

ME Bulletin

News for
Mechanical
Engineering Majors

Vol. 45, No. 1

ME Advising Office • 2560 EB • 355-3338

Fall, 2007

New Global Engineering Concentration!	5
Dr. Mukherjee Wins Teaching Award!	6
Dr. Haut's Football Ankle Sprain Research	7
Dr. Zhu's Engine Research	9



COVER STORY on Page 8

HEATHER PUNG

Last March, nine ME 481 students and alumni traveled with Dr. Somerton to Tanzania, a very poor east African country. They spent spring break designing and testing solar ovens that can be manufactured from materials available locally. This photo of the team includes a monk and several sisters from the Catholic mission.

Academic Advising

• *ME Freshmen and Sophomores* are advised by **Carmellia Davis-King** in the Freshman/Sophomore Advising Office. To schedule an appointment, please call 355-6616 x 1, or go to 1410 EB.

• *ME Juniors and Seniors* are advised by **Gaile Griffore**. To schedule an appointment, please call 355-3338, or go to 2560 EB.

Curriculum News

Options Changing to Concentrations: The Engineering Mechanics, Manufacturing Engineering, and Biomechanical Options are in the process of being changed to concentrations. The course requirements are NOT changing, however.

New Global Engineering Concentration: The ME department has approved a new Global Engineering Concentration. More information and a list of requirements for the new concentration can be found on page 5.

New Flowchart: Go to the ME undergraduate curriculum (<http://www.egr.msu.edu/me/undergrad/>) curriculum website and check out our new ME program flowchart! You can click on a course and get more information, such as a class outline or website.

Co-op Students: Before you leave for your Spring 2008 co-op rotation, please be sure to discuss your schedule for next Fall 2008 / Spring 2009 with your academic advisor.

ME 481–ME Design Projects requires *department approval* before you can enroll, and you must take this course during your last semester (or spring for August graduates). To obtain approval, please schedule an appointment with Gaile to finalize your long-term schedule. Call 355-3338 or stop by 2560 EB to make an appointment.

ME 489–Technical Communications (2 credits) is on the spring schedule. Instructor: **Craig Gunn**, ME Director of Communications. **IMPORTANT:** *This course is an Other Elective. It is not a Senior Elective.*

ME 491/201–Refrigeration will be offered next summer during the Second Session. This course counts as a Senior Elective (non-design). For a course description, email the ME Advising Office <griffore@egr.msu.edu>

Class Standing. ME juniors and seniors can obtain this information in 2560 EB. Sophomores should go to 1410 EB. Be prepared to show your MSU I.D. Sorry, this information cannot be given over the phone.

Job Search Advice: **Jennifer Jennings** from Career Services &

Placement is available to answer questions about your job search. To schedule an appointment with her, go to: <http://careernetwork.msu.edu/students/advising>

Prerequisites: The ME department expects all students, *including members of the Honors College*, to observe all course prerequisite requirements. If you have a question about prerequisites, contact the ME Advising Office.

IAH/ISS Diversity Requirement

Many courses in the Arts and Humanities area and in the Social, Behavioral, and Economic Sciences area, emphasize national diversity (designated “N” at the end of the course title), or international and multicultural diversity (designated “I” at the end of the course title). Some emphasize both national diversity, and international and multicultural diversity (designated “D” at the end of the course title).

⇒⇒⇒ **IMPORTANT RULE:**
Students must include at least one “N” course and one “I” course in their Integrative Studies programs. A “D” course may meet either an “N” or an “I” requirement, but not both.

ME Bulletin

The *ME Bulletin* is published twice a year (fall & spring) for sophomores, juniors, seniors, faculty, and staff of the Department of Mechanical Engineering. Photographs were taken by Craig Gunn unless noted otherwise.
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In This Issue

Advising, Curriculum News, Diversity Requirement	2
Department News, Career Planning, Student News	3
Associate Chair’s Corner by Dr. Somerton, December Grads	4
New Global Engineering Concentration	5
Dr Mukherjee Receives Teaching Award	6
Dean’s List, Football Ankle Sprain Research	7
COVER STORY: Creating a Solar Industry in Tanzania	8
Dr. Zhu’s Engine Research	10
Think About Graduate School by Dr. Radcliffe	11
Reader Feedback by Craig Gunn, Aachen (Study Abroad)	12
Lyon (Study Abroad), Summer Job Tips, ASME, Scholarships	13
SAE Baja, SAE Solar, Pi Tau Sigma	14
Spring Semester Senior Electives	15
Calendar of Upcoming Events	16

Department News



Professor Guoming (George) Zhu joined the ME faculty in May as an associate professor. Prior to joining the ME department, he was a technical fellow in advanced

powertrain systems for the Visteon Corporation. He has also worked for Cummins Engine Company. Dr. Zhu earned his PhD in 1992 in aerospace engineering at Purdue University. His BS and MS degrees (1982 and 1984 respectively) are from Beijing University of Aeronautics and Astronautics. His current research interests include adaptive control of electro-pneumatic valve actuators as well as closed loop combustion control of internal combustion (IC) engines.



Ms. Bobbie Slider, ME undergraduate program secretary for over four years, retired in June. She recently completed a nail technology program that has prepared her to be a nail

technician (manicurist), and she hopes to use her new skills to work with senior citizens.



Ms. Mary Pease is the new ME undergraduate secretary. Mary is married and has two children. In her spare time, she enjoys sewing, reading, gardening, and photography.

Mary has hung some beautiful examples of her photography in the ME Advising Office. Stop by 2560 EB and check them out!

Department News cont'd on pg 6

What Spartan Engineering Means to YOU! by Jennifer Jennings, Engineering Field Career Consultant

The College of Engineering at Michigan State University wants you to know that we are here to assist our students in achieving their career goals through all forms of experiential education, including research experience, cooperative education, internships, service learning, full-time job searching, and much more: Director of Employer Relations, **Garth Motschenbacher** coordinates activities with the MSU Career Services Network, in cooperation with the Cooperative Engineering Education Program, to develop and implement a full set of services to ensure that MSU engineering students maximize early opportunities in the workplace and obtain competitive placements upon graduation.

Director of Student Advancement, **Bernadette Friedrich** works with students and alumni at all levels to integrate their classroom knowledge with real life work opportunities, including internships, cooperative education, and research experiences.

Field Career Consultant, **Jennifer Jennings**, works with students at all stages of career exploration and planning. Students can get help developing a resume, interviewing, professional development, seeking internships or other experiential learning opportunities and full-time positions.

This office is offering seamless career exploration and connections for students, alumni, employers and faculty in the MSU College of Engineering.

What we can do for you?

- Assist in identifying work experience opportunities
- Offer professional development seminars
- Provide career services in resumes, interviewing, job search strategies and much more

What can you do?

