Professor Lavagnino Wins Teaching Award!
Microfluidic Electrokinetic Energy Harvesting by Dr. Bei
Soft Materials to Hard Problems by Dr. Lin

Professor Bei Fan is shown in her lab in front of a contact angle goniometer that is used to measure the wetting property of functional surfaces and surface tension of liquids. Read about her research on page 6.
Engineers are Problem Puzzle Solvers

Engineers are problem solvers! We find solutions to challenging and sometimes vexing problems. Sometimes the hardest part of problem solving is understanding the problem. Other times the most difficult part is knowing where to start, we have too many options. We have to be creative in the midst of constraints. In many ways, we’re in the business of solving puzzles.

I enjoy puzzles. I enjoy word puzzles like crosswords, number puzzles like Soduku, strategy puzzles like chess, and pattern puzzles like Set. I’ve found that working on puzzles helps me be a better engineer. In particular, thinking through my puzzle solving process lets me see how I can improve my engineering problem solving process.

When I solve puzzles, I use a lot of the skills that I’ve developed as an engineer. For example, puzzles usually have a set of rules that limit solutions. For crossword puzzles the letter in each box must match the vertical and horizontal words. For a Soduku, only one of each number is allowed in each row or column. The puzzle rules are useful for analyzing potential solutions. In engineering problems, the rules are given by the problem definition, engineering codes, or physical laws. Unlike crossword puzzles where the rules are given, engineers have to pull from a broad set of rules and determine which ones are relevant to a given problem. Once we know which rules should be applied to a problem, we know how to evaluate and compare competing solutions. Most importantly, we can begin to eliminate design options that don’t satisfy the rules. The earlier I identify the correct set of rules for a problem, the fewer mis-steps and re-designs I will require.

New puzzles are particularly vexing for me. And that makes them fun. The problem with a new puzzle is in the observation stage. The challenge, of course, is that I don’t know which observations are important. In many puzzles, the hardest part is finding a place to start the solution. Often that means studying the whole puzzle to look for a singular piece of information. The one place where you have enough information to take the next step. When I encounter a new type of puzzle, I usually have to solve a dozen puzzles before I start to see the pattern, but once I do that type of puzzle, it is much easier to solve. My observations are no longer random, I know what I’m looking for. Most engineering problems are overloaded with information. The tiny clues that tell us where to start are hard to spot for a novice problem solver. They often don’t see clues that indicate which physical laws are important, which mathematical representation is best, or how one should set up coordinates. The only way to develop these observational skills is to solve many problems. Solving multiple similar problems lets you develop a keen eye to observe the key elements of the problem.

Some puzzles require a change in perspective. If you’ve ever played Boggle or Chess, you’ve probably realized that rotating the board often allows you to see other combinations or other strategies. Rotating the board didn’t change the puzzle or the rules. It changed the way you looked at the problem. This allowed your brain to see new patterns and make new connections. When our engineering creativity stalls out, one solution is to change our perspective. This might involve literally changing our perspective, but often it involves looking at the problem in different ways. Sometimes the best way to change your perspective is to bring in new perspectives. Show your teammate or co-worker the problem and let them ask you questions. Such exchanges allow you to consider the problem through someone else’s eyes.
Perhaps my favorite tool for solving problems is to change lenses. In Sudoku, this means ignoring everything and asking simple questions that can be evaluated one at a time. For example: “What can I say about the number 9?” Or “Are there any rows with exactly one missing number?” Lenses let me take a complicated problem and look at just a small subset. This lets me avoid information overload. We apply lenses in engineering problems when we take a control volume or a free body diagram. We apply lenses when we ask questions like: Where is energy conserved? Or Where does entropy remain constant?

Thinking about my puzzle-solving process helps me improve my engineering problem solving skills. Of course, the reverse is much better, thinking about my engineering problems as puzzles helps me bring more creativity and enthusiasm to the challenge. Whether you’re solving problems or puzzles, spend a little time thinking about how you do it. You might find it makes you better at both.

**Nominate**

a professor for the 2023 Withrow Teaching Excellence Award!

