness Level of the prototype electric hybrid Humvee, TARDEC turned to a crack team of experts from Lawrence Tech's Automotive Engineering Institute. During a 17-month project, the team developed a performance simulation model for the Humvee prototype, recommended needed changes, and conducted evaluation experiments of acceleration performance using Lawrence Tech's four-wheel-drive vehicle chassis dynamometer (see sidebar at right).

"We put the prototype vehicle through all kinds of performance tests, and then we ran the same tests on our Simulink Performance Simulation Model and compared the results," explains Bansal, the project coordinator. "When the results didn't agree, we then analyzed the possible areas as to why they didn't agree. Since we didn't find any errors in our experiment, we determined that the Simulink Simulation Model needed some help."

Bansal's fellow project principals were David Bindschadler, chairman of the Department of Mathematics and Computer Science; and Ronald Foster, director of the biomedical engineering program. They were assisted by three faculty research associates and 10 student research assistants and laboratory technicians.

"We created a computer model with traditional industry knowledge and then we superimposed on that our expert knowledge on vehicle engineering and vehicle design," explains Bansal, a former chief engineer at Ford Motor Co. who has extensive expertise in vehicle systems engineering from concept to delivery. "That is creativity in action. Through our work as a team, we added something to mankind's store of knowledge."

Now that the project is complete, TARDEC can take the same model developed at Lawrence Tech to evaluate the performance of future hybrid electric vehicles.

"We created the model and validated the model and improved the model," says Bansal. "The bottom line is that we took on a major project and we delivered – and we exceeded customer expectations."

Automotive Engineering: A Degree with Wheels

Lawrence Tech's Master of Science in Automotive Engineering degree program is providing a springboard for new courses in vehicle dynamics and automotive control systems that give students experience with cutting-edge automotive research.

Advanced courses in both areas are being developed to take advantage of the research capabilities of the University's four-wheel-drive (4WD) vehicle chassis dynamometer, which is similar to a large treadmill. The dynamometer is equipped with individual wheel torque electronic controls, a unique feature that enables power distribution to be applied independently to each wheel, which in turn makes it possible to incorporate a much broader and diverse range of testing scenarios.

The dynamometer is used for industry research in areas such as vehicle traction control, turnability and ride stability, acceleration and braking, AWD driveline system performance, diagnostic testing, safety systems, fuel efficiency improvement, and emissions testing.

Achievement and Vision

The new dean of the College of Engineering aims to help Lawrence Tech get the regional and national prominence it deserves

Devdas Shetty

When Devdas Shetty arrived on the Lawrence Tech campus the first of this year as the new dean of the College of Engineering, he brought with him an impressive roster of achievements as well as a clear vision to increase the University's effectiveness in reaching out to industrial partners and to raise the profile of programs that are already considered among the finest in the country.

Shetty came to Lawrence Tech from the University of Hartford (UH) in Connecticut, where he was the dean of research, the director of the engineering applications center, the associate dean of the College of Engineering, and the Vernon D. Roosa endowed professor in manufacturing engineering.

Major awards received by Dean Devdas Shetty

James Frances Bent Award for Creativity
Edward S. Roth National Award for Manufacturing
American Society of Mechanical Engineers Faculty Award
Society of Manufacturing Engineers Honor Award

> "Shetty holds four patents for inventions that involved interdisciplinary areas of mechanical engineering, electronics and computer science"

Prior to joining UH in 1988, Shetty was an associate professor at the Albert Nerkin School of Engineering at Cooper Union for the Advancement of Science and Art, New York City (1983-88), associate professor at the University of West Indies, Trinidad (1978-83), and served as the senior technical officer at the United Nations Center on Computer-Aided Manufacturing (1974-78) in Bangalore, India.

A registered professional engineer and one of the pioneers in the field of mechatronics, Shetty received his doctoral degree in mechanical engineering from the Indian Institute of Technology in Delhi after finishing his bachelor's and master's degrees at the National Institute of Technology in Surathkal, India.