- Register on www.myspartancareer.com and upload your resume
- Prepare for and attend Career Gallery and other employment fairs
- Attend necessary seminars and workshops
- Gain work experience
- Network with employers

Just stop into 1340 EB, across from Sparty's or contact us:

[<careers@egr.msu.edu>](mailto:careers@egr.msu.edu)

We are an "MSU CAREER SERVICES NETWORK" member!

Student News

MSU Team Finishes Strong in Design Competition: A team of MSU mechanical engineering students finished second in the design competition at the American Society of Engineers District B Student Professional Development Conference held March 30 to April 1 in Ann Arbor. **Brandon Gulker, Andrew Schafer, Gregory Schafer, and Jacob Schulz** designed and built a device that can purify water using only human power input. Other competing schools included Carnegie Mellon University, the University of Cincinnati, and the University of Michigan. Their second place finish earned them the right to move on to the international competition where they will face twelve other teams from around the world. For further information contact: **Professor Craig W. Somerton**.

Melissa Carrier (BSME, May 2007) from Jennison was honored by the MSU Board of Trustees for her 4.0 grade point average. Melissa was also a member of the Honors College.

Eric Tingwall, ME and journalism senior from Novi, won the "Win a Trip to the Frankfurt Auto Show" essay contest, sponsored by *Inside Line*, a high-speed online car magazine. He was flown to Frankfurt, Germany, to cover auto show launches and other events as a reporter for *Inside Line's* blog Straightline.

Associate Chair's Corner

by Professor Craig W. Somerton



As I meet with representatives from industry, talk with our alumni, or visit other schools, it has become apparent to me that our graduates possess outstanding teaming and com-

munication skills, well beyond many of the other top schools in the country. I believe that this is a direct result of our design program. In truth, this program prepares our graduate to lead, create, and innovate. I observe that many of our graduates are successful in industry due to their ability to manage projects, projects not unlike the design projects in ME 371, ME 471, ME 412, and ME 481.

Our design program begins with the project in ME 371 Mechanical Design I. Teams of students are required to design and manufacture a machine that uses linkages, cams, and gears to accomplish tasks selected by each team. Every machine is different and stretches the students' creativity. Some past machines include an automated pencil sharpener, a pizza cutter, and a Kool-Aid mixer. These machines are handmade by the students and demonstrate the principles learned in lecture.

Our program then moves on to the design competition format in both ME 471 Mechanical Design II and ME 412 Heat Transfer Laboratory. For these classes the students must design a build a machine that performs a specified task. Some examples from ME 471 include the Baseball Frenzy, the Sip and Puff Controlled Fishing Rod for Quadriplegics, and the Widget Inspector. Projects for ME 412 have included the Ranque-Hilsch Vortex Tube Chiller, the Solar Coffee Re-heater, and the Birthday Candle Powered Desalinator. These projects prepare our students for the competitive nature of American industry.

70 Seniors to Graduate in December!

Congratulations to all mechanical engineering December graduates! On behalf of the ME faculty, I wish you the greatest happiness and success in your careers, graduate studies, and personal lives. The following students had applied for graduation by October 10. If your name is missing, please contact me immediately (Email Gaile at <griffore@egr.msu.edu> Tele: 517-355-3338).

Michael Kenworthy Balck
John White Benghauser
David Lee Biegas
Lindsay Cathryn Bockstiegel
Adam Mark Brannan
Adam Joshua Brzycki
Keith M Bury
Daniel Michael Cassar
Andrew David Coleman
Bryan Thomas Cooper
Julie Ann Crane
Laura Beth Daly
Evan Andrew Detone
Caitlen Shelby Douthitt
Scott Clement Doyle
Benjamin Michael Dreher
Patrick Michael Eathorne
Joshua Riley Ewing
Michael Ka Hing Fong
Brandon Clifford Goad
Arjang Gouneili
Benjamin Thomas Greyerbiehl
Alexander Raymond Grobbel
Patrick Gary Grondin
Brandon Geoffrey Gulker
Jordan Melvin Hauser
Richard Dustin Henderson
Matthew Thomas Hirschfield
Jeremy Vincent Horgan
Andrew Michael Howald
Michael David Hundt
Jillian Therese Joliat
Alan William Katz
Andrew David Kosinski
Lindsay Lynn Kredon

Thomas Richard Kret
Matthew M Langenderfer
Kyle William Lehrmann
Samuel Thomas Leitkam
Michael Neil MacCallum
Josh Christopher Maniago
Uday Bahadur Mathur
Justin David Mciver
Michael Patrick Mckimmy
Kevin Michael Miller
Matthew Oja Nagle
Sean Patrick Noonan
Joseph Michael Obeidi
Michael Patrick Oconnell
Jonathon Brent Ostroski
Brian Albert Pernick
Anthony Robert Piro
Sylvia Poplawska
Elliott James Radcliffe
Alejandro Miguel Recio-Sada,
Jay Vance Richards
David C Ruddock
Gregory Charles Schafer
Alison Kay Solomon
Sean Raymond Steffer
Scott Fraser Stieber
Paul Christian Strefling
Ryan P Taelman
Jessica Marilyn Theis
Elliot Scott Tippmann
Richard Arthur Utrup
Elizabeth Jennifer Volz
Bradley Allan Wackerle
Ryan Richard Wahula
Taylor Douglas Young



The crowning glory of the design program is ME 481 Mechanical Engineering Projects in which teams of students work on real world problems. Many of these problems are sponsored by industry and provide students with the opportunity to collaborate with practicing engineers. Typical projects include the development of new products or re-design of existing products to reduce costs or enhance reliability. Other projects are humanitarian based, in

which the students work with individuals who have special challenges. These projects are focused on the development of devices to improve the quality of life for people affected by diseases like cerebral palsy or spinal muscular atrophy.

We are an elite mechanical engineering program because of our design program. It requires a lot of work from both students and faculty, but as all alumni and employers tell me, it is worth it!

Introducing the New Global Engineering Concentration!

by Professor Eann Patterson, ME Chairperson

You would have to be a hermit living in the remotest corner of the UP in order to be unaware of the impact of globalization on the everyday life of ordinary citizens of our planet. Speed of response to customers needs has always been an important factor for a successful business and now engineering firms can take advantage of global communications to move projects around the world to reduce costs and time-to-market. Transfers might take place on the timeline of the project with fundamental research, product development, manufacturing and sales being coordinated on different continents. Alternatively the project might be transferred around the globe over a twenty-four hour period moving with daylight so that there is always a team of engi-

neers working on it while others sleep. In either case these dispersed teams need to be able to communicate and work together effectively and their leaders need to be able appreciate and function with a variety of cultures.

The Department's new Global Engineering Concentration has been conceived to provide students with an opportunity to gain experience of another culture while still gaining credit towards their graduation with a B.S. in mechanical engineering. Students will visit an overseas university for a semester, enroll in mechanical engineering courses provided by the host institution, take the examinations for the courses, and have the grades and credits add to their MSU

academic records. See the program specification below for more details.