**Deadline: Friday, Nov. 18**

**To access the Nomination Form:**
1) Go to the ME Website: [https://www.eegr.msu.edu/me/](https://www.eegr.msu.edu/me/)
2) Click on Undergraduate
3) Click on Forms and Policies
4) Select Withrow Nomination

**THANKS!**

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**Department News**

**Dr. Tamara Reid Bush** has accepted the position of Associate Dean for Inclusion and Diversity with the College of Engineering. She will serve on the senior management team and provide leadership for diversity, equity and inclusion efforts across all areas of the college. Dr. Bush has been serving as the ME Interim Chair since early 2021.

**Dr. Ranjan Mukherjee** has been appointed ME Interim Chair. He is the Martin J. Vanderploeg Endowed Chair and a professor of mechanical engineering. He joined the department in 1996 and served as the associate chair for graduate studies from 2014-2017. He is an ASME Fellow and is currently the editor-in-chief for the *ASME Journal of Dynamic Systems, Measurement and Control*. His research broadly focuses on robotics, mechatronics, and control applications.

**Dr. Ronald Averill** retired in August. Dr. Averill received his Ph.D. from the Virginia Polytechnic Institute and University in 1992. He taught courses and conducted research in computational mechanics, laminated composite structure: plate/shell finite element models, progressive failure analysis, optimal design, micromechanics, nonlinear structural response, metal forming, and smart structures. He has served as the ME Associate Chair for Undergraduate Studies since 2013.

**Dr. Geoffrey Recktenwald** has been appointment ME Associate Chair for Undergraduate Studies. Dr. Recktenwald is a Michigan native with bachelor’s degrees in mechanical engineering and physics from Cedarville University in Ohio. After receiving his Ph.D. in 2006 from Cornell University, he remained to teach engineering courses in the Department of Mechanical Engineering, Theoretical and Applied Mechanics, and Mathematics. In 2009 he began pursuing post-doctoral work at the University of Texas at Austin. His areas of expertise include vibrations and stability, methods development, and modeling radiation transport. In addition to teaching and working with students, he is an avid skier and plays soccer and hockey. He also enjoys riddles and an occasional bridge game.

**Dr. Shaoting Lin** has joined the ME department as an assistant professor. Dr. Lin received his Ph.D. in 2019 from MIT and remained there as a post-doc until coming to MSU. His research focuses on inventing high-performing soft materials.

**Dr. Michele Grimm** is on leave from MSU as she transitions to a new position as Dean of Engineering and Applied Sciences at the University at Albany. Dr. Grimm joined the ME department in 2019 and is the Wielenga Creative Engineering Endowed Professor.

**Academic Advising**

1) **ME Juniors and Seniors** are advised by **Gaile Griffore**. For an appointment, call 517-355-3338.

2) **ME Freshmen and Sophomores** are advised by **Jeffrey Tsang**. Instructions for making an appointment with him can be found here: [https://docs.google.com/document/d/1R8UbpqjZNjgM5vD7cRcPiz7Fh5RooDiYcfpUe-WU-L/edit](https://docs.google.com/document/d/1R8UbpqjZNjgM5vD7cRcPiz7Fh5RooDiYcfpUe-WU-L/edit)
Curriculum News

Co-op Students: Before you leave for your Spring 2023 co-op rotation, be sure to discuss your schedule for next Fall 2023/Spring 2024 with your academic advisor.

ME 451-Control Systems & ME 481-ME Design Projects require department approval before you can enroll. If you have an accurate long-term schedule on file in the ME Advising Office, request approval by submitting the following forms:

- ME 451- https://me.msu.edu/me-451-enrollment-approval-form
- ME 481- https://www.egr.msu.edu/me/me481-approval-form

If you do not have an accurate long-term schedule on file, schedule an appointment with Gaile by calling 517-355-3338.

Class Standing. ME juniors and seniors can obtain this information by emailing Gaile at griffore@egr.msu.edu. Be sure to use your MSU email address.

Job Search Advice: The Center is available to answer questions about your job search. To ask a question or schedule an appointment, go to: https://www.careers.egr.msu.edu/

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.

ME Juniors & Seniors Select Dr. Lavagnino for the 2022 Withrow Award!

Professor Michael Lavagnino received the 2022 Withrow Teaching Excellence Award last spring at a special awards luncheon and ceremony. He was presented with an inscribed plaque, a medallion, and a small stipend. Each year a committee consisting of student representatives from ASME and Pi Tau Sigma reviews nominations from ME juniors and seniors and makes the selection.