Shetty holds four patents for inventions that involved the interdisciplinary areas of mechanical engineering, electronics and computer science. In partnership with Albert Einstein College of Medicine of Yeshiva University in New York City, he invented the patented process for supporting patients with ambulatory systems for rehabilitation, which is expected to enhance the quality of life for elderly patients and others with mobility challenges.

The recipient of numerous awards and honors, Shetty is also the author of two books and more than 150 scientific articles and papers. His textbooks on mechatronics and product design are widely used in many universities around the world.

In 1999, as the principal investigator of an interdisciplinary team, he broke new ground in proposing and funding a major program with the National Science Foundation that resulted in a new integrated curriculum that is being adopted by many engineering schools. He is also internationally recognized for pioneering surface roughness inspection research, which has been implemented in aerospace industries.

At the University of Hartford, Shetty was widely recognized for his ability to establish partnerships between the university and industry, a role he plans to continue at Lawrence Tech in keeping with the University's mission to give engineering students theoretical tools and real-world, hands-on experience in an atmosphere of entrepreneurial leadership.

Married with two sons, Shetty succeeded Laird E. Johnston, a former General Motors and EDS executive who served as dean of engineering from 2000 to 2005 and again from 2006 until his retirement at the end of 2007.

Q & A with Dean Devdas Shetty

Q: What factor most attracted you to Lawrence Tech?

A: The factor that attracted me here is my belief that I might be able to make some difference. As a technological university, Lawrence Tech is focused on the future. Within Lawrence Tech, the College of Engineering is the leading school that can make a major impact on the whole institution. I have found Lawrence Tech to be an agile place that prepares its graduates to succeed in the workforce by giving them a highly effective balance of theory and application. The University has made a concerted effort to form corporate, industry, and government partnerships to advance research and the frontiers of engineering and science.

Q: What are your goals for the College of Engineering?

A: I want to see the College of Engineering positioned as a leader in engineering education with regional recognition and national prominence. I want to work on providing real-life challenges for students by forming industry partnerships and applied research at the undergraduate level. I want the college to be a leader in responding to change and to be known for its comprehensive range of undergraduate and graduate engineering programs that contribute to the needs of the region. I want to promote cross-disciplinary programs that promote synergy and innovation.

Q: How will you work with Lawrence Tech's other colleges?

A: I will work collaboratively with the Colleges of Arts and Sciences, Architecture and Design, and Management, and promote interdisciplinary engineering programs and applied research projects in an atmosphere of entrepreneurial spirit and global perspective. Based on the increasing need for health-care and medical technologies, we want to serve as a bridge between disciplines and promote research and education in bioengineering. We want to create and manage student and faculty groups involving multiple disciplines so that they are important catalysts for change. Interdisciplinary programs in architectural engineering, mechatronics, product design, energy, materials, and related technology areas will be promoted.

Q: What other initiatives do you foresee?

A: I want to work on the improvement of the infrastructure and laboratory facilities that will provide our students opportunities to work in teams and practice leadership. I want to maintain ongoing interaction with industry through major research review programs, collaborative research and grants, informative seminars, corporate partner events, internship and career placement, technology exchange, and advisory boards. We will strengthen ties with our alumni and donors whose professional experience is valuable to our graduating engineers.

News Briefs

News Briefs

Rakan Chabaan

Mazin Sliety

From Industry to Academia

Rakan Chabaan and Mazin Sliety, the two newest faculty members in the Department of Electrical and Computer Engineering, both bring extensive industry backgrounds to their new roles in Lawrence Tech's College of Engineering.

Prior to joining Lawrence Tech as associate professor, Chabaan had more than 13 years' experience at Ford Motor Co.'s Research and Development Center. His most recent project at Ford involved an Electric Power Assist Steering System (EPAS), which was used to replace a conventional power hydraulic steering system in a vehicle.

Chabaan's expertise includes digital signal processing, system identification and modeling in time and frequency domain, gain scheduling, and robust control systems. He has published several journal and conference papers. He also holds nine U.S. patents, several European patents, and two patents to be allowed. He received his PhD in electrical and computer engineering and a master's degree in electronics and computer control systems engineering, both from Wayne State University.

