Project-based research

Project name:	Mechanical design of wave rotor combustor turbine	**Project ID:**	R001 - Indy
Supervisor:	Razi Nalim	**Number of positions:**	3
Project Description:	The Combustion and Propulsion Research Lab in Indianapolis has been pioneering research on the wave rotor pressure-gain combustor for many years. Graduate students are working on technology development and fundamental studies. The undergraduate students would support this effort with mechanical design skills, including CADCAM, component design, manufacturing drawings, and some finite-element analysis.		
Final Deliverables:	Design reports and drawings		
Option:	For credits		
Option Information:	1 credits		
Desired Qualifications:	A or B in thermodynamics. Preferably experience in CAD and FEA.		

Project-based research

Project name:	Energy Storage Analytics	**Project ID:**	R002
Supervisor:	Partha P. Mukherjee	**Number of positions:**	4
Project Description:	Lithium ion (Li-ion) batteries are ubiquitous. Thermal safety and degradation characteristics of these systems are critical toward safer and high-performance batteries for electric vehicles. As part of this research, data-driven analytics of experimental and simulated performance under normal and anomalous operating conditions of Li-ion cells will be performed.		
Final Deliverables:	The final deliverable will be one end-of-semester research report (based on weekly progress presentations and updates) and one final presentation.		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Strong analytical skill and desire to learn new experimental and modeling/analysis tools.		

Project-based research

Project name:	Ecosystem mapping and valuestream mapping for truck and bus transportatio	**Project ID:**	R003 - Indy
Supervisor:	Razi Nalim	**Number of positions:**	2
Project Description:	The Center for Electrified & Automated Trucking in Indianapolis is working to bring industries in various sectors related to freight and public transportation to collaborate on research in electrification and automation. Undergraduate students will assist the director in learning about the value contributions and needs of businesses in this sphere, particularly the value that companies would gain from research and workforce development. The engineering students will be advised by business and engineering faculty members.		
Final Deliverables:	Database of company revenue potential and workforce needs related to truck and bus transportation.		
Option:	Discuss with advisor		
Option Information:	Options and details to be discussed with faculty advisor		
Desired Qualifications:	Broad interests in electrification, automation, transportation, and digital technologies		

Project-based research

Project name:	Comparative study of arterial compliance	**Project ID:**	R004 - Indy
Supervisor:	Huidan (Whitney) Yu	**Number of positions:**	4
Project Description:	Compliance tests will be conducted on (i) human/animal arteries, (ii) polytetrafluoroethylene (PTFE) grafts, and (iii) 3D-printed grafts within a developed mock circulation loop. The goal of the project is to identify novel elastic polymers that more closely replicate the compliance of native human arteries.		
Final Deliverables:	Biweekly report and meeting for progress. Experimental results that are publishable		
Option:	Volunteer		
Option Information:	Details to be discussed with faculty advisor		
Desired Qualifications:	GPA 3.0 and above. Physically located in Indianapolis campus.		

Project-based research

Project name:	Deep-learning-automated 3-D arterial construction based on Ultrasound B-mode images	**Project ID:**	R005 - Indy
Supervisor:	Huidan (Whitney) Yu	**Number of positions:**	2
Project Description:	Matlab algorithms will be developed to enable the 3-D construction of duplex ultrasound (DUS) B-mode images for diagnosing the local morphological abnormalities of diseased arterial systems. Rigorous validation and uncertainty quantification will demonstrate the equivalence of 3-D construction from DUS and CTA (computed tomography angiography) images.		
Final Deliverables:	Biweekly report and meeting for progress. Publishable results		
Option:	Volunteer		
Option Information:	Details to be discussed with faculty advisor		
Desired Qualifications:	GPA 3.2 and above. Good experience with Matlab coding.		