Dr. Leo Kempel, Dean of the College of Engineering, presents Dr. Lavagnino with the 2022 Withrow Teaching Excellence Award.

Dr. Michael Lavagnino, ME teaching specialist, is described by many of his students as “a professor who takes the time to care and understand his students’ needs and desires outside the classroom.” Students are quick to say: “He really wants all his students to do well” no matter what time of day his class is offered. “He does his best to engage all of the students and tries to create a passion for the subjects in all of them.” “Dr. Lavagnino is always available to help his students succeed.” His interests do not stop at the classroom. During the Covid pandemic, he was quick to transition to online teaching, minimizing stress on his students. As a student remarked: “It was one of the Zoom classes that I actually didn’t mind going to!” He “explains simply and understandably, accommodates when needed, and cares about the well-being of his students.”

Dr. Lavagnino received his B.S. degree from Rensselaer Polytechnic Institute. He went on to earn two master’s degrees, one in mechanical engineering and another in biomedical engineering from the University of Michigan, and a Ph.D. in engineering mechanics from Michigan State University.

Prior to joining the ME department in 2016, he served as a research associate in the MSU College of Veterinary Medicine which resulted in many publications and awards. His research areas include effective teaching, curriculum development, tendon mechanobiology, biomechanics, and orthopaedics. His personal interests include spending time with his family (even with three teenagers) and outdoor activities.
To be or not to be - that is the question by Craig Gunn, Director of Communications

Most of you are not reading Shakespeare on a daily basis, but you probably remember the words I used as the title of this piece. I could have sworn that at some point I wrote about the need to ask questions. Strangely enough I failed to ask anyone the pertinent question, “Have I ever written an article for the ME Bulletin on the act of questioning?” By not asking, my mental processes simply stopped and I didn’t move ahead on pursuing a very important subject. As I think about it, I realize that I had failed to do what I suggest that everyone does as a daily activity – Ask Questions.

When you were young, you probably didn’t get an enormous amount of instruction, but you certainly spent a great deal of time asking questions. You badgered everyone around you to answer questions like, “What is the moon made of?” Those wonderful people were quick to provide the usual answer – green cheese. And with that, you continued to ask and ask and ask. But now you are an adult and those questions seem to have been relegated to a far back burner and that burner is turned off. You don’t raise your hand and you shy away from asking for any form of help or answer. I would ask that you return to that time long ago when you were young and in-nocent and willing to spend your wak- ing hours asking about what you both wanted to know and needed to know. Those days were actually the Days of the Engineer. Days where you delved into the things you didn’t know and with their discovery you became more and more the individual you are today.

We learn by the questions that we ask of others and ourselves. We stagnate when we fail to mold those questions about our world that will make us better individuals and play-ers in a global environment. Start this day anew and make a pledge with yourself that you will take the plunge and become young again and question everything you can. And I might add that this is not just about engineering; it is about everything around you!

90 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 14. If your name is missing, please contact me immediately (Email Gaile at <griffore@egr.msu.edu> Tele: 517-355-3338).

• Your “Diploma Name” was not available when the ME Bulletin went to press. However, the Registrar will be contacting you to ask how you want your name to appear on your diploma.
• The Commencement Office now requires candidates to register to participate in a ceremony (walk). Here is the link: https://commencement.msu.edu/graduate-information

