Rutgers University

Department of Mechanical & Aerospace Engineering

2025-2026 Senior Design Projects

14:650:467/468 Design and Manufacturing I/II

Mechanical Engineering Projects

Table of Contents

ME PROJECT 1

Manta Ray

Advisor: Prof. Prosenjit Bagchi

Email: pbagchi@soe.rutgers.edu

Project Goals: Building a mechanical device that can swim using body undulation.

Project Envisioned Outcomes: Building a mechanical device that can swim using body undulation

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining			☑		
CNC machining	☑				
3D printing			☑		
Welding	☑				
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)		☑			
Microcontrollers (e.g., Arduino)			☑		
Bonding			☑		
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol			☑		
Python	☑				
Ansys			☑		
SolidWorks			☑		
Other CAD packages	☑				
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 2

Rutgers Rotational Stability Demonstrator

Advisor: Prof. Haim Baruh

Email: baruh@soe.rutgers.edu

Project Goals and Envisioned Outcomes:

This project aims to design a contraption that demonstrates that the free (unrestricted) motion of several objects becomes unstable with time. For example, one can take a rectangular-shaped object and spin it about its axes. It is well known that rotation about the axis of intermediate moment of inertia is unstable. It is also known that for shapes like the letter T, there are additional rotational instabilities. In this project, we will build a contraption and design several different-shaped objects so that the instability can be visually demonstrated. One possibility is to take an already-built gimbal (or build one ourselves), and modify it to take on different payloads. Please note that execution of this project involves some dynamics simulations.

Prof. Baruh showed a YouTube video of this phenomenon to a group of high school students and the students found the concept very intriguing. We would like to take this contraption for demonstrations at local high schools or at science fairs.

Students Expertise: (Please contact the advisor for more information)

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design					
Analysis					
Hand tools					
Traditional Machining					
CNC machining					
3D printing					
Welding					
Wiring					
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)					
Microcontrollers (e.g., Arduino)					
Bonding					
Processing (e.g., vacuum bag, autoclave)					

Software Expertise: (Please contact the advisor for more information)

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab					
Comsol					
Python					
Ansys					
SolidWorks					
Other CAD packages					
Siemens NX					
LabView					
E-Calc					
AVL					
Xfoil					
Machine vision program					

ME PROJECT 3

Synergistic Wind and Water Power - WET Center Project

Advisor: Prof. Onur Bilgen

Email: o.bilgen@rutgers.edu

Project Goals: The goal of the project is to develop a synergistic renewable energy system that combines wind energy and water power. The senior design project is part of a university-funded project called the WET Center Project.

Project Envisioned Outcomes: Several hybrid energy systems will be designed, analyzed, manufactured and tested. The team will gain experience in these areas.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis				☑	
Hand tools				☑	
Traditional Machining				☑	
CNC machining				☑	
3D printing				☑	
Welding	☑				
Wiring				☑	
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)				☑	
Microcontrollers (e.g., Arduino)				☑	
Bonding				☑	
Processing (e.g., vacuum bag, autoclave)				☑	

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab				☑	
Comsol		☑			
Python				☑	
Ansys		☑			
SolidWorks				☑	
Other CAD packages				☑	
Siemens NX		☑			
LabView		☑			
E-Calc		☑			
AVL	☑				
Xfoil		☑			
Machine vision program		☑			

ME PROJECT 4

Turbine and Propulsion Test Setup - WET Center Project

Advisor: Prof. Onur Bilgen

Email: o.bilgen@rutgers.edu

Project Goals:

"The goal of the project is to design, test, and validate an experimental setup for testing turbines and propellers in a low-speed wind tunnel. The senior design project is part of a university-funded project called the WET Center Project. The students should be very comfortable with the following: 1) Design/analysis and programming software such as Matlab, Ansys, Solid Works, Siemens NX or other CAD packages, LabVIEW, etc.; 2) Simple analog or digital electronics such as resistors, capacitors, op-amps, microcontrollers (i.e. Arduino, Raspberry Pi), wiring, soldering, etc.; 3) Fabrication techniques such as 3D printing, bonding, vacuum bagging, manual fabrication, etc."