Project-based research

Project name:	Analysis of a prototype two-phase flow expansion turbine	**Project ID:**	R006
Supervisor:	Eckhard A. Groll	**Number of positions:**	3
Project Description:	Continuation of a fall 2025 project to commission a new test stand for a two-phase flow expansion turbine to be used in a CO2 refrigeration system. Task include finalizing the data acquisition and data reduction procedure, conducting shake-down tests, conducting performance tests and corresponding reporting. This will be a 3-credit hour independent project requiring approximately 12 hours of laboratory work per week during the semester and students will receive a letter grade for this effort. Students can use this as ME/tech elective credits.		
Final Deliverables:	Weekly PowerPoint presentations summarizing recent progress and future tasks. Final report and final presentation at the end of the semester.		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Minimum of junior standing in ME (completion of 5 semesters at Purdue by Dec. 2024).		

Project-based research

Project name:	Parametric Study of Oscillating Heat Pipes	**Project ID:**	R007
Supervisor:	Liang Pan	**Number of positions:**	4
Project Description:	Oscillating heat pipes favors high working efficiency and can potentially offer high peak cooling capability for high power applications. Existing manufacturing techniques allow the quick creations of complicated flow structures, however the design and testing of the oscillating heat pipes are not currently implemented at high heating powers with reconfigurable shapes. This project will assemble a team of students to work with current graduate students to design, fabricate and test the performance of oscillating heat pipes under different use configurations.		
Final Deliverables:	Fabricated heat pipes and testing results.		
Option:	Discuss with advisor		
Option Information:	Options and details to be discussed with faculty advisor		
Desired Qualifications:	Applicants expect to have one or more of the following capabilities. 1. Fabrication skills in machine shop2. Use of CAD software3. Labview programing4. Thermodynamics and Heat transfer		

Project-based research

Project name:	Microscale 3D Printing using Volumetric Lithographic Methods	**Project ID:**	R008
Supervisor:	Liang Pan	**Number of positions:**	3
Project Description:	Three-dimensional (3D) printing is routinely performed by writing 1D shapes (point-by-point) or 2D shapes (layer-by-layer), using different methods, such Stereolithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), and Digital Light Process (DLP). Here we will assemble a team to experimentally implement a microscale 3D printer method with software and hardware infrastructure that can support a new operation mode to placing 3D shapes (such as cubes, spheres, or other complex 3D shapes) by using volumetric lithographic method. This is the continuation for project from previous years. Participants will learn the previous development and build upon existing infrastructures.		
Final Deliverables:	A working microscale 3D printer, including the hardware and control software		
Option:	Discuss with advisor		
Option Information:	Options and details to be discussed with faculty advisor		
Desired Qualifications:	Applicants expect to have one of the following capabilities. 1. Operation of 3D printers2. Use of CAD to create 3D geometries3. Programing4. Basic digital circuits and the use of oscilloscope and other electronics. 5. Machining		

Project-based research

Project name:	Advanced materials	**Project ID:**	R009
Supervisor:	Jong Hyun Choi	**Number of positions:**	3
Project Description:	This project aims to develop programmable nanostructures and reconfigurable/switchable systems. We use two distinct approaches.1. DNA nanotechnologyIn this approach we use synthetic DNA molecules as engineering building blocks. We design DNA molecules that can be assembled into computer-designed nanostructures for specific functions. We study mechanical properties of the DNA assemblies.2. 2D materialsTwo-dimensional transition metal chalcogenide semiconductors (e.g., MoS2 and WSe2) are emerging materials with extraordinary physical properties including strong photoluminescence and conductivity. We develop ovel strategies to modulate and control their optoelectronic properties.		
Final Deliverables:	Monthly reports and final presentation		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Passionate juniors with good academic standing		

Project-based research

Project name:	Fabrication and characterization of micro/nanoscale mechanical and optical devices	**Project ID:**	R010
Supervisor:	Yung C Shin	**Number of positions:**	2
Project Description:	Two-photon polymerization (TPP) is a unique and prominent additive manufacturing (AM) technique that offers the capability of fabricating true 3D dimensional micro/nanostructures with spatial resolution in the nanometer regime using a femtosecond laser. Given the ever-longing demand for complex three-dimensional microscale structures with fine features in the semiconductor and biomedical domains, TPP presents an optimal solution.This research involves the design, fabrication, and characterization of optical devices such as flat lenses (metasurfaces), diffractive optical elements, Fresnel lenses, micro lens arrays (MLAs), photonic crystals (PCs) etc.		
Final Deliverables:	It is expected to submit weekly reports describing the findings and results of the research during the regularly scheduled meetings. A final written report is required for the final grade, which must contain a literature review, design of metal material, 3D printing of the designed structure, all the experimental characterization and analysis results.		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Sophomore or higher standing with a minimum GPA of 3.4		