Ben Abdallah
Abdulkareem Alasmari
Ali Al Brahim
Jahzeel Alcantar Gallegos
Renad Alhassani
William Altier
Gianna Andriacchi
Kyle Anulare
Michael Bachleda
Evan Backer
Jeremy Balzer
Elco Blanco
Amber Bliven
Jennifer Blowers
Frederick Bruner
Qixian Chen
Mason Chorpenning
Anna Citko
Nathaniel Clarke
Sean Cornellier
Nick Crane
Atticus Crimmins
Ha Ninh Dang
Matthew Davidson
Kobie Davis
Justin De Coster
Jacob Demsik
Joseph Deschaine
John Dibella
Bryn Dittmar
Cameron Dork
Eric Ernvall
Julia Fox
Michael Gertley
Seth Gower
Bryce Hitchcock
Caleb Holtschlag
Dino Iotvchev
Luke Janecke
Miguel Jarquin-Lopez
Charley Jiang
Ethan Keppy
Parang Khanal
Natalie Kniely
Spencer Labuda
Evan Lamb
David Lawless
Sahe Lederle
Kendall Lusk
Patrick Marchal
Tyler Marshall
Bradley Matte
Mark McClosey
Ash McKesson
Maddy McKown
Katie McMillan
Nick Montpas
Parker Morris
Keairi Myrick
Ethan Neitzke
Tung Nguyen
Alex Oreilly
Rob Paquette
Meghan Parkinson
Ryan Peters
Peter Phan
Austin Pollock
Abdulhamid Salem
Victoria Saxton
Donnie Schuster
Matt Simental
Suven Sinha
Spencer Stefani
Lucas St. John
Thomas Supal
Shamit Topiwala
Jackey Tran
Trent Treppa
Drew Tyrrell
Daniel Vance
Grace Veenstra
Kainnon Vilminot
Robert Walston
Jeremiah Waterman
Garrett Watson
Zach White
Luke Willemsen
Zak Woods
Ryota Yoshiida
Kyle Zerafa
Liquid energy harvesting is renewable, clean, and capable of generating abundant electricity (1015 W). These qualities make this approach a promising candidate for solving our urgent energy crisis and curbing greenhouse gas emissions caused by fossil fuels. Liquid energy is stored in a rich variety of forms that contribute to the energy transfer across the global water cycle. However, traditional methods for harvesting liquid energy primarily rely on bulky electromagnetic generators to convert merely the kinetic energy of falling water to electricity. Unfortunately, this approach only harnesses limited liquid energy. Recently, technologies such as electrokinetics (Eks), triboelectric nanogenerators (TENGs), and piezoelectric nanogenerators (PENGs) are capable of decoupling liquid energy harvesting from electromagnetic generators to harvest liquid energy stored in various forms (e.g., water flow, evaporation, moisture, raindrops, tide, and ocean waves). Of these new technologies, Eks are particularly elegant and versatile compared with TENGs and PENGs. Using Eks, it is possible to generate electricity by simply having a liquid flow over a surface or through a micro/nano channel (Fig. 1 (b)). This liquid flow generates a current or potential known as an “electrokinetic effect”. Compared to PENGs and TENGs, Eks employ a simple approach capable of generating a steady and constant output (rather than pulsed) while achieving a higher average power density. In addition, this approach is more mechanically durable than PENGs and TENGs as Eks require no moving parts and do not exhibit the strain effect. Furthermore, Eks are versatile: they can harvest different forms of liquid energy (e.g., mechanical, thermal, chemical) while TENGs and PENGs mainly harvest mechanical energy. This versatility makes Eks ideally suitable for a variety of applications, ranging from small scale in situ power sources for bioelectronics, wearable devices and lab-on-chip devices, to scaled up energy systems (e.g., array of micro/nano channels) for energy recovery in water treatment and blue energy harvesting. An envisioned application as the flexible powers sources for smart wearable devices is shown is Fig 1.

However, for Eks to fulfill their potential for wide-spread, clean electricity generation, several existing shortcomings must be addressed. Currently, the electric output of conventional Eks that use channels with flat solid surfaces is still too low to be of practical use. This limitation is due to hindered ion transport at the liquid-solid interfaces caused by large interface friction. EK performance is dictated by the liquid-surface interfacial properties, where larger interface charges and slipping interfaces (i.e., non-zero flow velocity at the interface) for reduced friction are preferred. Therefore, it is critical to design novel slippery surfaces with high surface charge densities to improve the EK energy conversion performance.

Recently Professor Fan’s research showed that the generated electric potential and electric current of electrokinetic flow over a slippery liquid-filled surface (Fig. 1(b)) can be enhanced 1.5 times larger than those generated over a smooth surface. These encouraging preliminary results strongly suggest that slippery liquid-filled surfaces may be able to overcome the major obstacles associated with EK energy conversion performance enhancement, leading to a breakthrough in microfluidic electrokinetic energy conversion systems. Professor Fan’s research aims to discover new fundamental properties of Eks over engineered interfaces to design a novel durable slippery liquid-filled surface for Eks that overcome these challenges and will enhance the voltage generation by two orders of magnitude larger over that generated using a solid surface to achieve a voltage of ~1 V or larger using one microchannel. Thus, the generated voltage is comparable to conventional voltage sources, which will position Eks as practical energy devices. Currently, Professor Fan is collaborating with University of Texas Dallas professors Xianming Dai and Stefano Leonardi to conduct this research and this project is funded by National Science Foundation.
New faculty member Dr. Shaoting Lin develops extreme soft materials to solve challenging problems in long-term healthcare, sustainable water harvesting, and energy-saving buildings.