Exchange agreements are being explored with English language universities in Taiwan and Turkey, and agreements already exist with the University of Surrey in England. Further exchanges will be explored in Europe and the Pacific Rim in order to both provide a choice of cultures for students to experience and to provide the capacity for perhaps 30% or more of undergraduate students in mechanical engineering to venture abroad as part of their studies. Such an experience will not only substantially increase their employment prospects but is also likely to be a life-changing event in many and unpredictable ways. Don't just think about it – go and do it!

GLOBAL ENGINEERING CONCENTRATION REQUIREMENTS

(12 credits)

The aim of this concentration is to provide opportunities for students to broaden their experience of other cultures while simultaneously progressing towards qualification as a professional engineer. The ability to understand and appreciate other cultural perspectives is significantly enhanced by living within another culture and such an experience will both improve the employability and effectiveness of engineering graduates in the global economy. The concentration is intended to allow students to spend at least a semester studying in an overseas institution, taking credit-bearing courses provided by the host institution as part of their elective choices. To support this concentration, relationships will be established with Departments in a number of countries, such as Australia, China (HK), Scandinavia, and the UK.

To complete a Bachelor of Science degree in mechanical engineering with the global engineering concentration, students must complete the requirements for the B.S. degree in mechanical engineering, including the following 12 credits obtained as part of a study abroad experience:[†]

•**ME 438 Global Team Design Project** (3 credits)

A design intensive experience performed as part of a team at the host institution that involves the synthesis of engineering fundamentals and elements of business, management and marketing. Assessment should involve both written and oral presentations.

•**ME 439 Mechanical Engineering Applications in a Global Context** (9 credits)

Mechanical Engineering courses to be selected by the student with the approval of their advisor and endorsed by the Department Chair or his/her nominee. The courses will be equivalent in content and level to those offered as Senior Electives within the Mechanical Engineering program at Michigan State University. Any reasonable combination of not more than five courses will be selected to the equivalent of nine credits.

CREDIT DISTRIBUTION: The 3 credits of ME 438 will satisfy the Senior Elective design intensive requirement. The 9 credits of ME 439 will satisfy the remaining Senior Elective requirement.

[†]All courses will be conducted at an institution of equivalent standing to Michigan State University and usually in English. Credits must be gained in courses provided and taught by the host institution. Credit and grade equivalence will be set by the ME Department Chair or his/her nominee.

Professor Mukherjee Receives 2007 Withrow Award!

Professor Mukherjee received the 2007 Withrow Teaching Excellence Award last spring at a special awards luncheon and ceremony. He was presented with an inscribed plaque, a medallion to wear at commencement ceremonies, and a small stipend.

Professor Ranjan Mukherjee is the recipient of the 2007 Withrow Teaching Excellence Award. Each year a committee consisting of the last three faculty award winners, plus student representatives from ASME, SAE, and Pi Tau Sigma, makes the selection after reviewing nominations from ME juniors and seniors.

After receiving his Ph.D. from the University of California at Santa Barbara in 1991, Dr. Mukherjee became a member of the ME faculty at the Naval Postgraduate School in Monterey, California. He joined our department in 1996. His research focuses on fundamental problems of dynamic systems, measurements, and controls and novel problems in robotics and control applications. He conducts both theoretical and experimental work on a variety of mechatronic systems that include space and mobile robotic systems; telerobotic systems for minimally invasive surgery; miniature robotic systems for Department of Defense applications; and control and sensing problems in

magnetic bearings, hot-air balloons, shape-memory alloy actuators, flexible structures, and micro-electro-mechanical systems (MEMS) resonators.

Dr. Mukherjee is respected by his students as being truly passionate about the material he teaches and caring that they understand it. He is known for his ability to communicate complex ideas in a form that is readily understood by everyone.

"His manner in the classroom makes concepts easy to understand and also establishes him as a 'teacher' and not just a 'teller.'" "Dr. Mukherjee gives excellent notes and lectures, excellent explanations of concepts, very good and informative real-life examples of material covered in class, and he's pretty funny." "He is very approachable and is always willing to answer questions." Dr. Mukherjee epitomizes the researcher who has not left teaching and his students behind. One of his students put it this way: "I've never had a teacher break down complicated material so well. He is an awesome teacher!"

Dr. Mukherjee is teaching both sections of ME 361 this semester. He is married and has two daughters. In his spare time, he enjoys listening to music and playing soccer.

Withrow Teaching Excellence Award NOMINATIONS ARE NOW OPEN!

Nominate your favorite prof for the 2008 Withrow Teaching Excellence Award! It's easy!

<https://stuedms.msu.edu/withrow.php>

Deadline: Friday, Nov. 16

Department News (Cont'd from pg 2)

Mr. Tim Hinds has been appointed to develop and be the lead instructor for the new freshman Cornerstone Program. This program will introduce freshmen to the disciplines of engineering and the engineering problem solving approach through team-based projects. The second course in the sequence (EGR 102) will replace CSE 131.

The dedication ceremony for the Energy and Automotive Research Laboratories (ERC South), was held on August 24. This is a \$10 million facility on the MSU campus that will focus on improving automobile engine efficiency, reducing vehicle emissions, and seeking alternative energy sources.

<http://newsbulletin.msu.edu/nov2305/earl.html>

Professors Cloud, Liu, and Patterson from ME, and **Professor Drzal** from CHEMS, are moving their research operations to the Composite Vehicle Research Center, which is located across the street from the Henry Center and the University Club.



PHOTO BY HARLEY SEELEY

Dean's List

Congratulations to these 156 ME majors who made the Dean's List after Spring and Summer 2007. To be on the Dean's List, you must have a semester GPA of 3.5 or better. *This list is from October 1. For updates, go to: <http://www.reg.msu.edu/ROInfo/GradHonor/DeansList.asp>. For updates, please consult the website.*