Project Envisioned Outcomes: An experimental setup will be designed, analyzed, manufactured and tested. The team will gain experience in these areas.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis				☑	
Hand tools				☑	
Traditional Machining			☑		
CNC machining		☑			
3D printing				☑	
Welding	☑				
Wiring				☑	
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)				☑	
Microcontrollers (e.g., Arduino)				☑	
Bonding				☑	
Processing (e.g., vacuum bag, autoclave)				☑	

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab				☑	
Comsol				☑	
Python			☑		
Ansys		☑			
SolidWorks				☑	
Other CAD packages				☑	
Siemens NX				☑	
LabView			☑		
E-Calc			☑		
AVL			☑		
Xfoil			☑		
Machine vision program	☑				

ME PROJECT 5

SMARTWEAR: Design and Development of an AI-Enabled Wearable Device for Real-Time Health Monitoring and Anomaly Detection I

Advisor: Prof. Joseph Cohen

Email: joseph.cohen3@rutgers.edu

Project Goals: The goal of this project is to design, build, and test a prototype of a wearable device that is ergonomic, energy-efficient, and capable of continuously monitoring key physiological signals (e.g., heart rate, skin temperature, SpO2, motion, possibly electrodermal activity). The appropriate sensors and microcontrollers should be integrated into a compact wearable form factor (e.g., wristband or patch). Machine learning algorithms should be developed to analyze sensor data and detect early signs of health anomalies (e.g., arrhythmias, stress episodes, or abnormal temperature trends). Ideally, data will be collected in real time and transmitted to a smartphone or cloud platform over Bluetooth/Wi-Fi for real-time data visualization. Finally, the accuracy of the AI-enabled device should be validated through testing on simulated or real data from healthy participants and synthetic anomalies.

Project Envisioned Outcomes:

- A functional wearable prototype capable of non-invasive health monitoring.

- A machine learning model pipeline trained to identify anomalies in real-time physiological data, with performance metrics such as precision, recall, and latency.

- Potential for publication, commercialization, competition entry, or follow-on research in biomedical sensing or personalized health technologies.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools	☑				
Traditional Machining		☑			
CNC machining		☑			
3D printing		☑			
Welding	☑				
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)			☑		
Microcontrollers (e.g., Arduino)			☑		
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol	☑				
Python				☑	
Ansys	☑				
SolidWorks			☑		
Other CAD packages		☑			
Siemens NX		☑			
LabView		☑			
E-Calc		☑			
AVL		☑			
Xfoil		☑			
Machine vision program			☑		

ME PROJECT 6

SMARTWEAR: Design and Development of an AI-Enabled Wearable Device for Real-Time Health Monitoring and Anomaly Detection II

Advisor: Prof. Joseph Cohen

Email: joseph.cohen3@rutgers.edu

Project Goals: The goal of this project is to design, build, and test a prototype of a wearable device that is ergonomic, energy-efficient, and capable of continuously monitoring key physiological signals (e.g., heart rate, skin temperature, SpO2, motion, possibly electrodermal activity). The appropriate sensors and microcontrollers should be integrated into a compact wearable form factor (e.g., wristband or patch). Machine learning algorithms should be developed to analyze sensor data and detect early signs of health anomalies (e.g., arrhythmias, stress episodes, or abnormal temperature trends). Ideally, data will be collected in real time and transmitted to a smartphone or cloud platform over Bluetooth/Wi-Fi for real-time data visualization. Finally, the accuracy of the AI-enabled device should be validated through testing on simulated or real data from healthy participants and synthetic anomalies.

Project Envisioned Outcomes:

- A functional wearable prototype capable of non-invasive health monitoring.

- A machine learning model pipeline trained to identify anomalies in real-time physiological data, with performance metrics such as precision, recall, and latency.

- Potential for publication, commercialization, competition entry, or follow-on research in biomedical sensing or personalized health technologies.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools	☑				
Traditional Machining		☑			
CNC machining		☑			
3D printing		☑			
Welding	☑				
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)			☑		
Microcontrollers (e.g., Arduino)			☑		
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol	☑				
Python				☑	
Ansys	☑				
SolidWorks			☑		
Other CAD packages		☑			
Siemens NX		☑			
LabView		☑			
E-Calc		☑			
AVL		☑			
Xfoil		☑			
Machine vision program			☑		

ME PROJECT 7

Wearable Obstacle Detection and Feedback System for Visually Impaired Navigation

Advisor: Prof. Kimberly Cook-Chennault

Email: cookchen@soe.rutgers.edu

Project Abstract: Navigating unfamiliar or crowded environments presents a daily challenge for individuals who are blind or visually impaired. Traditional mobility aids such as canes offer limited awareness of head-height obstacles or dynamic changes in the surrounding environment. The objective of this project is to design and prototype a wearable assistive device that can be mounted on the body or glasses and uses integrated sensors (e.g., ultrasonic, infrared, or camera modules) to detect nearby objects, obstacles, or changes in terrain. The device should classify obstacles based on distance and orientation using pre-programmed logic or lightweight image/signal processing tools (e.g., MATLAB), and provide real-time feedback to the user via haptic or audio cues. The final design must prioritize wearability, low power consumption, reliability, and ease of use for people with visual impairments.