Shaoting Lin, an expert at the intersection of solid mechanics, polymer physics, and advanced manufacturing of soft materials, joined MSU’s Department of Mechanical Engineering on August 15, 2022.

With his focus on inventing high-performing soft materials, Lin will be part of the vibrant community of Spartan engineers designing human-centered and environmentally benign intelligent materials for developing technologies in healthcare and water-energy nexus.

Use Fundamental Tools to Invent Extreme Soft Materials

Lin comes to MSU from the Department of Mechanical Engineering at MIT, where he worked as a post-doctoral researcher with Prof. Gang Chen and Prof. Xuanhe Zhao. He focuses on understanding the processing-structure-property relationships of soft materials, thereby pushing the limit of the mechanical and physical properties of soft materials. Lin believes a cross-scale understanding of soft materials plays an indispensable role in understanding phenomena that span across different length scales, from nanometer single-chain level, to mesoscale network-topology level, up to macroscales bulk-material level.

Using such fundamental tools, Lin and his colleagues have invented versatile extreme soft materials with diverse engineering applications, including a mechanically-trained artificial muscle that resists crack propagation using aligned nanofibrils, a similar toughening mechanism in skeleton muscles (PNAS, 116, 21, 2019); an ingestible and expanding pill that monitors the stomach for up to a month (Nat. Commun., 10, 2019); a gelatin-like material that mimics lobster underbelly’s stretch and strength (Matter, 4, 6, 2021), a stretchable anti-fogging tape that enables fog-free glasses, protective goggles, and efficient solar-powered freshwater production (Adv. Funct. Mater., 31, 36, 2021); and a wearable smart wound dressing that senses temperature, lights up, and delivers medicine to the skin (Adv. Mater., 28, 22, 2021).

What Comes Next?

Our quests for extreme soft materials relate directly to all the amazing technologies that will shape our future. One of our ambitious goals is to create sensitive skins or clothes that can feel and respond to unforeseen environmental variables, a missing ingredient even for the best robots so far. We envision tough hydrogels, one emerging intelligent soft material with programmable shape morphing and light changing, that will be the solution to that missing ingredient. The human body typically has the “sixth sense” known as proprioception, capable of feeling environment variables at specified locations. Can we create the “sixth sense” for robots?

Openings for Undergraduates

Lin Research Group welcomes creative, dedicated, and enthusiastic scientists and engineers! We are strongly committed to collectively creating an inclusive, welcoming, supportive, and collaborative group culture. We believe building a culture of diversity, equity, and inclusion helps us to tackle challenging problems.

Successful candidates should have a strong interest in the broad area of mechanics, materials, and manufacturing. In addition, the candidates should be highly motivated, collaborative, and open-minded. Prospective students should contact Dr. Lin by email with a resume and a brief statement.
So, What is Cryogenic Engineering? by Dr. Pete Knudson

Contrary to the image portrayed in TV shows and movies, cryogenic engineering is not freezing people (or other living things). Cryogenic engineers are needed in aerospace, the process and energy industries, medical research, and for other very low temperature research and sciences. They design, build, test, and operate thermal-fluid systems that operate at temperatures beginning around the normal boiling point of liquefied natural gas (LNG). This could range from a cryogenic propellant storage and transfer system, to an air separation plant or hydrogen liquefier, to a cooling system needed for magnetic resonance imaging or quantum computing.

In fact there is a large cryogenic plant here at MSU located at the Facility for Rare Isotope Beams (FRIB) that cools a multitude of superconducting devices used to accelerate charged particles for nuclear physics research. This cryogenic plant is one of the largest in the world. Occupying 18,000 square feet, it operates at 2 degrees (Kelvin) above absolute zero can require up to 4 megawatts of input power. It is a complex thermal-fluid process system, and uses equipment like compressors, heat exchangers, adsorbers, phase-separators, turbines, and vacuum insulated process piping and components.