Project-based research

Project name:	Additive manufacturing of soft materials by ink-jet 3D printing	**Project ID:**	R011
Supervisor:	Yung C Shin	**Number of positions:**	1
Project Description:	This study is to explore the additive manufacturing capabilities of novel soft materials such as different polymers, metal + polymers or ceramic + polymers, using a 3D inkjet type printer available in the supervisorâ€™s lab. The student is expected to optimize the process parameters to build successful samples using the selected materials and characterize their geometric accuracy, microstructural and mechanical properties.		
Final Deliverables:	Weekly reports to show the summary of each work. A final written report is required for the final grade, which contains all the experimental results, collected testing results and analysis results.		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Sophomore or higher standing with the minimum GPA of 3.4		

Project-based research

Project name:	Realization of meta-material via 3D additive manufacturing	**Project ID:**	R012
Supervisor:	Yung C Shin	**Number of positions:**	2
Project Description:	Metamaterials are artificial or man-made materials that are crafted to achieve physical behaviors that are not demonstrated by the constituting material in its conventional sense. They are achieved by cumulating the behavior of the unit cell designed into the macro scale and thereby the effects are also translated into the macro scale. This research is to experimentally exploit the feasibility of building different metamaterials by using 3D additive manufacturing. Various analysis tools will be used to design meta materials and the final design will be built by 3D printing and tested.		
Final Deliverables:	It is expected to submit weekly reports describing the findings and results of the research during the regularly scheduled meetings. A final written report is required for the final grade, which must contain a literature review, design of metal material, 3D printing of the designed structure, all the experimental characterization and analysis results.		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Sophomore or higher standing with a minimum GPA of 3.4		

Project-based research

Project name:	Data-driven modeling of microstructure- properties relationships for additively manufactured metal parts	**Project ID:**	R013
Supervisor:	Yung C Shin	**Number of positions:**	2
Project Description:	This study is to investigate the mechanical properties of metal alloy parts built by various metal additive manufacturing (AM) processes in terms of the resultant microstructure and to establish a data-driven model between the microstructure and mechanical properties, ,which will contribute to the drastic reduction of process lead time and certification of parts. In addition, opportunities exist to print actual metal tensile specimens using the available AM facilities on campus, conduct heat treatment, if necessary, carry out microstructure measurements, and perform mechanical testing using a universal testing machine in the supervisorâ€™s lab.		
Final Deliverables:	It is expected to submit weekly reports describing the progress, findings and results of the research project during the regularly scheduled meetings. A final written report is required for the final grade, which shall contain a literature review, collected microstructure data, all the experimental results, and analysis results.		
Option:	For credits		
Option Information:	0 credits		
Desired Qualifications:	Junior or higher standing with a minimum GPA of 3.5 with the mechanics of material background.		

Project-based research

Project name:	Mechanical Engineering Education Research	**Project ID:**	R014
Supervisor:	Eric Holloway	**Number of positions:**	2
Project Description:	Are you interested in how engineers are educated and the research behind it? Questions such as how to measure and assess student learning, what are measures of student success, and how are students prepared to enter the workforce? I am working on several quantitative and qualitative projects assessing student learning and outcomes in Mechanical Engineering and other engineering disciplines to understand how students are being prepared for professional practice. Our team needs ME undergraduates who are considering grad school, are interested in educational issues, have excellent skills in MATLAB and Excel, and have open minds to learn about educational research methods! Projects include assessing sophomore success metrics, assessing studentsâ€™ professional skills, and assessing learning in makerspaces, among others.		
Final Deliverables:	The final deliverables will depend on the qualifications of the applicants and which project students are assigned to. Details will be worked out at the start of the semester.		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	ME junior or senior; Prefer students who are seriously considering graduate school. Will only consider students who can commit to working with our team both Spring '25 and Fall '25 semesters		