SPRING 2007: Muamer Abdurahmanovic, Joaquin Affonso, Adam Alderman, Paul Allen, Saud Alrakhayes, Muhammad Aslam, Timothy Aspinall, Michael Balck, Alexis Bauer, Matt Bauer, Timothy Baumer, Anthony Beal, Logan Beam, John Benghouser, David Biegas, Ryan Boak, Adam Brannan, Adam Brzycki, Daniel Cassar, Christopher Cater, Andrew Cawood, Louis Cervone, Andrew Coleman, Matthew Compher, Bryan Cooper, Julie Crane, Joel Darin, Taylor Darling, Trevor DeLand, Anthony Dellicolli, Kevin Derrick, Daniel Diebolt, Tiffany DiPetta, Jared Dorvinen, Michael Douglass, Caitlen Douthitt, Patrick Eathorne, Mark Ehrenberger, George Elliott, Ryan Emmorey, Bryant Ennis, Kevin Etzel, Allen Eyler, Neil Ferguson, Eric Fournier, Lucas Fratta, Nathan Geib, Chad Glinsky, Douglas Gobeski, Mark Goldy, Joao Goncalves, Stephen Griffith, Patrick Grondin, James Guitar, Brandon Gulker, Jacob Haf, Stephen Hammack, Patrick Hammer, Andrew Harbin, Matthew Hays, Richard Henderson, Jeremy Horgan, Clarence Huff IV, Michael Hundt, Zef Ivanovic, Cipto Joegiono, Jillian Joliat, Spiros Kakos, Zachary Kaltz, Alan Katz, Ryan Kelly, David Kempf, Justin Ketterer, Doo-Hwan Kim, Matthew Kimball, Chad Kleinow, Kyle Koepf, Andrew Kosinski, Lindsay Kredo, Thomas Kret, Andrew Kruk, Ashley Kulczykcki, Jeffrey Laforge, Matthew Langenderfer, Megan Lawrence, Samuel Leitkam, Kayton Lenhart, Allison Lewis, Benjamin Llewellyn, Christopher Lowe, Jeffrey Mann, Erik Marshall, Mary Martin, Eric McElmurry, Kevin McKay, Michael McKimmy, Justin Meeder, Alan Mickiewicz, Kevin Miller, Sara Murawa, Matthew Nowc, Luke O'Brien, Anwelli Okpue, Keith Ortman, Jonathon Ostroski, Anthony Piro, Matthew Pung, Brandon Quaranto, Elliott Radcliffe, Michelle Raetz, Jill Randall, Christopher Rawsky, Joy Reichenbach, Andrew Rogers, Matthew Rokosz, David Ruddock, Matthew Ryerkerk, Joshua Samp, Brian Schulte, Lauren Sharp, Shangyun Shi, Shaheen Shidfar, Jared Sickles, Matthew Siero, Ross Skilling, Aaron Smith, Anita Solitro, Jacob Sprague, Sean Steffer, Scott Stieber, Paul Strefling, Christopher Sweeney, Ryan Taelman, Jin Tam, Eric Tauzer, Jessica Theis, Elliot Tippmann, Diana Toan, Richard Utrup, Bradley Wackerle, Bryan Wagenknecht, Eric Waggy, Cody Wagner, Steven Wagner, Richard Wahl, Ryan Wahula, Jillian Warner, Matthew Warner, Matthew Weir, Matthew Winkley, Chi-Hong Yung, Oliver Zemanek

SUMMER 2007: Timothy Degraff, Erin Johnson, Krishna Vistarakula, Steven Yang

Studying Relationships Between High Ankle Sprains and the Football Turf by Professor Roger C. Haut

In football, ankle sprains account for about 10% of the reported injuries. "High" ankle sprains are particularly difficult to rehabilitate and require a long recovery time often costing a player most of a season and millions of dollars in lost revenue and medical expenses. A commonly accepted risk factor for this type of injury is a mismatch between the cleat design on the shoe and the playing surface, resulting in a high coefficient of friction. In order to better understand this relationship the Orthopaedic Biomechanics Laboratory (OBL), directed by **Dr. Roger C. Haut** (ME) and **Dr. John Powell** (KIN), have a study funded by the NFL Charities Foundation.

The objective of this research is twofold: (1) to develop an experimental cadaver model of high ankle sprains, and (2) to develop a biofidelic, mechanical surrogate of the human ankle that can be used to evaluate the injury potential of various shoe-surface interface conditions.

Recent studies suggest that exposure to artificial turfs during an NFL player's career may increase the odds of musculoskeletal injury by 2.5 times. A shoe-surface interface tester [see photo] is currently being used at MSU to document the break-away torques developed at the ankle for ten different cleat designs and fifteen different turfs. These data will then be correlated with the behavior of the human ankle in cadaver studies to determine the risk of injury for each interface condition.

Additionally, an epidemiological research study funded by the NFL is being led by Dr. John Powell to document daily shoe type, playing surface, and injuries recorded by thirty different NCAA Division I college football teams. The data will provide baseline evidence of injury patterns associated with various cleat designs and playing surfaces in college football. These data will be used to de-



PHOTO PROVIDED BY PROF. HAUT

ME senior Greg Schafer (kneeling) and ME graduate student Mark Villwock are shown preparing for a shoe/surface interface test using the surrogate mechanical ankle.

velop guidelines for the relative risk of lower extremity injury based on cleat design and playing surface.

If you want to know more about this project or opportunities for getting involved in this or other research, log onto the OBL website at OBL.MSU.EDU or email Dr. Haut at haut@msu.edu

Tutoring

- The Guided Learning Center (GLC) offers free drop in tutoring in math up to differential equations and science courses (chemistry, physics, etc.). They are open from 4 to 9 p.m. on Monday-Friday, and occasionally later. For individual tutoring, or to inquire about possible tutoring in engineering courses, email **Mr. Rickey Caldwell** caldwe20@msu.edu
- ME graduate student and Pi Tau Sigma undergraduate tutors can be contacted through the ME Advising Office. These tutors do charge a fee, which you can negotiate with them. If you are interested, email **Gaile Griffiore** at griffiore@egr.msu.edu

COVER STORY – Creating a Solar Oven Industry in Tanzania: A Capstone Design Project

by Professor Craig W. Somerton

Five students, four alumni, and a faculty member in the Department of Mechanical Engineering spent spring break 2007 in Tanzania (*tan-zuh-nee'-uh*), a country in east Africa. They were not, however, your ordinary tourists, visiting game reserves, etc. Rather they were working to improve the lives of the Tanzanian people.

In conjunction with a Michigan nonprofit organization, Solar Circle

(www.solar-circle.org), they participated in the creation of an industry in Tanzania that will supply its people with solar ovens manufactured from materials available in that country. Tanzania is one of the poorest countries in the world with one of the highest death rates from AIDS. Currently, Tanzanians rely on wood fires for cooking. This practice is responsible for deforestation, degraded ecosystems, smoke-related

respiratory diseases that represent the second leading cause of death, and malnourished children. Located just south of the equator, sunlight exists as one of Tanzania's most abundant resources. Then why not use solar energy for cooking?

In August 2005, **Judy Martin**, the founder and president of Solar Circle approached three faculty members in the Department of Mechanical Engineering, **Bob Hubbard, Bob Chalou, and Craig Somerton**. They worked with Judy to develop a prototype solar oven. Last fall a prototype was designed, built, and tested, and then Judy took the design with her to Tanzania where it performed reasonably well. However, there were still issues to be resolved. She identified ME 481 as the next logical step for the design.