Project Goals:

- Design and prototype a wearable device that can be mounted on glasses or clothing and is ergonomically suited for users with visual impairments.
- Integrate a sensor suite (e.g., ultrasonic, IR, or depth-sensing cameras) capable of detecting common indoor and outdoor obstacles at varying distances and elevations.
- Develop a real-time feedback mechanism (haptic or auditory) to convey information about obstacle proximity, type, or direction to the user in a non-visual manner.
- Implement sensor data processing using MATLAB and/or embedded systems to classify spatial data and trigger appropriate feedback patterns.
- Validate the system through controlled testing scenarios simulating real-world navigation environments (e.g., hallways, classrooms, sidewalks).
- Ensure system safety, low power consumption, and user comfort, with emphasis on robustness and intuitive use.

Project Envisioned Outcomes:

1. A working prototype of the wearable device that successfully detects and communicates the presence of objects in the user's path.

2. A mechanical design that is lightweight, comfortable, and durable enough for continuous use, with thoughtful sensor placement and enclosure design.
3. A MATLAB-based or embedded system algorithm that classifies object proximity and sends appropriate feedback signals to the user.
4. A user-tested interface with clear and interpretable haptic or audio signals indicating distance and type of obstacle.
5. A final report and poster presentation

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis				☑	
Hand tools				☑	
Traditional Machining	☑				
CNC machining	☑				
3D printing				☑	
Welding	☑				
Wiring				☑	
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)				☑	
Microcontrollers (e.g., Arduino)				☑	
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab				☑	
Comsol		☑			
Python				☑	
Ansys					
SolidWorks			☑		
Other CAD packages			☑		
Siemens NX		☑			
LabView			☑		
E-Calc			☑		
AVL			☑		
Xfoil			☑		
Machine vision program				☑	

ME PROJECT 8

Bio-Inspired Flapping Wing Energy Harvester I

Advisor: Prof. Mitsunori Denda

Email: denda@rutgers.edu

Project Goals: Built on the latest in flapping flight research, the patent-pending technology at the core of this project has been shown to produce efficiencies higher than the best wind turbines on the market.

Project Envisioned Outcomes: How? Recently, scientists discovered that birds use advanced flapping aerodynamics to move through the air up to 5 times more efficiently that man-made aircraft. The goal of this project is to use these recently discovered phenomena to efficiently harvest energy from the wind. Team members will design and construct their own wind energy harvester, then test its performance under different conditions. They will have access to CAD models of working prototypes that have been previously built and tested, and they will also have access to proprietary MATLAB and Python programs which can predict efficiency before building the device.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining			☑		
CNC machining	☑				
3D printing			☑		
Welding	☑				
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)	☑				
Microcontrollers (e.g., Arduino)	☑				
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol	☑		☑		
Python	☑				
Ansys			☑		
SolidWorks			☑		
Other CAD packages	☑				
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 9

Bio-Inspired Flapping Wing Energy Harvester II

Advisor: Prof. Mitsunori Denda

Email: denda@rutgers.edu

Project Goals: Built on the latest in flapping flight research, the patent-pending technology at the core of this project has been shown to produce efficiencies higher than the best wind turbines on the market.

Project Envisioned Outcomes: How? Recently, scientists discovered that birds use advanced flapping aerodynamics to move through the air up to 5 times more efficiently that man-made aircraft. The goal of this project is to use these recently discovered phenomena to efficiently harvest energy from the wind. Team members will design and construct their own wind energy harvester, then test its performance under different conditions. They will have access to CAD models of working prototypes that have been previously built and tested, and they will also have access to proprietary MATLAB and Python programs which can predict efficiency before building the device.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining			☑		
CNC machining	☑				
3D printing			☑		
Welding	☑				
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)	☑				
Microcontrollers (e.g., Arduino)	☑				
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol	☑		☑		
Python	☑				
Ansys			☑		
SolidWorks			☑		
Other CAD packages	☑				
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 10

Liquid-Based Portable Filtration Device to Improve Indoor Air Quality During Smoke Events

Advisor: Prof. German Drazer

Email: german.drazer@rutgers.edu

Project Goals: The overall goal is to design an efficient air particulate filtration system. The system should be able to significantly reduce particulate matter concentration (e. g. 80% reduction PM2.5) in a short time (e. g. 1 hour) in a typical room (e. g. 150 square feet, 8 foot-ceiling) and maintain it for prolonged periods of time (e. g. days to weeks).

Project Envisioned Outcomes: Creating a novel air filtration device for particulate matter

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design		☑			
Analysis		☑			
Hand tools		☑			
Traditional Machining	☑				
CNC machining	☑				
3D printing		☑			
Welding	☑				
Wiring		☑			
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)		☑			
Microcontrollers (e.g., Arduino)		☑			
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab		☑			
Comsol	☑				
Python	☑				
Ansys		☑			
SolidWorks		☑			
Other CAD packages		☑			
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

Additional Requirements and Information:

https://www.youtube.com/watch?v=qDVcZ_scUss

ME PROJECT 11

Integrating Water and Solar Energy Solutions

Advisor: Prof. Zhixiong Guo

Email: zguo@rutgers.edu

Project Abstract: The Earth receives an immense amount of solar energy, yet a large portion of it goes untapped while we continue to exhaust finite fossil fuel resources. At the same time, about 97% of the planet's water is saline, making freshwater scarcity a growing global challenge. Solar desalination offers a sustainable method for turning saltwater into usable water using solar power. Additionally, water can also be harvested directly from the atmosphere.