Prior to joining Lawrence Tech as an assistant professor, Sliety had 11 years' experience in research, teaching, and industry. He spent the last six years in the development of telematics products. He was the system engineer for OnStar Gen 5, OnStar Gen 6, and Harman/Becker "MyGIG" telematics and infotainment products.

Sliety received a PhD in systems engineering from Oakland University and a master's in electrical engineering from University of Central Florida. He has published several refereed journal and conference papers. He has one awarded patent, two patent applications, one trade secret, and seven publications in telematics and wireless communications.

Sliety's research interests include antenna design, full vehicle-level antenna and EMI modeling and measurements, RF measurements and performance characterization, and location and communication applications in automotive, aerospace, homeland security, and biomedical applications.

Elin Jensen

Lisa Anneberg

Fire Drill

Elin Jensen, an assistant professor in the Department of Civil Engineering, has won a prestigious $400,000 National Science Foundation Faculty Early Career Development (CAREER) award for her work on the mechanical behavior of concrete and structural elements exposed to severe fire.

The experiments will be conducted over a five-year period, beginning in May 2008, in Lawrence Tech's new, large-scale fire/load facility. Located in the Center for Innovative Materials Research, the test facility is designed to simulate real fires of various types and duration.

This project will have an immediate and widespread impact on the fire safety engineering community by influencing performance-based design and code development. Both undergraduate and graduate engineering and architectural students will directly benefit through classroom participation as well as long- and short-term research opportunities.

Let There Be Light

Lisa Anneberg, an associate professor in the Department of Electrical and Computer Engineering, received a $10,000 grant from the Environmental Protection Agency's P3 – People, Prosperity and the Planet – awards competition to study innovative lighting projects.

One aspect of the study is to demonstrate the environmental and economic advantages of light-emitting diode (LED) lighting as an alternative to traditional incandescent lighting. LED holds considerable promise for residential use because it lasts nearly five times as long – in many cases even longer – than a standard incandescent bulb, yet requires much less power, thus making it more efficient.

Under Anneberg's direction, interdisciplinary students will design two architecturally attractive, cost-effective, and energy-efficient residential lights. The electrical engineering students will concentrate on technical aspects related to electrical components, the architecture students will address the quality and quantity of light requirements, and the interior design students will address the aesthetics. A management graduate student will analyze and estimate costs for production.

The final design will be judged at the EPA's P3 Award competition during the National Sustainable Design Expo in Washington, D.C.

Bridge Work

Donald Carpenter, an associate professor, and Hiroshan Hettiarachchi, an assistant professor in the Department of Civil Engineering, have won a three-year research contract (2007-10) from the Michigan Department of Transportation to evaluate scouring at bridge piers situated in waterways.

Scouring is a concern recognized at the national level because it is responsible for approximately 60 percent of all U.S. highway bridge failures. In 1993 alone, more than 2,500 bridges were destroyed or severely damaged due to scour caused by severe flooding.

Lawrence Tech's scour research team will closely work with their collaborators at Wayne State University during this project. Lawrence Tech's portion of the project is worth $166,000 out of the $285,000 total project award.

In addition to computer modeling and field data collection, the scour research team will also study how scour of soils at bridge piers and abutments can be simulated using the Jet Erosion Test to correlate erodibility and soil strength properties. Findings from this research will help Michigan safeguard its transportation infrastructure as well as bring more research opportunities to Lawrence Tech in the future.

Prolific Professor

Michael Cloud, an associate professor in the Department of Electrical and Computer Engineering, has been hard at work on several new book manuscripts. He is currently working with external colleagues on a Russian-English scientific phrase dictionary, an introductory monograph on interval analysis, a monograph on the mathematical theory of elasticity, and a graduate-level electromagnetics textbook.

Cloud has coauthored seven previous books, including three on applied functional analysis and one on tensor analysis. His book on mathematical inequalities has been published in both English and Japanese.

Mighty Models

In Lawrence Tech's first research project for the Portland Cement Association (PCA), graduate student Kofi Ayensu and faculty advisor Elin Jensen from the Department of Civil Engineering, developed a new, streamlined model to compare the cost-effectiveness of lateral-load-resisting systems for low-, mid-, and high-rise concrete apartment buildings.