To design cryogenic systems, it is necessary to have an excellent understanding of thermodynamics, fluid mechanics, and mechanical design, since these disciplines must be carefully integrated to produce an operable and efficient system. The Dept. of Mechanical Engineering offers two classes, taught by staff engineers who work in the cryogenics department at FRIB, to introduce engineering students to this field. ME414-Mechanical Design of Cryogenic Systems, offered in the fall semester, introduces the mechanical design fundamentals. ME413-Cryogenic Thermal Systems, offered in the spring semester, covers the thermodynamic and process (or systems) engineering design fundamentals. There are also research opportunities for motivated students who would like to pursue an advanced engineering degree (https://frib.msu.edu/science/ase/cryogenic/index.html). For more information, please contact Dr. Pete Knudsen (knudsen@frib.msu.edu) or Dr. Nusair Hasan (hasann@frib.msu.edu).
Congratulations to these 489 ME majors who made the Dean’s List after Spring and Summer 2021. To be on the Dean’s List, you must have a semester GPA of 3.5 or better. This list is from September 20. For updates, go to: http://www.reg.msu.edu/ROInfo/GradHonor/DeansList.aspx

**Dean’s List**


**SUMMER 2022:** Brett Earnest, Sydney Kelly, Alessio Laura, Ben Roraff, Zhekai Shi, Kai Thin, Ali Turmakhanov, John Young.

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**Undergraduate Program Educational Objectives**

**Department of Mechanical Engineering**

**Michigan State University**

(Approved by the ME Department Faculty (August 29, 2022))

**Our graduates will:**

- Be recognized as competent and ethical engineers practicing in a diverse range of activities.
- Use their mechanical engineering education as a stimulus for personal and professional growth.
- Be recognized for their capability, creativity, leadership, and application of knowledge.
- Be recognized as critical thinkers, both independently and as members of a team, who identify problems and develop effective solutions.

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Department of Mechanical Engineering

Formula SAE

Michigan State Formula Racing proudly represents Michigan State University in Formula SAE, the world’s largest collegiate design series, which challenges students to design and build a small, open-wheel race car from the ground up each year.

For over 30 years, MSU Formula Racing has provided students the opportunity to apply classroom principles to real-world, problem solving scenarios in a fast-paced work environment. As a result, experienced members of our team are poised to make an immediate impact in the workforce through their in-depth understanding of engineering, manufacturing, and project management.

Over the summer, the team decided to make the ambitious switch to a fully electric vehicle. Throughout the summer and fall, the team has been working around the clock to design, plan, and run simulations to ensure a smooth transition from internal combustion to electric.

While designing the team’s first electric vehicle in the background, the team has been preparing it’s final internal combustion vehicle, SR-23, for competition in the spring. Everyone is focused on making improvements and testing the car to ensure it is running properly and competition ready!

Be sure to follow us on social media for updates on team activity throughout the season! @msuformularacing on Facebook and Instagram. Go green. Go white. Go fast!

Submitted by Noah Benson, Project Manager
SPRING SEMESTER SENIOR ELECTIVES

The asterisk (*) after a course number indicates that it has been officially designated as “Design Intensive.” The instructor information is subject to change.

ME 413 Cryogenic-Thermal Systems. 3(3-0). Prereq: (ME 410 or concurrently). Hasan/Knudsen.
ME 426 Introduction to Composite Materials. 3(3-0). Prereq: (ME 222). Xiao.
ME 433 Introduction to Computational Fluid Dynamics. 3(3-0). Prereq: ME 410 or concurrently. Yuan.
ME 441 Aerodynamics and Aircraft Performance. 3(3-0). Prereq: (ME 332). Allison.
ME 442* Turbomachinery. 3(3-0). Prereq: (ME 332). Engeda.
ME 445* Automotive Powertrain Design. 3(3-0). Prereq: ME 444. Schock.
ME 456* Mechatronic System Design. 3(2-3). Prereq: (ECE 345 or concurrently) and (ME 391 or concurrently). Zhu.
ME 464 Intermediate Dynamics. 3(3-0). Prereq: (ME 361). Khasawneh.
ME 465* Computer Aided Optimal Design. 3(3-0). Prereq: (ME 222 and ME 280) and (ME 370 or concurrently). Tai.
ME 477 Manufacturing Processes. 3(3-0). Prereq: (ME 222) and (MSE 250). Guo.
ME 478* Product Development. 3(3-0). Prereq: (ME 477). Kwon.
ME 490 Independent Study. 1-4 credits. See Override Instruction #2 below. You may reenroll for a maximum of 6 credits.
ME 495 Tissue Mechanics. 3(3-0). Prereq: (ME 222). Biomedical Concentration Course. Back.
ME 497* Biomechanical Design in Product Development. 3(3-0). Prereq: (ME 370 or concurrently). Biomedical Concentration Course. Bush/Nguyen.
BE 444 Biosensors for Medical Diagnostics. 3(3-0). Prereqs: (BS 161) and (CEM 141) and (ECE 345). Biomedical Concentration Course. TBA.
CHE 483 Brewing and Distilled Beverage Technology. See Override Instruction #3 below. See the Schedule of Courses for location information. Prereq: (Age 21 or higher) and (Senior standing) and (ME 410-Heat Transfer or concurrently). Shriner.
ENE 422 Applied Hydraulics. 3(2-2). Prereq: ME 332. Mantha.