During the 2006-07 academic year two capstone design teams developed a solar oven specifically tailored for manufacture in Tanzania. Both teams were advised by Craig Somerton, Associate Chairperson for the Undergraduate Program. After developing several conceptual designs, the teams decided on a box oven design, which consists of a cooking chamber fitted with reflectors



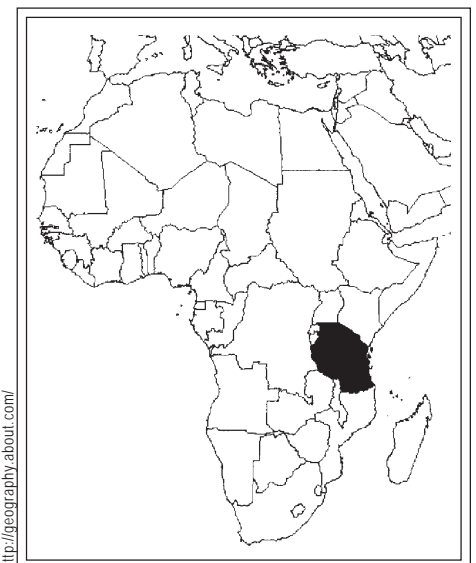
Stacie Proctor and Allison Lewis make oven seals.

HEATHER PUNG



Teaching at a girl's school in Masasi..

JOHN HAUSKA



<http://geography.about.com/>

that direct sunlight into the chamber. Materials were tested and selected with the aim of optimizing the position of the reflectors to maximize the delivery of solar energy to the oven. Four different oven configurations were identified that would be tested in Tanzania.

During the 2007 spring break, the teams were able to take the product development process a step further by traveling with Professor Somerton to Ndanda and Masasi, Tanzania, to build the ovens, test them, and refine the design. A key aspect of this trip was to meet the people who will benefit from the oven and develop an understanding of the customer. But of course, it really went way beyond that. "Engineering is about helping people and we met people whose lives will be transformed by this solar oven," Somerton said. The trip was funded from private donors, including a generous gift from the Somerton Family Trust.

In order to spread the word concerning solar cooking the MSU team made a presentation at the Girls Secondary School in Masasi. Over a hundred girls listened to the talk and then participated in a hands-on exercise that taught them the basic principles of solar radiation.

Stacie Proctor, a mechanical engineering senior said, "This was a once in a lifetime trip for all of the students. We met people and shared information on solar ovens but we also went beyond that and just found a connection as people. I know I have made some lifelong friends from this trip and I am changed forever. I hope I left the people I met changed for the better as well."

The Team

Adam Brannan	John Hauska
Allison Lewis	Judy Martin
Heather Pung	Stacie Proctor
Craig Somerton	Veronica Vasquez
J. J. Westover	Andrew White
	Matt Winkley



Testing the ovens.

HEATHER PUNG



Final solar oven design.

J. J. WESTOVER

Closed Loop Ignition Timing Control for Internal Combustion Engines

by Guoming (George) Zhu, ME & ECE Departments

Internal Combustion (IC) engines are optimized to meet exhaust emission requirements with the best fuel economy. Spark timing is used as one of the optimization parameters for best fuel economy within given emission constraints.

For normal operation, engine spark timing is often optimized to provide Minimal advance for the Best Torque (MBT). On the other hand, engine combustion stability and knock avoidance requirements also constrain engine spark timing within a certain region, called the feasible spark timing region. For certain operational conditions, it is desirable to operate the engine continuously at the borderline of the feasible region. For instance, under certain operational conditions, engine MBT timing is located outside of the feasible spark-timing region due to the requirement to avoid engine knock. Obtaining the maximum brake torque requires the engine to operate at the knock limit (borderline knock limit) of the feasible region. In order to reduce cold start Hydrocarbon (HC) emissions under different operating conditions, it is desirable to locate the spark timing at the retard limit of the feasible region for fast catalyst light-off. This is due to the desire to maintain a certain level of combustion stability.

Figure 1 shows a typical spark timing feasible region as a function of EGR (exhaust gas recirculation) for a desired level of combustion stability with a coefficient of variation (COV) of IMEP (indicated mean effective pressure) less than 3 percent, where the green line represents the engine MBT spark timing, red line represents the engine advanced (knock) spark limit, and the blue line represents the retard spark limit. It can be observed that knock, MBT and retard limits vary as a function of EGR rate, which makes it difficult to control the optimal spark

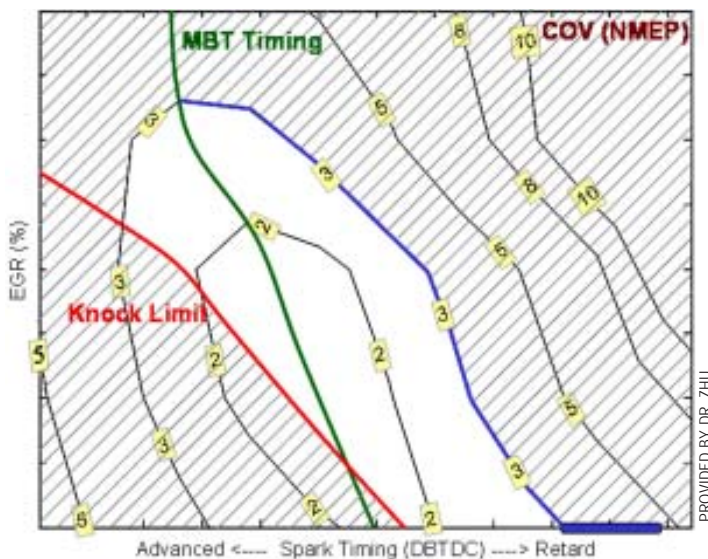


Figure 1: Feasible region of spark timing

timing in an open loop fashion. Further, this feasible region varies in shape with different engine operational and environmental conditions.

In current production applications, MBT timing is an open loop feedforward control whose values are experimentally determined by conducting spark sweeps at different speed and load points, and at different environmental operating conditions. Almost every calibration point needs a spark sweep to see if the engine can be operated at the MBT timing condition. If not, a certain degree of safety margin is needed to avoid pre-ignition or knock during engine operation. Open-loop spark mapping usually requires a tremendous amount of effort and time to achieve a satisfactory calibration.

Existing knock spark limit control utilizes an accelerometer based knock sensor for feedback control. Due to the low signal-to-noise ratio, conventional approaches are based on the use of a knock flag signal obtained by comparing the knock intensity signal of a knock sensor to a given threshold. The knock intensity signal is defined as the integrated value, over a given knock window, of the absolute value signal obtained by filtering the raw knock sensor signal using a band-pass filter. This knock flag signal is the input to a dual-rate (slow and fast correction) count-up/count-down engine knock limit controller. The disadvantage of this control scheme is that it continually takes the engine in and out of knock, rather than operating continually at the desired borderline knock limit. In addition, at certain operating points knock observability can be severely compromised by engine mechanical noises such as valve closures and piston slap which may be picked up by the accelerometer. Such issues result in conservative ignition timing that leads to reduced engine performance.

As discussed before, during a cold start, it is desirable to operate the engine at its retard spark-timing limit for minimal HC emissions. The retard spark-timing limit is often constrained by engine combustion stability metrics such as COV of IMEP. Due to unavailability of production ready in-cylinder pressure sensors, the retard spark-timing limit is obtained through an off-line engine mapping process, leading to conservative calibrations. In addition, to accommodate the range of fuels used throughout a market, this calibration is made even more conservative.