Project-based research

Project name:	Engine Test Cell Research	**Project ID:**	R015
Supervisor:	Eric Holloway	**Number of positions:**	2
Project Description:	Our team needs assistance from highly qualified ME undergraduate students interested in working on diesel and natural gas engine research at Herrick Labs. This position will work with a team of faculty, graduate students, and undergraduates to accomplish a range of activities at Herrick Labs, including engine experiments, engine and test cell maintenance, data processing, troubleshooting, and other activities supporting multiple research platforms. The undergraduates typically perform a mix of hands-on activities on the engine and in the test cell, as well as assisting with CAD, MATLAB scripts, GT-Power modeling, and assisting the faculty and grad students with multiple engine/test cell tasks.		
Final Deliverables:	The final deliverables will depend on the qualifications of the applicants and which project students are assigned to. Details will be worked out at the start of the semester.		
Option:	For credits		
Option Information:	2 credits		
Desired Qualifications:	ME junior or senior. Prefer students who are seriously considering graduate school. Will only consider students who can commit to working with our team both Spring '25 and Fall '25 semesters. Ideal candidates will have prior experience with engines.		

Project-based research

Project name:	MSRAL Research	**Project ID:**	R016
Supervisor:	Dave Cappelleri	**Number of positions:**	3
Project Description:	The Multi-Scale Robotics & Automation Lab (MSRAL, www.multiscalerobotics.org) performs cutting-edge research on robotic and automation systems at various length scales: macro-scale (cm to m), meso-scale (~100â€™s of Î¼m to a few mmâ€™s), and micro-scale (10â€™s of Î¼m to 100â€™s of Î¼m. MSRAL has projects on multi-scale robotic manipulation, automation, and assembly, mobile micro robotics, micro aerial and ground vehicle design & control, medical robotics and devices, agricultural robotics, and space robotics. See more here:https://youtu.be/b-Ge1tEr_DQ		
Final Deliverables:	Final report; Project dependent deliverables may include a working prototype/demonstration		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Junior standing or higher; Experience with robotics, mechatronics, 3D printing, electronics, and programming is preferred.		

Project-based research

Project name:	Thermometers, Strain Gauges and Defect Detectors for Semiconductors using Light	**Project ID:**	R017
Supervisor:	Thomas Beechem	**Number of positions:**	3
Project Description:	Who we areâ€¦ Specere is a latin word that means â€œto look or behold.â€• Thatâ€™s what we do. We look, explore, and examine different ways to: (1) move energy with light and (2) get information from light. More specifically, we are a light lab employing infrared physics to create spectroscopic, thermal, and sensing solutions.Research Topic, Semiconductor Sensing: Semiconductor chips are some of the most technologically advanced machines humanity has ever made. Like any complex machine, they break. Methods for predicting where they will break and why they have broken are therefore necessary. You will help us make the thermometers, strain gauges, and â€œdefect detectorsâ€• that are up to the task using some of the worldâ€™s most advanced semiconductor characterization tools that we develop here at Purdue.Whatâ€™ Youâ€™ll Do: Team members will be responsible for performing spectroscopic measurements of next generation semiconductor materials, devices, and packages. Specifically, you will use Raman (sounds like but is not the noodle) and photoluminescence (fancy for glow in the dark) to image the temperature, stress, and presence of defects in everything from commercial logic chips made by Intel to materials being considered for next generation memory devices. Direct mentoring from Dr. B will build your skills in advanced spectroscopic tools (Raman, photoluminescence), coding, technical communication and professional development. In addition, you will have the chance to participate in writing journal articles and pursuing patents based on your work.		
Final Deliverables:	Group Presentation outlining technical progress with accompanying â€œmeeting slideâ€• deck outlining research progress through term.		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	We look for motivated and hard-working undergraduates having both strong aspirations for post-graduate studies as well as those that are just considering the possibility of grad school.		