In this project, you're encouraged to explore creative and unconventional approaches to water collection powered by solar energy. For instance, you could design and build a prototype for solar desalination or an atmospheric water harvesting device. The goal is to apply the knowledge gained in your college studies to the real-world engineering challenge of designing, constructing, and analyzing systems that utilize natural renewable resources.

Project Goals: The goal is to apply the knowledge gained in your college studies to the real-world engineering challenge of designing, constructing, and analyzing systems that utilize natural renewable resources.

Project Envisioned Outcomes: Build a device and test

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining			☑		
CNC machining	☑				
3D printing	☑				
Welding	☑				
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)		☑			
Microcontrollers (e.g., Arduino)	☑				
Bonding		☑			
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab		☑			
Comsol		☑			
Python	☑				
Ansys	☑				
SolidWorks		☑			
Other CAD packages	☑				
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 12

AI-Based Autonomous Monitoring of Milling Machine Tool

Advisor: Prof. Yuebin Guo

Email: yuebin.guo@rutgers.edu

Project Goals: Learn manufacturing processes, machines, and monitoring by integrating sensors and AI

Project Envisioned Outcomes: Hands-on expertise of AI-based sensing and monitoring with manufacturing applications

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis				☑	
Hand tools				☑	
Traditional Machining		☑			
CNC machining		☑			
3D printing		☑			
Welding	☑				
Wiring				☑	
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)				☑	
Microcontrollers (e.g., Arduino)				☑	
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab				☑	
Comsol			☑		
Python				☑	
Ansys		☑			
SolidWorks		☑			
Other CAD packages		☑			
Siemens NX				☑	
LabView				☑	
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program		☑			

ME PROJECT 13

Disk Jet Impingement Deposition Equipment

Advisor: Prof. Yogesh Jaluria

Email: jaluria@soe.rutgers.edu

Project Abstract: Design, fabricate and test a deposition system consisting of a vertical air jet impinging on a rotating disk for processes, such as painting, coating, and spray deposition, which are used in manufacturing. High flow rate and uniform flow over the rotating surface are desirable. The rotational speed and inlet velocity should be variable for different processes.

Project Goals: Design and fabricate the system. Test the results at different rpm and inflow rates.

Project Envisioned Outcomes: System, performance tests, optimize for uniformity.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining		☑			
CNC machining	☑				
3D printing		☑			
Welding	☑				
Wiring		☑			
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)			☑		
Microcontrollers (e.g., Arduino)		☑			
Bonding		☑			
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol			☑		
Python	☑				
Ansys		☑			
SolidWorks			☑		
Other CAD packages	☑				
Siemens NX	☑				
LabView			☑		
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 14

Concentrated Solar Energy System

Advisor: Prof. Yogesh Jaluria

Email: jaluria@soe.rutgers.edu

Project Abstract: Design and fabricate a concentrated solar energy system, with tracking of the Sun, to heat water, which may be used for thermal processing, desalination, or heating. Also, include an energy storage system to take care of night-time and other durations when solar energy is not available.

Project Goals: Design and fabricate the system. Test it on a hot sunny day. Track the temperature rise during the day and fall during night.

Project Envisioned Outcomes: System designed and fabricated. Test results on heating and storage.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining		☑			
CNC machining	☑				
3D printing		☑			
Welding	☑				
Wiring		☑			
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)			☑		
Microcontrollers (e.g., Arduino)		☑			
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol			☑		
Python	☑				
Ansys			☑		
SolidWorks			☑		
Other CAD packages	☑				
Siemens NX	☑				
LabView			☑		
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 15

Design of Miniature Wind Tunnel for Measuring Pitching Moment on an Airfoil

Advisor: Prof. Doyle Knight

Email: ddknight@rutgers.edu

Project Goals:

The following tasks will be performed:
1) CAD design of wind tunnel
2) fabrication of wind tunnel using 3D printing
3) assembly of electronics
4) maintain up-to-date budget within the limit set by the Department,
5) maintain Canvas website with all results.