In recent years, various closed loop spark timing control schemes have been proposed based upon in-cylinder pressure measurements or spark ionization current sensing. Based upon test data, it has been found that the peak cylinder pressure (PCP) usually occurs around 15° after TDC (top dead center) at MBT timing. The 50% mass fraction burned (MFB) point generally occurs between 8° and

10° after TDC when MBT timing is achieved.

Due to the recent advance of electronics technology, ionization current can be detected at 15 microamperes with very low background noise. The high quality of an in-cylinder ionization signal makes it possible to derive a linear knock intensity that is proportional to the knock level. It can also be processed to derive a metric for combustion quality similar to COV of IMEP and closeness of combustion to partial burn and misfire limit, which can be used as a feedback signal for retard limit control. Engine MBT timing can also be derived from in-cylinder ionization signals similar to the pressure signals. Since MBT criteria derived from pressure and ionization signals are solely based upon observations and may change at different operating conditions, the associated control algorithms still require some dynamometer based calibration effort. It is clear that the combustion process has to be matched with the engine cylinder volume change to attain the best torque. The major advantage for the ionization based closed loop MBT timing control is that no additional sensing element or assembly steps are required, since it uses the spark plug as an ignition actuator and a combustion sensor.

A closed loop ignition control architecture (see Figure 2) combines MBT timing control, knock and retard timing limit control strategies into an integrated one. The integrated ignition control architecture allows the engine to operate at its true MBT timing when it is not limited by borderline knock limit and to operate at its borderline knock limit when it is limited by knock. Alternatively, it allows the engine to be operated at its borderline retard limit when it is limited by combustion stability. This control architecture uses either in-cylinder pressure or an ionization signal for closed loop ignition timing control.¹

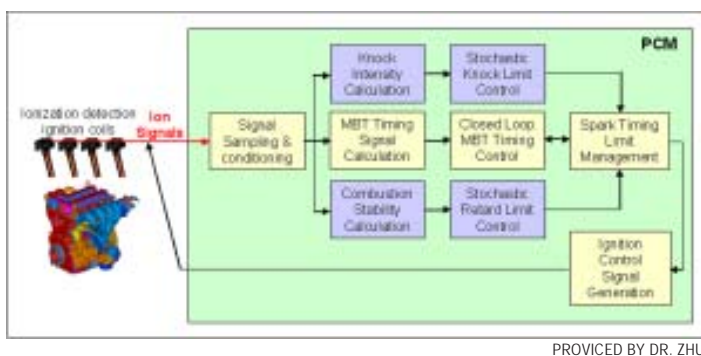


Figure 2: Closed loop ignition timing control system

¹G.G Zhu, I. Haskara, J. Winkelman, "Closed loop ignition timing control using ionization current feedback," *IEEE Transaction on Control System Technology*, May, 2007.

Think About Graduate School by Clark J. Radcliffe, Assoc. Chair for Graduate Programs

Think about joining us for a graduate degree. The Mechanical Engineering Graduate Programs are starting another exciting year. We have just opened the new Energy and Automotive Research Laboratories (ERC South) and have received word of funding for two new research centers: one funded by the U.S. Air Force in computational fluid mechanics and one funded by the U.S. Army in composite vehicle design. Currently Mechanical Engineering at Michigan State University has about 120 graduate students evenly split between M.S. and Ph.D. students. The new research centers will substantially increase that number over the next two to three years. This is an opportunity for new students to participate in new and exciting emerging technology.

Why go to graduate school? There are two immediate answers to this question. First, graduate degrees permit you to control and shape your engineering career in ways that are impossible without them. Graduate degrees help you develop the expertise that uniquely qualifies you for those special professional positions that every engineer looks forward to. Second, the salaries paid to engineers rises dramatically with degree level. EngineerSalary.com says expected salary for an inexperienced "ME-Analytical" with a B.S. is \$56,000 rises to about \$75,000 with a M.S. and \$95,000 with a Ph.D. Of course, experience raises these salaries but no single qualification raises them faster than graduate degrees.

Can I afford to go to Graduate School? Yes, you can. Most of our ME graduate students have a teaching or research assistantship. A typical assistantship pays health care, tuition and salary worth about \$30,000 per year or more.

When can I start? Students start any semester. Most of our graduate students start Fall semester. Many students start Spring semester. A few start Summer semester. If you are finishing your BS degree with less than a full load, you can *dual enroll* for a semester and earn credit towards a B.S. and M.S. in the same semester.

When should I apply? NOW. There is no time like the present. Although the external deadline for Spring semester was September 15th, we accept last minute applications from MSU students. The longer you wait, the less chance we can find a research or teaching assistantship for you. We can defer applications if you want but *Apply now*.

Come see us. To learn more, contact the **Graduate Secretary Aida Montalvo** <megradad@egr.msu.edu> or myself in the Mechanical Engineering Graduate Program Office 2318EB.

Get Feedback from Your Readers!

by Craig Gunn, ME Director of Communications

As some of you can remember, one of the things that I harp on, when I present ideas on communication in classes, is the issue of finding readers. I am sure that many of you cringe when someone suggests that you have your work read by others. But if that is a problem with you, it is time to start the healing process and seek out those individuals who will not only read your text but provide you with sensible and valuable comments that will make whatever you write better.

We are all overly sensitive about our written production. We feel that we may be inadequate and that any other set of eyes looking at our text will only embarrass us. Now if you think that way, how more embarrassed will you be when a faculty member or your boss sits down to read your work and is horrified. I think that I would prefer being a little embarrassed in front of my friends than being humiliated and ridiculed by my boss for a very poor performance in writing.

Text production is not easy. It requires a lot of effort to make it valuable reading for others. With that in mind, we should realize that when others read our text, they can see things that we have missed, glossed over, or just plain inadequately explained. We may not use commas very well, so our writing gets confusing. We may not have a good command of the language, so our text sounds stilted or silly. We may not produce good structure so the reader falls asleep before they get to the really important issues. These are all places where a concerned and intelligent reader can offer suggestions and useful comments while providing logical questions that allow you to improve what you have written.

When you start to decide on your collection of good readers, make plans to evaluate the comments that these readers make. Do they just say, "It's



ME major Will Pan (seated) gets helpful suggestions about his writing from Gary Golden (ME) and Emily Baher (ECE).

okay," or do they tell you where they get confused. Do they ask questions about words that you use? Do they make comments about how they would like more or less information on your topic? Do you find that they don't spend a lot of time on rules but on areas of information that will improve the text markedly? The latter group of readers should be cultivated. Take their comments to heart. The former you don't need to bother in the future as readers. Value comes in the form of constructive comments.