Project-based research

Project name:	Machine learning for enhanced industrial and biological fluid dynamics	**Project ID:**	R018
Supervisor:	Carlos M Corvalan	**Number of positions:**	3
Project Description:	This research will study the integration of Machine Learning (ML) into fluid mechanicsresearch. The project aims to leverage the vast data generated by experiments andsimulations to gain deeper insights, predict, and optimize fluid flow systems. The researchobjectives include: Analyzing the strengths and limitations of ML in the context of fluidmechanics research. Emulate the learning mechanisms employed by biological systems tomanipulate fluid flow and translate these insights into novel strategies and optimizationalgorithms for artificial systems through the application of machine learning and data-drivenapproaches. Leverage the feature extraction capabilities of autoencoders to developefficient, lower-dimensional representations of high-fidelity fluid dynamics systems, enablingthe creation of compact and computationally affordable reduced-order models for industrialand biological applications.		
Final Deliverables:	Develop working computer codes that leverage machine learning to solve engineering problems		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Background in linear algebra, differential equations and scientific computing are desirable		

Project-based research

Project name:	Biotech	**Project ID:**	R019
Supervisor:	Euiwon Bae	**Number of positions:**	2
Project Description:	Applied optics is looking for UG students who are interested in developing biosensors. Project will include polyacrylamide gel fabrication, Rheometer gel stiffness characterization, fluorescence imaging, and some level of cell culture (under supervision) and analysis. Part of the project involves MATLAB coding and analyzing fluorescence images captured from the microscope.		
Final Deliverables:	Weekly meeting and powerpoint updates is required.Final deliverables are 1) final report an 2) final prototype (depends on the progress)		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Students who can work as a team; typically have 2-3 UG students work around everyone's class schedule.		

Project-based research

Project name:	Open-source light scattering simulation	**Project ID:**	R020
Supervisor:	Euiwon Bae	**Number of positions:**	2
Project Description:	Any incoming photons on an object can be absorbed, transmitted, or scattered. Scattering is a well-known phenomenon leveraged in diverse fields such as biology, engineering, and manufacturing. The main aim of the current project is to utilize the open-source code from the National Institute of Standards and Technology (NIST) which is a C++ class library developed by the sensor science division of NIST to enhance the computational capability of elastic light scattering-based defect detection devices which are widely used in the process of production of chips and in quality control of microfabrication.		
Final Deliverables:	-Weekly meeting updates in PPT format-Using the original open-source code, any updates from the code should be submitted-Final report at the end of the semester		
Option:	Discuss with advisor		
Option Information:	Options and details to be discussed with faculty advisor		
Desired Qualifications:	Having some programing experience is preferred but if you are willing to learn, that is also fine.		

Project-based research

Project name:	Application of Machine Learning Algorithms to the Structural Analysis of mechanical and aerospace systems	**Project ID:**	R021
Supervisor:	Fabio Semperlotti	**Number of positions:**	4
Project Description:	In recent years, machine learning and artificial intelligence algorithms have been rapidly expanding to the computational mechanics world. They offer the possibility to perform very challenging computations that would otherwise be beyond reach for more classical methods based on the numerical solution of differential equations.The project will involve the development and numerical implementation of machine learning algorithms to simulate the response of structural and multiphysics systems in the static and dynamic regimes. You will acquire the following knowledge: basic knowledge of neural network architectures; basic skills for the simulation of neural networks (writing and executing simple codes); basic theoretical and numerical skills for the static and dynamic analysis of structural systems.		
Final Deliverables:	Final report summarizing the models developed and the numerical results obtained. Original results of sufficient impact will be expanded in a technical publications (either conference or journal).		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Juniors and seniors. Interest in solid mechanics, dynamics, and programming. Helpful skills: Matlab, Python, Finite Elements.		