Project Envisioned Outcomes:

- The design specifications for the miniature wind tunnel are:
    - Measure flow velocity in m/s
    - Measure angle of attack of airfoil in deg
    - Measure aerodynamic moment about the quarter chord as function of angle of attack in Nt-m
    - View airfoil and flow around airfoil through transparent side windows (see example photo)
- A LabView VI will provide the following functions
    - Control and measurement of wind tunnel speed
    - Control and measurement of angle of attack
    - Measurement of aerodynamic moment about the quarter chord of the airfoil
    - Control smoke injection upstream of airfoil to visualize flow
    - Presentation of all data in LabView VI
    - Store data in file(s)
    - Transmit data by email
- Assembled wind tunnel must fit within locker in MERL
- Total budget \$700 per team (subject to revision)

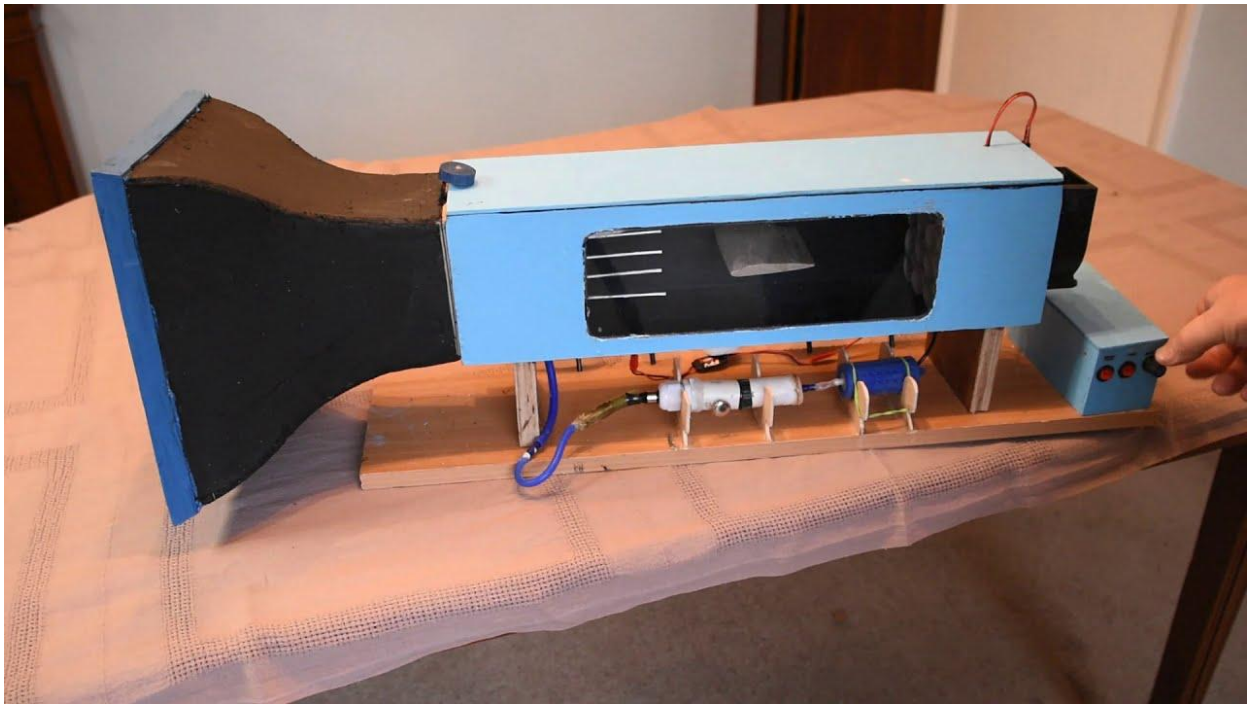
Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design	☑				
Analysis			☑		
Hand tools			☑		
Traditional Machining	☑				
CNC machining	☑				
3D printing		☑			
Welding	☑				
Wiring		☑			
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)		☑			
Microcontrollers (e.g., Arduino)		☑			
Bonding		☑			
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol			☑		
Python	☑				
Ansys			☑		
SolidWorks			☑		
Other CAD packages	☑				
Siemens NX	☑				
LabView		☑			
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

Example Photo:



ME PROJECT 16

Mini-Extruder Printer Head for a Thermoplastic Pellet-Fed 3D Printer

Advisor: Prof. Jennifer Lynch-Branzoi

Email: jklynch@soe.rutgers.edu

Project Goals: The project goal is to build a mini-extruder to be used for a thermoplastic pellet-fed 3D printer. The mini-extruder should be capable of processing various thermoplastic polymers over a wider temperature range (180 – 400 °C) and at variable RPM. The printing bed and movement system is already assembled. A pellet-fed 3D printer allows pellets to be fed directly into the 3D printer without first having to manufacture a fiber, as typical thermoplastic 3D printers are fiber fed.

