Faculty Name	Program/Expertise Area	Campus/ Worksite	Format	Student Eligibility
Adil Ahmad	**Computer Systems, Security, and Architecture**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: Our group has designed a prototype that enables critical security invariants in virtual machines (e.g., protects system logs generated by these machines and prevents attackers from modifying operating system code) on AMD EPYC server CPUs. In this project, we would like to deploy and test this prototype within a real-world framework used in current cloud virtual machines. Such a deployment will make it significantly easier for users who would like to leverage the security properties of our system to create secure virtual machines. **Students will:** (a) Understand code written for our prototype and the real-world framework, (b) write C/rust code to merge our prototype with deployed system, and (c) generate test-cases to debug/verify the correctness of merged code. **Prerequisite skills/knowledge**: Must have taken a cybersecurity or operating system course; a computer architecture course is a plus!

Aditi Chattopadhyay	**Investigation of Nanofiller-Enhanced Multifunctional Composite Materials in Aerospace Structures**	**Tempe**	**In person**	**U. S. Citizens only**

Project description: Development of novel composites with carbon nanotube membranes for improved mechanical, electrical, and electromagnetic shielding properties. **Students will:** Prepare material standardized samples and assist in performing microscopy and mechanical testing. **Prerequisite skills/knowledge:** Junior or senior undergraduate students from mechanical or aerospace engineering; some background in mechanics of materials is a plus.

Aditi Chattopadhyay	**Investigation of Scale-Dependent Response and Microstructure Characterization of Meteorites**	**Tempe**	**In person**	**U. S. Citizens only**

Project description: Understanding the physical scale-dependent mechanical & dynamic properties of meteoritic materials and gain insight into their deformation mechanisms and fracture & impact dynamics. **Students will:** Assist with conducting ballistic impact and quasi-static compressive tests on meteorite samples coupled with digital image correlation technique and with performing microscopy on the impact fragments. **Prerequisite skills/knowledge:** Junior and senior undergraduate students from mechanical or aerospace engineering; some experience in hands-on experiments is a plus.

Aditi Chattopadhyay	**Investigation of Multifunctional Electro-Active Smart Materials**	**Tempe**	**In person**	**U. S. Citizens only**

Project description: Development of novel nano-enhanced, multifunctional, electro-active shape memory polymeric materials with improved mechanical, electrical, and thermal properties as well as self-sensing and self-healing capability. **Students will:** Optimize uniform dispersion of nanoparticles to fabricate complex nanoengineered composite materials which maximizes both multifunctionality and mechanical performance. **Prerequisite skills/knowledge:** Junior or senior undergraduate students from mechanical or aerospace engineering; some background in mechanics of materials is a plus.

Adolfo Escobedo	**Operations Research and Computing**	**Tempe**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: Research projects will explore how to enhance the concept of the wisdom of the crowd; related activities may include crowdsourced prediction, computation, and opinion tasks. **Students will:** Design and implement online crowdsourcing activities. If time permits, they will analyze data collected from them. **Prerequisite skills/knowledge:** Students should have some experience in 1) web programming, 2) algorithm design, and/or 3) sociology/psychology (to design interesting activities). Above all, students should have intellectual curiosity to explore new areas.

Adolfo Escobedo	**Operations Research, Planning, and Logistics**	**Tempe**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: Improve the planning and operation of large-scale systems; applications include logistics, power systems, and service systems. **Students will:** Develop mathematical models and algorithms for improving decision-making in the target service systems; this will entail coding, implementing, and testing computer-based decision-making tools. **Prerequisite skills/knowledge:** Junior and senior undergraduate students and graduate students from Industrial Engineering, Operations Research, Mathematics, and other technical fields can contribute.

Faculty Name	Program/Expertise Area	Campus/ Worksite	Format	Student Eligibility
Amarsagar Reddy Ramapuram Matavalam	**Power Systems/ Machine Learning**	**Tempe**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: Research on applying graph neural networks to perform scalable learning on classification and regression problems for electric power systems. **Students will:** Understand the challenges of applying data science and machine learning to geometric data such as graphs. They will then design and study novel algorithms that interactively and adaptively leverage structure present in the problem. This project has the potential to make fundamental contributions to the application of machine learning to electrical power systems. **Prerequisite skills/knowledge:** An ideal student will have background in using pytorch/tensorflow/Julia, minimal knowledge of electric power systems and data science methods.

Amarsagar Reddy Ramapuram Matavalam	**Machine Learning/Power Systems**	**Tempe**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: Learning physics informed neural ordinary differential equations for power grid dynamics for accurate and quick prediction of trajectories. **Students will:** Understand the basics of differential equations and how to simulate them. They will then apply ezisting code in pytorch/tensorflow/jax to apply it to differential equations corresponding to power systems. This project has the potential to become a long-term research topic in applying neural ODEs to power grids. **Prerequisite skills/knowledge:** An ideal student will have background in using pytorch/tensorflow/jax/Julia with minimal knowledge of differential equations. The information about power systems can be learned during the internship.