Project-based research

Project name:	Viscoelastic contact mechanics analysis coding in Python	**Project ID:**	R022
Supervisor:	Ryan Wagner	**Number of positions:**	3
Project Description:	The contact between two bodies can be analyzed by different contact mechanics models that describe the evolution of force, displacement, stress, and strain. Depending on the loading rate, area of contact, and magnitude of applied force, different physical processes can dominate the response. For low forces and soft materials both adhesive forces (i.e. van der walls interactions) and viscoelastic forces (i.e. force proportional to velocity) are important. Attardâ€™s method is a rigorous contact mechanics model that includes both adhesive and viscoelastic forces. However, Attardâ€™s method is computationally difficult to solve as it involves a coupled series of partial differential equations that lack an exact solution. In this project we will work to implement a computationally efficient solutions to Attardâ€™s method in the python programing language. This code will be optimized to be easily understood and then shared in a public code repository.		
Final Deliverables:	Written and oral report		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Interest in program and/or structural mechanics		

Project-based research

Project name:	Microscale heat flux analysis through a sharp surface coupled tip	**Project ID:**	R023
Supervisor:	Ryan Wagner	**Number of positions:**	3
Project Description:	Tip based nanometer scale sensing and manufacturing is a basis for various microscopy and lithography techniques. In this project we will explore via simulations and experiments the transport of heat through a sharp nanometer scale tip. Simulations will be carried out using the finite element method in COMSOL. Experiments will be performed on an atomic force microscopy system that is equipped with a heating laser. The goal of the project is to better understand the spatial and temporal distribution of temperature within the tip and sample as a function of heating conditions, environmental conditions, and sample properties. The heated tip can then be leveraged to achieve thermomechanical analysis of surfaces and localized surface sampling for chemical analysis.		
Final Deliverables:	Written and oral report		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Interest in heat transfer, nanotechnology, and/or metrology		

Project-based research

Project name:	Nanoscale Heat Transfer in Semiconductor Thin Films	**Project ID:**	R024
Supervisor:	Xianfan Xu	**Number of positions:**	1
Project Description:	This project deals with study of heat transfer in very thin film semiconductor materials using Raman Spectroscopy and ultrafast laser measurement systems. Heat transfer in advanced semiconductor materials including 2D materials (very thin layered materials bonded by van der Waalâ€™s force) shows superior characteristics for applications in numerous advanced devices. Their thermal transport behaviors are also different compared with bulk materials, and an understanding of the transport process is important for the applications of these materials. We use non-contact optical method (i.e., lasers etc.) to investigate heat flow and control in these materials. The undergraduate student will work with graduate students to learn to use state-of-the-art experimental facilities, carry out experiments, and analyze experimental results.		
Final Deliverables:	Summary Report		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Mechanical Engineering Junior or Senior standing with GPA > 3.5, having taken ME315 is a plus.		

Project-based research

Project name:	Nanoscale 3D printing	**Project ID:**	R025
Supervisor:	Xianfan Xu	**Number of positions:**	1
Project Description:	The ability to create 3D structures in the micro and nanoscale is important for many applications including electronics, microfluidics, and tissue engineering. This project deals with developing and testing of a laser-based setup for building 3D structures with sub-micrometer resolution. A method known as femtosecond laser two photon polymerization is used to fabricate such structures in which a resin is exposed to laser. Moving the laser in a predefined path results in the desired shape and structure. The 3D printing process incorporates the steps from designing a CAD model file to slicing the model in layers to generating the motion path of the laser needed for fabricating the structure. Machine learning is also being used to improve the printing accuracy. Possible involvements by the undergraduate researcher include developing control algorithms, better CAD models, and better manufacturing strategies.		
Final Deliverables:	Summary Report		
Option:	For pay		
Option Information:	10 hours/week, and 15 $/hour		
Desired Qualifications:	Mechanical Engineering Junior or Senior standing with GPA > 3.5, CAD models, knowing Python is a plus."For Credit" can also be arranged as 3 credits.		