Project Envisioned Outcomes: This project will provide the 3D printer melting/feeding print head and will be combined with the printing bed and movement system into one functioning thermoplastic pellet-fed 3D printer prototype capable of printing a variety of thermoplastic polymers.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining	☑				
CNC machining	☑				
3D printing		☑			
Welding	☑				
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)	☑				
Microcontrollers (e.g., Arduino)		☑			
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab	☑				
Comsol	☑				
Python	☑				
Ansys	☑		☑		
SolidWorks			☑		
Other CAD packages					
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 17

Hybrid Additive Manufacturing System

Advisor: Prof. Rajiv Malhotra

Email: rajiv.malhotra@rutgers.edu

Project Goals: To create a system that combines welding based additive manufacturing with rolling in the same machine.

Project Envisioned Outcomes: Ability to roll additively manufactured lines as soon as they are fabricated.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis				☑	
Hand tools				☑	
Traditional Machining		☑			
CNC machining	☑				
3D printing	☑				
Welding	☑				
Wiring	☑				
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)	☑				
Microcontrollers (e.g., Arduino)	☑				
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab	☑				
Comsol	☑				
Python	☑				
Ansys	☑				
SolidWorks					☑
Other CAD packages					☑
Siemens NX			☑		
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 18

Surfboard Propulsion System to Facilitate Catching Waves

Advisor: Prof. Aaron Mazzeo

Email: aaron.mazzeo@rutgers.edu

Project Goals: Create a mechanical storage and delivery system to facilitate catching waves

Project Envisioned Outcomes: Safely triggered release of energy, mechanical capture of energy, and efficient delivery of thrust

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining		☑			
CNC machining		☑			
3D printing		☑			
Welding	☑				
Wiring		☑			
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)	☑				
Microcontrollers (e.g., Arduino)	☑				
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol	☑				
Python	☑				
Ansys			☑		
SolidWorks			☑		
Other CAD packages	☑				
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 19

Negative Poisson's Ratio Materials: Design and Manufacturing

Advisor: Prof. Andrew Norris

Email: norris@rutgers.edu

Project Goals: To design and manufacture materials with negative Poisson's ratio

Project Envisioned Outcomes: Students will use 3D printing and other manufacturing methods to design different types of materials that display negative Poisson's ratio. In the process the students will learn mechanics, properties of materials, design, manufacturing, and testing. The best outcome will be a variety of different types of materials that all have negative PR.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools		☑			
Traditional Machining		☑			
CNC machining	☑				
3D printing			☑		
Welding	☑				
Wiring	☑				
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)	☑				
Microcontrollers (e.g., Arduino)	☑				
Bonding		☑			
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol			☑		
Python		☑			
Ansys	☑				
SolidWorks		☑			
Other CAD packages			☑		
Siemens NX					
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 20

Machines for Testing the Mechanical Strength of Additive Manufactured Parts

Advisor: Prof. Andrew Norris

Email: norris@rutgers.edu

Project Goals: The objective is to design and build machines to test the mechanical properties of additive manufactured parts, such as 3D printed parts using polymers and metals.

Project Envisioned Outcomes: Additive manufacturing has limitations depending on the feature size that impacts the mechanical strength in ways that are hard to predict. This project will explore different ways to measure mechanical properties of AM parts. Possible designs are (1) an impact machine (like a Charpy impacter), and (2) a machine to measure vibrational modal frequencies, which are directly related to the elastic constants.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining	☑				
CNC machining		☑			
3D printing			☑		
Welding	☑				
Wiring	☑				
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)	☑				
Microcontrollers (e.g., Arduino)	☑				
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol			☑		
Python		☑			
Ansys		☑			
SolidWorks		☑			
Other CAD packages		☑			
Siemens NX		☑			
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

Additional Requirements and Information:

Some experience with additive manufacturing would be great.

ME PROJECT 21

RFR (Title TBD)

This is a Closed Project

Advisor: Prof. Assimina Pelegri

Email: pelegri@rutgers.edu

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design					
Analysis					
Hand tools					
Traditional Machining					
CNC machining					
3D printing					
Welding					
Wiring					
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)					
Microcontrollers (e.g., Arduino)					
Bonding					
Processing (e.g., vacuum bag, autoclave)					

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab					
Comsol					
Python					
Ansys					
SolidWorks					
Other CAD packages					
Siemens NX					
LabView					
E-Calc					
AVL					
Xfoil					
Machine vision program					

ME PROJECT 22

Commercial Grade Nutrition Bar Extruder Machine 2.0

Advisor: Prof. Todd Rossi

Email: todd.m.rossi@rutgers.edu,

Project Goals: Next generation design from 2024-25 senior design project - Automating a cutting system, adding a shredder mechanism before hopper, optimizing the screw to improve output speed, and Food safety considerations