And if you still feel uncomfortable, keep in mind that the readers that you finally choose are commenting for one and only one reason: everything that they suggest is meant to make you look better. They want to raise your text above its current level to a higher plane. They are looking out for you and your interests. Keep that in mind and all the comments you collect will result in better text and an improved vision of you.

Aachen, Germany

by Professor John Foss

Our exchange program with the RWTH-Aachen (a premier European technical university) has been in existence since 1983. For 2008 we will enter a new phase in which our students will be in Aachen from May 15 through the month of July. This new program drops the required courses to 9 credits: GRM 102 or higher (4 credits), and ME 490 Independent Research (5 credits). This new format will make it possible for a much wider range of students to participate, since ME 410 is no longer part of the program.

As before, the program is structured to allow European travel by setting the academic work for Monday through Thursday (our students become very proficient at using the rail system).

The opportunity to study "their language" in "their country" is of obvious benefit in this era of multinational corporations. There are many employment advantages of a significant international experience. The opportunity to explain (during an employment interview) that one has worked in a research group with German colleagues – and in an environment that deals with the most advanced techniques and equipment – makes it clear that one has had a *significant international experience*.

Up to 10 carefully selected MSU students will be admitted into the 2008 program during the 2007 fall semester. These students will carry out a preparatory 1-credit ME 490 in the spring semester 2008. Further details are available by contacting **Prof. J. Foss** <foss@egr.msu.edu> Former students will also be available to provide their insights on the benefits of this exceptional experience.

Lyon, France Program

by Professor André Bénard

The Department of Mechanical Engineering offers a month-long study abroad program for junior-level students in Lyon, France each summer. The students stay at ECAM, a French engineering school located in the old part of Lyon, for the entire month of June. They are required to enroll for a minimum of 3 credits, and they work on a research project (independent study) guided by a mechanical engineering professor. They also take a French language course "French Language and Culture for Foreigners" (taught in French).

If you are interested in this program, please contact:

Ms. Maggie Blair-Ramsey
<blairram@egr.msu.edu> or

Professor André Bénard
<benard@egr.msu.edu>
for more information.

Summer Job Tips

Construct a resume. Send it, along with a cover letter to companies in your home town or other preferred locations. Do not overlook small and medium sized companies. Be politely persistent and follow up with another letter, telephone call, or a personal visit. Type all correspondence.

Register with the Career Services Network and MySpartanCareer by going to their website at <http://www.csp.msu.edu/> or www.myspartancareer.com. Click on MySpartanCareer and register. MySpartanCareer provides electronic event updates, want ads for internships, summer, full-time, on-campus and off-campus jobs and a tracking system so you can keep it all organized. MySpartanCareer also allows you to sign up for on-campus interviews.

Visit The Center/SpartanEngineering, in 1340 EB...across from Sparty's

Consult these sources: professors,

relatives, friends, ME seniors, telephone books, manufacturers' directories from local chambers of commerce, *Peterson's Guide*, and the *College Placement Annual*.

Watch your email for summer job notices from the ME Advising Office.

American Society of Mechanical Engineers

The American Society of Mechanical Engineers (ASME) is dedicated to helping students create a connection outside the classroom and get the jump start they need into the work place.



ASME sponsors many events, bringing in big name companies such as Boeing, Georgia Pacific, Unilever, Shell, Dow Chemical, and Whirlpool. These are some that will speak this year. In the future, look forward to student activities and other presentation from companies nationwide.

Becoming a member of ASME is beneficial and easy to do. ASME membership links you to great career opportunities that other engineering students don't have. ASME provides members with valuable team building skills the chance to network with industries and faculty. Having trouble catching an internship or a co-op? Joining a group such as ASME gives you a great resume builder and that competitive edge that sets you apart from the rest. One of the best benefits of joining ASME is access to over \$100,000 in scholarships that only AMSE members can receive!

To become a member, just visit our website at www.egr.msu.edu/asmc or to 2328K EB to pick up and submit your application. Membership is FREE for freshmen, so don't wait until next year to join. Not a freshmen? Membership is only \$30 per year, with \$5 of it going towards the MSU chapter to help finance events, presentations, and the free

food and drinks provided at these gatherings.

Besides the great connections to companies and scholarships, ASME members receive a subscription for the ASME magazine and get to attend all ASME events to find out company presentation dates, suggest companies that interest you, or just give your personal feedback.

Want to get more out of ASME? Want to get your voice heard around the panel, other clubs and societies, or even throughout the college of engineering? Then you should consider running for an officer position. Helping run an organization such as ASME gives students a great deal of real-world experience and looks even better on a resume. Officer elections are held in the spring semester, and these positions will need to be filled as graduating officers leave.

So get involved with ASME and the college of engineering and make the most out of your MSU education. ASME members help create new programs that benefit not only current MSU students but future MSU students as well. Visit www.egr.msu.edu/asmc for further details on meetings, events, community service, membership and more. Submitted by Louis Cervone, Newsletter Editor.

Scholarships

The 2008-09 College of Engineering Scholarship application will be available on the College of Engineering website in November. When it is ready to use, the College will send out an email announcement with the link. The deadline for submitting your application will be Friday, February 29.



PHOTO PROVIDED BY JOSH THOMET

MSU Baja Team

SAE The Michigan State University Baja Racing Team has started out the season strong with one of its largest ever recruitment efforts. This is just a small piece of the Team's plan to increase publicity and interest in baja racing.

The Team began the racing season with a road trip to Columbus, Ohio to the Transportation Research Facility for a Honda sponsored invitational race. Out of 24 cars, the Team fell just short of capturing 1st place, following Auburn University by only 17 seconds. Invitational races such as these prove to be a great learning experience and practice for the spring SAE races. To further prepare for the SAE season, the Team plans to attend the Michigan Tech University winter race in mid-February.

Plans for the 2008 car consist of several new innovative designs including a new experimental drive line, and attempting to race one of the first successful 4 wheel drive vehicles. The goal of these new concepts is to improve competition placement in areas where the Team has seen problems in the past.

As always, the Baja Racing Team is looking for new members and sponsorship. If you're interested in joining the team please contact **Josh Thomet** or **Ken Maisonville**; remember the team is open to all majors. As

for sponsorship, the team's new ideas and endeavors always come with the need of new sponsors. To learn how to sponsor the team and find out how sponsorship can benefit the donor please contact Josh or Ken.

For more information or contact information check out the Team's website: www.egr.msu.edu/baja. Submitted by *Emily Duszynski*.