Project-based research

Project name:	Building torque-controlled actuation system for tip-extension robot	**Project ID:**	R026
Supervisor:	Laura Blumenschein	**Number of positions:**	1
Project Description:	Tip extension â€œvineâ€• robots are a class of soft robot that extends its length by eversion of material at its tip. This process is driven by the antagonistic interaction between internal air pressure and a motor which controls the release of material, and controlling the force applied by the motor paves way for adaptive, intelligent behaviors of the robot. This project aims to build a prototype that integrates a brushless DC (BLDC) motor, which is good at low-speed, torque-controlled applications, to a vine robot base station and test out control laws based on feedback signals such as current, speed, and position.		
Final Deliverables:	Design for new growing robot with torque controller		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Requires experience with physical prototyping and knowledge of feedback control. Past experience working with BLDC motors (such as on quadcopters and mobile robots) is preferred.		

Project-based research

Project name:	Laser-based manufacturing of soft robots from thin-film materials	**Project ID:**	R027
Supervisor:	Laura Blumenschein	**Number of positions:**	1
Project Description:	Many soft robotic devices are created from joining layers of thin-film materials to create inflatables that respond to air pressure inputs in desirable ways. Laser cutting machines can do so by â€œweldingâ€• the thermoplastic films with great precision and efficiency, but the intense power of laser beams makes controlling the process a challenge. This project looks at how machine settings, patterns, and treatments to the films affect the outcome of the weld, and aims to establish a procedure to manufacture soft robots reliably.		
Final Deliverables:	Experimental results of laser manufacturing testsFinal presentation		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	Experience with laser cutting and/or 3D printing, and knowledge of heat-transfer are preferred.		

Project-based research

Project name:	Mechanical design and control integration of laser-based flow diagnostics systen	**Project ID:**	R028
Supervisor:	Jun Chen	**Number of positions:**	2
Project Description:	The undergraduate researchers will work with graduate students in my group to design subsystems for a laser-based flow diagnostics system. The project involves the mechanical design of the test rigs and integrating camera-laser control using microcontrollers. The prototype system will be tested at a cardiovascular application to study hemodynamics and another one for large-scale flow measurement.		
Final Deliverables:	Design package and physical prototype.		
Option:	Discuss with advisor		
Option Information:	Options and details to be discussed with faculty advisor		
Desired Qualifications:	Good GPA. Passion for hand-on work.		

Project-based research

Project name:	Freehand Sketch Recognition	**Project ID:**	R029
Supervisor:	Min Liu	**Number of positions:**	2
Project Description:	Freehand sketching is still the most efficient way to communicate design ideas for mechanical engineers, while in most current mechanical CAD systems, strict parametric sketches are used for constructing detailed CAD models. To bridge the gap, this project research on converting hand-drawn sketches into parametric models, leverages advanced machine learning models (CNNs, GNNs, transformers) combined with geometric and constraint-solving algorithms.		
Final Deliverables:	One end-of-semester technic report based on weekly progress presentations and meeting) and one final presentation.		
Option:	Discuss with advisor		
Option Information:	Options and details to be discussed with faculty advisor		
Desired Qualifications:	Motivated juniors or seniors; Experience with Parametric CAD and basic programing skills		

Project-based research

Project name:	Finite Element Analysis	**Project ID:**	R030
Supervisor:	Thomas Siegmund	**Number of positions:**	2
Project Description:	Conduct a project within the Microstructure Testing and Analysis Lab https://engineering.purdue.edu/MYMECH.The project will make use of finite element analysis and its application. Specific topics to be determined.		
Final Deliverables:	A report, model files and results. Present a poster at the Spring Undergraduate Research Conference at Purdue.		
Option:	For credits		
Option Information:	3 credits		
Desired Qualifications:	ME 489 or similar		