Project Envisioned Outcomes: Build second generation design. Push towards commercial product.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining			☑		
CNC machining	☑				
3D printing			☑		
Welding	☑				
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)			☑		
Microcontrollers (e.g., Arduino)			☑		
Bonding			☑		
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab	☑				
Comsol	☑				
Python	☑				
Ansys	☑				
SolidWorks			☑		
Other CAD packages	☑		☑		
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

Additional Requirements and Information:

https://drive.google.com/drive/folders/1f5LCh6HQl-M5wgNp0K-n4gFZojUz3MZA?usp=drive_link

ME PROJECT 23

Standalone Solar PV System Monitor and Controller

Advisor: Prof. Todd Rossi

Email: todd.m.rossi@rutgers.edu,

Project Goals: Build monitoring system with cloud connection and app to manage standalone solar PV system generation, loads, and storage of standalone solar PV system to achieve requirements.

Project Envisioned Outcomes: Monitor and report performance, model to anticipate future power availability, identify unexpected problems impacting required outcomes, manage contingencies, recommend upgrades as needed.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools		☑			
Traditional Machining	☑				
CNC machining	☑				
3D printing			☑		
Welding	☑				
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)			☑		
Microcontrollers (e.g., Arduino)			☑		
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab	☑				
Comsol	☑				
Python			☑		
Ansys	☑				
SolidWorks			☑		
Other CAD packages			☑		
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 24

RFR (Title TBD)

This is a Closed Project

Advisor: Prof. Jerry Shan

Email: jshan@rutgers.edu

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design					
Analysis					
Hand tools					
Traditional Machining					
CNC machining					
3D printing					
Welding					
Wiring					
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)					
Microcontrollers (e.g., Arduino)					
Bonding					
Processing (e.g., vacuum bag, autoclave)					

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab					
Comsol					
Python					
Ansys					
SolidWorks					
Other CAD packages					
Siemens NX					
LabView					
E-Calc					
AVL					
Xfoil					
Machine vision program					

ME PROJECT 25

Manufacturing (Title TBD)

This is a Closed Project

Advisor: Prof. Jonathan Singer

Email: jonathan.singer@rutgers.edu

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design					
Analysis					
Hand tools					
Traditional Machining					
CNC machining					
3D printing					
Welding					
Wiring					
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)					
Microcontrollers (e.g., Arduino)					
Bonding					
Processing (e.g., vacuum bag, autoclave)					

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab					
Comsol					
Python					
Ansys					
SolidWorks					
Other CAD packages					
Siemens NX					
LabView					
E-Calc					
AVL					
Xfoil					
Machine vision program					

ME PROJECT 26

3-D Printed Custom Tennis Racquet

Advisor: Prof. Stephen Tse

Email: sdytse@rutgers.edu

Project Goals: Students will research tennis racquet design and mechanics and produce a 3-D printed tennis racquet with an angled head.

Project Envisioned Outcomes: Strung racquets with different angled heads will be compared computationally and tested physically. Other aspects of racquet design can also be explored.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining			☑		
CNC machining			☑		
3D printing			☑		
Welding	☑				
Wiring		☑			
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)		☑			
Microcontrollers (e.g., Arduino)		☑			
Bonding		☑			
Processing (e.g., vacuum bag, autoclave)		☑			

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol			☑		
Python			☑		
Ansys			☑		
SolidWorks			☑		
Other CAD packages			☑		
Siemens NX	☑				
LabView		☑			
E-Calc		☑			
AVL		☑			
Xfoil		☑			
Machine vision program		☑			

ME PROJECT 27

Artificial Intelligence Device for Object Detection Using Simple Measurement Signals

Advisor: Prof. Nikolaos Vlassis

Email: nick.vlassis@rutgers.edu

Project Goals: To develop a compact, cost-effective device that collects simple measurement signals and uses basic motion control, with artificial intelligence assisting in the interpretation of these signals to detect, localize, and characterize objects. The device will be designed for easy assembly and operation by engineering students, with comprehensive documentation provided.

Project Envisioned Outcomes: A functional prototype of the AI-based detection device, supported by full documentation covering hardware assembly, software implementation, and operational use. Deliverables will include hardware specifications, AI algorithms for signal interpretation and object inference, and integration procedures for accurate localization and orientation estimation.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools		☑			
Traditional Machining		☑			
CNC machining		☑			
3D printing		☑			
Welding		☑			
Wiring		☑			
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)		☑			
Microcontrollers (e.g., Arduino)			☑		
Bonding			☑		
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab		☑			
Comsol		☑			
Python				☑	
Ansys		☑			
SolidWorks		☑			
Other CAD packages				☑	
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program			☑		

ME PROJECT 28

Design of Strong and Lightweight Cylindrical Pressure Vessel Using Carbon Fibers and Epoxy Resin

Advisor: Prof. George Weng

Email: gjweng@rutgers.edu

Project Goals: To build a light-weight composite cylindrical pressure vessel that can sustain high pressure without failure.