Join the Solar Car Team at MSU

The MSU Solar Car Team is a registered student organization devoted to the design, construction, testing, and racing of a solar powered electric vehicle. The team was started about seven years ago. We have biweekly meetings, one on Tuesday nights at 9 PM, and one on Thursday nights at 7 PM. Both meetings take place in room 1234 Engineering Building. The majors involved with this group are primarily those engineering (electrical, mechanical, material science, civil, computer Science) but we also have some marketing, education, and telecommunications majors. However, anyone interested is more than welcome. We want to be successful in the 2200 mile solar car race in 2008. Also we work on enhancing our historic EV1 as test bed for modern tech-

Pi Tau Sigma



Pi Tau Sigma, the Mechanical Engineering Honor Society, has gotten off to a great start, and we are very excited about this semester. The year began with four academic presentations featuring

Chrysler, Marathon Oil Company, Shell Oil Company, and Whirlpool Corporation where we learned about job opportunities for mechanical engineers in the auto, oil and appliance industries. We have helped our community by preparing dinner at the Ronald McDonald House. Our biggest event each semester, the Golf Outing, which is open to all engineering students, teed off on September 29th. If you are interested in this event for next semester, e-mail [<gowerbla@msu.edu>](mailto:gowerbla@msu.edu)

One of our biggest social events, Wing Night at BDubs, was on Tuesday, October 16. This is a social gathering for Pi Tau Sigma members and initiates where they can eat as many wings as they want for free! On Saturday, October 20, we were at the Spartan Future Engineers Open House answering any questions that high school juniors and seniors had regarding engineering. We have another service event at Ronald McDonald House scheduled for Thursday, November 8. We will also be having recruiters from Caterpillar for an information session in November (date TBA). They will be talking about internship and job opportunities. Please visit our website at <http://www.egr.msu.edu/pts/> for more information. We hope to see you at our upcoming events! Submitted by *Basak Oguz, President*.



nology. If you are interested, you can visit our website at: www.egr.msu.edu/solar, email us at [<solar@msu.edu>](mailto:solar@msu.edu) or contact **Zach Puplis** at (269) 277-4608. Go Solar Green! Submitted by *Dr. Mueller*.

SPRING SEMESTER SENIOR ELECTIVES

►The asterisk (*) after a course number indicates that it has been officially designated as “Design Intensive.”

- ME 417* **Design of Alternative Energy Systems.** 3(3-0). Prereq: ME 410 or concurrently. *Bénard.*
- ME 442* **Turbomachinery.** 3(3-0). Prereq: ME 332. *Mueller.*
- ME 445* **Automotive Powertrain Design.** 3(3-0). Prereq: ME 444. *Novak.*
- ME 457 **Mechatronic System Modeling and Simulation.** 3(3-0). Prereq: ME 451 or concurrently. *Rosenberg.*
- ME 464 **Intermediate Dynamics.** 3(3-0). Prereq: ME 361. *Shaw.*
- ME 475* **Computer Aided Design of Structures.** 3(2-3). Prereq: ME 471 or concurrently. *Averill.*
- ME 477 **Manufacturing Processes.** 3(3-0). Prereq: ME 222 and MSE 250. PLEASE NOTE that the ME department cannot change your ME lab section in another course to fit the ME 477 schedule. *Thompson.*
- ME 478 **Product Development.** 3(3-0). Requires Override—See #1 below. Prereq: ME 361, 477, and Tier I Writing. *Thompson.*
- ME 490 **Independent Study.** 1-4 credits. Requires Override—See #2 Below. You may re-enroll for a maximum of 6 credits.
- ME 495 **Tissue Mechanics.** 3(3-0). Prereq: ME 222. *BME Option Course.* *Haut.*
- ME 497 **Biomechanical Design.** 3(3-0). Prereq: None for ME majors. *BME Option Course.* PLEASE NOTE that the ME department cannot change your ME lab section in another course to fit the ME 497 schedule. *Reid-Bush.*
- BME 401 **Quantitative Human Biology.** 3(4-0). Prereqs: CEM 141, MTH 235, PHY 184, plus PSL 250 or concurrently, *BME Option Course.* *Paganini.*
- CE 422 **Applied Hydraulics.** 3(2-2). Prereqs: ME 332 and 391. *Wallace.*
- MSE 425 **Biomaterials & Biocompatibility.** 3(3-0). Prereq: PSL 250 or concurrently and MSE 250. *BME Option Course.* *Baumann.*
- MSE 426 **Introduction to Composite Materials.** 3(3-0). Prereq: ME 222. *Loos.*
- MSE 466 **Fracture and Failure Analysis.** 3(2-3). Prereq: MSE 250. Recommended background: MSE 320 and 331. *Lukas.*

OVERRIDE INSTRUCTIONS

ME Override Form Link: <http://www.egr.msu.edu/me/undergrad/forms>

- 1) Priority for ME 478 is given to students who are on record as Manufacturing Option students. To be “on record” you must meet with Gaile Griffore to plan a long-term schedule that includes the option.
- 2) ME 490–Independent Study: Find a professor who is willing to supervise your project, and discuss your plans with him/her. Complete an *ME 490/490H Enrollment Contract*, available in the ME Advising Office in 2560 EB. After you and your professor have signed it, return the form to the ME Advising Office for the remaining signatures and override.
- 3) Complete the *Graduate Course Override* form, available in the ME Advising Office in 2560 EB. This is a paper form.

Undergraduate Program Educational Objectives Department of Mechanical Engineering Michigan State University

(Approved by the ME Department Faculty on February 17, 2005)

Objective 1: Our graduates will be competent engineers practicing in a diverse range of activities.

Objective 2: Our graduates will use their mechanical engineering education as an impetus for personal & professional growth.

Objective 3: Our graduates will have achieved a noteworthy level of workplace responsibility through understanding their environment and capabilities, including the importance of knowledge management.

Objective 4: Our graduates will be independent thinkers who take ownership in identifying problems and determining effective solution strategies in a timely manner.

Fall Semester Calendar

November 9	All currently enrolled students who have not enrolled by 8 p.m. in at least one course for Spring will pay a \$50 late fee.
November 16	Deadline for Withrow Teaching Award Nominations. The nomination form is located at: https://stuedms.msu.edu/withrow.php
Nov 22-23	Thanksgiving recess
November 30	“The Gathering” (fall social) at Dr. Somerton’s house. All ME student, faculty, and staff welcome! Sponsored by ASME.
December 7	Last day of classes & ME Design Day.
December 8	Undergrad Commencement Ceremony-Breslin at 2 pm. Lasts about 2 hours. No tickets required.
Dec 10-14	Final Exams
Dec 15-Jan 6	Semester Break
January 11	Last day of Free Add Period for Spring 2008.
March 1	Approximate application deadline for April FE exam
March 10	Computer/Telephone Enrollment period for summer semester begins
Mar 28	Computer Enrollment period for fall/spring 2008-2009 begins. Your appointment date (the first time you can log on) will be posted on StuInfo in mid-March.

The MSU College of Engineering Design Day

Friday, December 7, 2007
MSU Union

Come and see our students
lead, create, and innovate

Activities include:

- Competitions
- Presentations
- Demonstrations
- Awards



MICHIGAN STATE
UNIVERSITY

ME Advising Office

Dept of Mechanical Engineering

2560 Engineering Building

East Lansing MI 48824-1226