A total of 18 apartment buildings were modeled and designed for the PCA educational fellowship. Models for selecting cost-effective moment-resisting or shearwall framing systems will be valuable tools for all decision makers in the design and construction process. Engineers, in particular, will be able to select economical framing systems faster, thus reducing design time.

News Briefs

Police Protection

Marianne Wilhelm, an adjunct professor in the College of Engineering, is the principal investigator on a two-year project for the National Institute of Justice that will examine the effectiveness of the soft body armor – or bulletproof vests – worn by police officers.

In Phase I of the project, researchers will determine if injury and fatality rates could be reduced if soft body armor were redesigned to cover body areas that are currently exposed. In Phase II, they will evaluate the impact of increased coverage area on the tasks typically performed by police officers, such as firing a weapon, handling equipment, or getting into or out of a vehicle quickly.

Wilhelm is currently gathering injury statistics – a difficult task given the dearth of information presently available – while researchers at the Center for Advanced Vehicle Systems at Mississippi State University, a partner institution, are conducting pilot studies with local law enforcement officers. This involves using motion capture technology to evaluate the officers while performing various tasks, using both their regular department-issued armor and an improved-coverage armor.

Beyond the Classroom

Lawrence Tech's student chapter of the American Society of Civil Engineers (ASCE) is dedicated to promoting a strong extracurricular experience for civil engineering majors. The chapter is comprised of undergraduate and graduate students who share an interest in bridges, structures, transportation, soils, and construction.

The chapter holds general meetings twice a month featuring guest speakers from the civil engineering field. These presentations help students see how what they are learning in the classroom can be applied to a real-life job scenario. The meetings also give students a chance to network for possible internships and full-time employment.

Each year groups of senior ASCE members compete in the regional and national ASCE Concrete Canoe and Steel Bridge competitions. One Lawrence Tech team designs and builds a concrete canoe to race against other schools, and another team designs and fabricates a steel bridge to meet a number of challanges and to support a variety of loads.

Lawrence Tech's Steel Bridge Team captured first-place honors in the North Central Conference competition last year.

Professional Pride

More than 300 graduates of Lawrence Tech's College of Engineering are members of the Order of the Engineer, an organization dedicated to fostering a spirit of pride and responsibility in the engineering profession and bridging the gap between training and experience.

The Order of the Engineer is the roster of engineers in the United States who have participated in the Engineer's Ring Ceremony and who have publicly accepted the "Obligation of an Engineer," a formal statement of an engineer's responsibility to the public and to the profession.

The Ring Ceremony is the public induction into the order, during which the engineer candidates formally accept the "Obligation of an Engineer" and receive a stainless steel ring to be worn as a symbol on the fifth finger of the working hand.

Advanced Software

Lawrence Tech has adopted CATIA V5 software that provides students with access to an engineering computer-aided design (CAD) platform widely used in the aerospace and automotive industries.

With a retail value of $67 million, the software came through the Higher Education and Training (HEAT) program, a joint initiative between ENGINEERING.com, IBM, and Dassault Systemes, aimed at delivering real-world, hands-on experience to engineering students in today's high-tech, competitive job market.

CATIA V5 covers a wide range of engineering design activities, such as 3D modeling, engineering structural and thermal analysis, manufacturing simulation, HVAC design, engineering drawings, and engineering visualization and simulation.

Lawrence Tech is one of the few colleges in the country that provide all undergraduate students with laptop computers. The CATIA V5 software has been installed on the laptops of more than 1,000 engineering students and is available to other students as well.

Opportunities in Engineering at Lawrence Tech

Numerous programs in engineering are offered at Lawrence Tech. All are offered at the University's full-service campus in Southfield and several programs are also offered at Lawrence Tech Education Centers in Lansing, Livonia, or Clarkston. For more information, contact the Admissions Office at 800.CALL.LTU, admissions@ltu.edu, or ltu.edu/futurestudents.