Graduate Level Courses: Honors College members and/or students with 3.5+ GPAs might consider taking a graduate course as a senior elective. Before enrolling, several signatures, including that of the instructor, are required. Possible choices for Spring 2022 include ME 814, 825, 861, and 872. See Override Instruction #4 below.

**SENIOR ELECTIVE OVERRIDE INSTRUCTIONS**

1) General Override Request Procedure: Complete and submit the ME Override Request Form: [https://www.egr.msu.edu/me/me-override-request](https://www.egr.msu.edu/me/me-override-request). Please note that the ME department cannot overfill required courses to resolve conflicts with Senior Electives, Other Electives, Integrative Studies courses and employment schedules.

2) ME 490–Independent Study Enrollment Procedure: Find a professor who is willing to supervise your independent study, and discuss your plans with him/her. Complete an ME 490/490H Enrollment Contract (independent study form), available in the ME Advising Office in 2560 EB. After you and your professor have completed and signed both sides, return the form to the ME Advising Office for the remaining signatures, override, and enrollment.

3) CHE 483–This course has a maximum enrollment of 100. When it is full, no additional overrides will be given. You can still add your name to the wait list, but it would be a good idea to enroll in a back-up course.

4) Complete the Graduate Course Override form, which can be obtained from Gaile (griffore@egr.msu.edu).
Fall Semester Calendar

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<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Details</th>
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<tr>
<td>October 26</td>
<td>Graduate School Info Meeting. 6-8 p.m. Location TBD.</td>
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<td>October 31</td>
<td>Scheduled enrollment begins for Spring and Summer 2023.</td>
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<td>November 18</td>
<td>Deadline for Withrow Teaching Award Nominations. The nomination form is on the ME website. [Click on Undergraduate, and then Forms and Policies.]</td>
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<td>Nov 24-25</td>
<td>Thanksgiving recess</td>
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<td>December 11</td>
<td>Last day of classes &amp; Design Day.</td>
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<td>Dec 12-16</td>
<td>Final Exams</td>
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<tr>
<td>December 17</td>
<td>Undergrad Commencement Ceremony-2:00 p.m. in Breslin. Lasts about 2 hours.</td>
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<td>Dec 17-Jan 8</td>
<td>Semester Break</td>
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<tr>
<td>January 13</td>
<td>On-line Open Add Period for Spring 2023 ends. Also, this is the deadline for May 2022 and August 2022 graduates to apply for graduation and have their names printed in the commencement program.</td>
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Tutoring

- **The ME Learning Center** has free mentors for ME 201, 222, and 361. It is open at 6-10 p.m. on Sunday through Thursday.

- **Paid Undergraduate Tutors** are available for many ME courses. Students in need of tutoring help for a particular course are matched with fellow students who have performed well in that course. Payment is negotiated privately between the tutor and the student within appropriate limits. For help go to: [https://sites.google.com/view/msu-tbp-pts-tutoring-database/home](https://sites.google.com/view/msu-tbp-pts-tutoring-database/home)

MSU is an affirmative action, equal opportunity employer. MSU is committed to achieving excellence through cultural diversity. The university actively encourages applications and/or nominations of women, persons of color, veterans and persons with disabilities.