Project Envisioned Outcomes: A hardware composite cylindrical pressure vessel.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design		☑			
Analysis		☑			
Hand tools		☑			
Traditional Machining		☑			
CNC machining		☑			
3D printing		☑			
Welding		☑			
Wiring		☑			
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)		☑			
Microcontrollers (e.g., Arduino)		☑			
Bonding		☑			
Processing (e.g., vacuum bag, autoclave)		☑			

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol	☑				
Python	☑				
Ansys	☑				
SolidWorks	☑				
Other CAD packages	☑				
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 29

Mechatronic Systems for a Six Degree-Of-Freedom (6-DOF) Shaking Platform

Advisor: Prof. Jingang Yi

Email: jgyi@rutgers.edu

Project Goals: Design, fabricate and testing a 6-DOF shaking platform for mechanical and aerospace applications.

Project Envisioned Outcomes: A working platform that produces 6-DOF motion with payload

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis			☑		
Hand tools			☑		
Traditional Machining				☑	
CNC machining			☑		
3D printing			☑		
Welding			☑		
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)			☑		
Microcontrollers (e.g., Arduino)			☑		
Bonding		☑			
Processing (e.g., vaccum bag, autoclave)		☑			

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol			☑		
Python			☑		
Ansys			☑		
SolidWorks					☑
Other CAD packages			☑		
Siemens NX	☑				
LabView		☑			
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

ME PROJECT 30

Novel Differential Servo Drive for Autonomous Robot Tracking and Manuver

Advisor: Prof. Qingze Zou

Email: qzzou@rutgers.edu

Project Goals and Envisioned Outcomes: In this project, your team will work to design, build, test, and validate a novel differential omnidirectional servo drive system on an autonomous robot. Unlike the traditional motor servo drive on autonomous robots, the differential omnidirectional servo drive will allow independent torque and speed control of each wheel separately, thereby offering much more freedom and maneuverability to the autonomous robot tracking and driving. This will eliminate the locomotion constraint of the autonomous robot (car) due to its nonholonomic dynamics, making it much easier in tasks as parallel parking, and offer a function as a continuously variable transmission in fuel-engine-based vehicles. Your team will build and integrate this novel servo design into an autonomous robot, and test its function in maneuver such as arbitrary rotation, starting, parallel parking. Particularly, your team will build the robot to achieve the functions and maneuverability as required in the collegiate VEXU robotics competition in the 2025-2026 season.

Students Expertise: (Please contact the advisor for more information)

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design					
Analysis					
Hand tools					
Traditional Machining					
CNC machining					
3D printing					
Welding					
Wiring					
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)					
Microcontrollers (e.g., Arduino)					
Bonding					
Processing (e.g., vacuum bag, autoclave)					

Software Expertise: (Please contact the advisor for more information)

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab					
Comsol					
Python					
Ansys					
SolidWorks					
Other CAD packages					
Siemens NX					
LabView					
E-Calc					
AVL					
Xfoil					
Machine vision program					

ME PROJECT 31

Development of Electrochemiluminescent Microscopy for Nanosensing and Single Cell Dynamics Characterization

Advisor: Prof. Qingze Zou

Email: qzzou@rutgers.edu

Project Goals and Envisioned Outcomes: In this project, we seek to design, construct, and test an electrochemiluminescent (ECL) microscope for nanosensing and biological-related applications to characterize single cell dynamics. ECL microscopy utilizes the luminescence signal generated in electrochemical reactions to detect a wide range of inorganic and organic species at micro to nano scale. Coupling with high-resolution optical microscope, ECL recently has been explored for investigating dynamic material reactions and biological interactions at sub-micrometer to nanometer scale, becoming a powerful tool for a wide range of studies including biosensors, battery development in renewable energy, to inter-cellular interactions in a single cell. In this project, we will integrate the ECL microscope to an atomic force microscope (AFM) to combine both measurements on the same platform, thereby, offering nanoscale measurement capability previously not possible. Your group will design the ECL device consisting of electrical circuit and mechanical structure (sample holder) for exciting and generating the ECL signal, fabricate and build the ECL device, integrate it to AFM, and then conduct preliminary experiments to test and validate its function in renewable energy and cellular biology studies.

Students Expertise: (Please contact the advisor for more information)

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design					
Analysis					
Hand tools					
Traditional Machining					
CNC machining					
3D printing					
Welding					
Wiring					
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)					
Microcontrollers (e.g., Arduino)					
Bonding					
Processing (e.g., vacuum bag, autoclave)					

Software Expertise: (Please contact the advisor for more information)

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab					
Comsol					
Python					
Ansys					
SolidWorks					
Other CAD packages					
Siemens NX					
LabView					
E-Calc					
AVL					
Xfoil					
Machine vision program					