Bachelor's (most offered days or evenings)
- Bachelor of Science in Biomedical Engineering
  - Concentrations:
    - Biochemical
    - Electrical
    - Mechanical
- Bachelor of Science in Civil Engineering
- Bachelor of Science in Computer Engineering
- Bachelor of Science in Construction Management
- Bachelor of Science in Electrical Engineering
  - Concentrations:
    - Computer Engineering
    - Electronic Engineering
    - Energy Engineering
- Bachelor of Science in Engineering Technology
- Bachelor of Science in Industrial Operations Engineering
- Bachelor of Science in Mechanical Engineering
  - Concentrations:
    - Alternative Energy
    - Automotive Engineering
    - Manufacturing Engineering
    - Mechanical System Design
    - Thermal System Design

Bachelor of Science Minors
- Aeronautical Engineering
- Energy Engineering

Master's (offered evenings)
- Master of Civil Engineering
- Master of Construction Engineering Management
- Master of Engineering in Manufacturing Systems
- Master of Engineering Management (also online)
- Master of Science in Automotive Engineering
- Master of Science in Civil Engineering (thesis option)
- Master of Science in Electrical and Computer Engineering
- Master of Science in Mechanical Engineering
- Master of Science in Mechatronic Systems Engineering

Doctoral (offered evenings)
- Doctor of Engineering in Manufacturing Systems

Associate Degrees (offered evenings)
- Associate of Science in Communications Engineering Technology
- Associate of Science in Construction Engineering Technology
- Associate of Science in Manufacturing Engineering Technology
- Associate of Science in Mechanical Engineering Technology

Undergraduate Certificates
- Aeronautical Engineering
- Energy Engineering
- Entrepreneurial Engineering

Master's Certificates
- Energy and Environmental Management
- Manufacturing Systems

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Lawrence Tech takes lead in international hydrogen-powered kart race

Element One, a student team at Lawrence Technological University, has taken the equivalent of the pole position in the international Formula Zero racing series for zero-emission, hydrogen-fuel-cell-powered race karts. Formula Zero race officials based in Amsterdam have notified Lawrence Tech's team that it has qualified for the race and finished first in the design competition.

All competitors must use identical 8.5kW hydrogen fuel cells, and only six are available.

"None of this would be possible without hard work, dedication, and determination to win," said student team member Mike Samaroo, BSME'08, in announcing Element One's success. "However, keep in mind that this was just the design competition, and although this was a huge accomplishment for our team, we still have the championship to win."

The racing season is scheduled to begin in August in Rotterdam.

Formula Zero's purpose is to use a racing competition to promote the potential of hydrogen fuel cells to provide a zero-emission solution for transportation. The Formula Zero Championship, Student Edition, was created under the guidance of the Alternative Energies Commission of the Federation Internationale De L'Automobile (FIA), the worldwide governing body of major motor sports series. The long-term goal is to create a racing competition with full-scale race cars.

University teams will compete in smaller, essentially go-kart-sized versions capable of reaching 70 mph. Students had to design a kart with room for the driver as well as the fuel-cell package, a hydrogen tank, an electric motor and super capacitors to provide rapid acceleration.

When it came time to design the body of the racing kart, Lawrence Tech's engineering team reached out to students in the new transportation design program inaugurated last fall in Lawrence Tech's College of Architecture and Design. This groundbreaking program combines design theory with engineering so that students can gain the technical knowledge to maintain design intent.

The result is a design distinctly different from the karts currently competing on the professional race circuit, according to Camille Robbins, BSME'08, Lawrence Tech's Body & Chassis team leader.

Robbins said the final design of the vehicle was inspired by the new F-22 and F-35 fighter planes with the intent of creating something instantly recognizable as American. "We wanted something that was cutting edge, but not too involved," she said.

Element One also incorporated new materials made out of carbon fiber – a lighter, stronger replacement for steel that has been tested in numerous research projects at Lawrence Tech's Center for Innovative Materials Research (CIMR).

The overall goal of Lawrence Tech's Element One team is "to change the way people think about energy and sustainability through high-performance, zero-emissions racing."

For more, visit www.formulazero.nl or Lawrence Tech's team website, www.ltufz.com.

Student team member Mike Samaroo discusses Lawrence Tech's entry in the international Formula Zero competition, assisted by teammates Adrian Snyder and Camille Robbins.