Project-based research

Project name:	Catalytic water treatment processes	**Project ID:**	R031
Supervisor:	David Warsinger	**Number of positions:**	2
Project Description:	Water pollution is a significant concern in many countries and requires innovative technologies to tackle them. Many pollutants hazardous to human health, including pesticides, fluoropolymers, and pathogens, can be broken down into their constituent minerals through photocatalysis. However, existing membranes need substantially improved UV light utilization and penetration for real-world use. We are working on consistently-sized nanostructures near the wavelengths of UV light to control light and enhance the performance of novel photocatalytic membranes. Furthermore, our group works on separation technologies to remove Per- and polyfluoroalkyl substances (PFAS). The team is pursuing multiple projects to explore batch reverse osmosis, nanofabricated membranes, light-driven reactions, artificial intelligence control algorithms, and thermodynamic optimization of energy systems.		
Final Deliverables:	The student who joins this lab will be expected to attend weekly lab meetings and sub-group meetings. This project seeks students who possess chemistry knowledge and a preliminary understanding of membrane sciences. The student's primary involvement will be in fabricating new membranes, characterization , and design experiments for testing the technologies. In addition to the required skills mentioned above, applicants with additional experience with some of the following programs are preferred: Python, Adobe Illustrator and CAD tools. The student will be expected to give weekly progress updates . The student should also be eager to collaborate with other researchers outside of mechanical engineering to draw from a broad range of expertise in pursuing our research goals.		
Option:	For pay		
Option Information:	12 hours/week, and 17 $/hour		
Desired Qualifications:	- Some background in prototype development/manufacturing will be useful.- Hands on experience in conducting experiments in the lab.- Experience with python/MATLAB will be useful for assisting inside projects related to the technology we are developing.- Students should have a strong interest in experimental research, motivation to pursue research problems related to air purification to tackle future pandemics.-Pay or credit are both options.		

Project-based research

Project name:	Acoustic bioaerosol removal in HVAC systems	**Project ID:**	R032
Supervisor:	David Warsinger	**Number of positions:**	2
Project Description:	Particulate Matter (PM) 2.5 and various gaseous pollutants in the surrounding air pose a significant threat to humanity. The quality of indoor air depends on the air quality of outdoor sources, and given the increased amount of time spent indoors by humans, research on air quality needs more focus than ever. Current state-of-the-art filtration technologies have severe limitations in capturing specific particle sizes called the most penetrating particle sizes (MPPS). This project explores a novel air purification technology that uses acoustic waves to enhance the capture efficiency of fiber filters. We investigate the potential of acoustic interaction and streaming forces to manipulate the movement of aerosols within a flowing stream to direct them toward the filter fibers. These systems require high-efficiency filters to remove MPPS, which further causes a high-pressure drop in the system.In this work, we try to harness the potential of acoustic radiation and streaming forces to improve the capture efficiency of the fiber filters. Our numerical simulations showed an increase of up to 12x -123x for different configurations of fiber filters. Currently, we are constructing a bench-scale experimental setup to demonstrate the complex interaction between the acoustic waves, fiber filters, and particles. This setup focuses on generating aerosols that mimic real-world particle size distributions. The particle-laden air stream enters a bench-scale duct where the acoustic filtration device is mounted. Finally, the number concentration of particles upstream and downstream of the acoustic filtration device is measured to evaluate the capture efficiency of the system.		
Final Deliverables:	The student who joins this lab will be expected to attend weekly lab meetings and sub-group meetings. This project seeks students who possess fluid mechanics knowledge and a preliminary understanding of aerosol transport and acoustics. The student's primary involvement will be in designing experiments to investigate aerosols' behavior in internal flows when subjected to acoustic forces. In addition to the required skills mentioned above, applicants with additional experience with some of the following programs are preferred: Python, Adobe Illustrator and Arduino. The student will be expected to give weekly progress updates and will have the opportunity to present some of their updates at quarterly meetings with industry members in Purdueâ€™s Center for High Performance Buildings. The student should also be eager to collaborate with other researchers outside of mechanical engineering to draw from a broad range of expertise in pursuing our research goals.		
Option:	For pay		
Option Information:	12 hours/week, and 17 $/hour		

Project-based research

Desired Qualifications:	- Some background in prototype development/manufacturing will be useful.- Hands on experience in building pressurized air(pneumatic) circuits- Knowledge on building electronic circuits would be beneficial- Experience with python/MATLAB will be useful for assisting inside projects related to the technology we are developing.- Students should have a strong interest in experimental research, motivation to pursue research problems related to air purification to tackle future pandemics.- Familiarity with HVAC is not required, but would be beneficial.-Pay or credit are both options