Anamitra Pal	**Power Systems**	**Tempe**	**Virtual**	**U. S. Citizen or non-U. S. Citizen**

Project description: The research project focuses on creating new ways to estimate different electrical quantities in a power system. The quality of estimation is a function of the quality of the sensor being used to perform the estimation as well as the relation between the measurement obtained from the sensor and the quantity to be estimated. The sensor that will be focused in this research is a phasor measurement unit (PMU), while the electrical quantities being estimated range from the static and dynamic states of the power system to line parameters and inertia. The primary deliverable of this project is fast, consistent, and accurate power system estimation under diverse operating and sensing conditions. **Student will:** Generate a database that will be used to train different machine learning models. **Prerequisite skills/knowledge:** MATLAB, Python

David Nielsen	**Chemical Engineering**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: Synthetic Biology and Metabolic Engineering of microbes for renewable biochemical production.

Giulia Pedrielli	**Optimization, Machine Learning, Computational Biology, Cyber Physical Systems**	**Tempe**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: ***Motivation***. Epidemiological models lack accuracy no matter how complex the representation of disease spread mechanics. One of the shortcomings of traditional models is that they lack consideration of the decisional behavior of agents (humans) within the modeling loop. ***Current State.*** Our team has developed a high fidelity model for the spatio-temporal simulation of COVID, SIRTEM. While SIRTEM has shown good results, it reduces the human behavior to a few time-dependent parameters function of observed cases. This results in three drawbacks: it potentially lacks identifiability, it requires accurate observations, it does not generalize to novel/unseen pandemics. ***Project objectives***. Embed human responses using behavior change theories starting from our current models. Several decision theory models will be explored and tested with the objective to: (i) increase the accuracy of the current method; (ii) generalize the current method to be employed for unseen pandemics. **Student will:** Be closely followed by the developers of SIRTEM and by a socio-behavioral modeling expert. The objective is to add the dynamical model that expresses the human decisional framework to the epidemiological model. **Prerequisite skills/knowledge:** Python coding skills ODEs/PDEs simulation epidemics and behavioral models knowledge is welcome but not required as the student will be provided the support.

Faculty Name	Program/Expertise Area	Campus/ Worksite	Format	Student Eligibility
Giulia Pedrielli	**Optimization/Machine Learning**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: ***Motivation.*** RNA is an important macromolecule for gene regulation, catalysis, delivery, sensing, etc. While RNA can be found in nature, increasing interest is in the synthesis of RNAs for therapeutic, testing, and more. A key for the functionality of RNAs is their structure. Therefore evaluating/predicting the structure of RNA molecules is vital. ***Current State***. In spite of the interest in this area still there are little to no data for RNA molecules, hindering the use of state-of-the-art machine learning algorithms such as the groundbreaking AlphaFold. Our group has developed several models that integrate scientists design knowledge and have proven capable to evaluate natural RNAs with high accuracy. ***Project Objectives.*** We want to extend our work on natural RNAs to the case of synthetic structures by capturing explicitly scientists' preferred design choices. We will collaborate with partners at Rutgers University for the chemistry/biology and experimental components. **Student will:** Work with our machine learning pipelines to perform training and testing. Once familiar with the group tool we will explore design choices to extend the ML models and embed critical molecule design choices from our collaborators at Rutgers. **Prerequisite skills/knowledge:** Machine Learning models and familiarity with key AI/ML libraries (keras, pytorch, TensorFlow, etc.), Python coding, biology knowledge is welcome, but not required. The student will be supported by the expertise of other team members from Chemistry and Physics backgrounds.

Giulia Pedrielli	**Cyberphysical Systems/Machine Learning/Optimization/**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: ***Motivation.*** Smart factories have permeated throughout manufacturing from technology design, to monitoring with innovative sensor systems and unprecedented memory and computational power. Digital twins (virtual representations of the physical system) are key for the success of these paradigms. Their design and integration allow increased performance under normal and stress conditions. ***Current State.*** While the concept of digital twin has been explored in the recent literature, and commercial packages are becoming state-of-the-art at product level, implementations at the process and system level are far from being adopted in the factory floor. Simulations such as discrete event methods are too slow to connect to the physical system in real time, hindering the full realization of a digital twin loop. ***Project Objectives.*** Develop an adaptive and intelligent framework for the generation of digital twins at multiple resolutions that can be created as a function of the specific analysis, control or security task. **Student will:** Be concerned with approaches for model simplification and model abstraction. The student will be provided with our high-fidelity models for a set of target systems and will work collaboratively with the group to define abstraction strategy to simplify the model deriving lower fidelity approximations. **Prerequisite skills/knowledge:** Hybrid Automata, Automata Learning, Python coding skills, Event Based Systems.

Heather Clark	**Nanosensors for Bioimaging**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: My group is currently working at the interface of chemistry and biology to develop and apply novel nanoscale probes for biological measurements. In order to fulfill our goal of chemical imaging deep in the body (brain, central nervous system, circulatory system) we are we are tailoring our sensors to be compatible with advanced imaging techniques (diffuse in vivo flow cytometry, photoacoustics, or MRI) to image deep in the body. Ultimately, we will use the probes to image specific chemical processes and biomarkers in the brain/body, in real-time. **Student will:** Be investigating synthetic alternatives to DNA as a scaffold for our sensors. They will be designing and fabricating nanosensors composed of DNA origami shapes and investigating the impact of shape and material on the degradation in blood using HPLC. The goal is to tune the lifetime of a sensor for use in the body, so that a reliable measurement can be made before clearance of the particle. **Prerequisite skills/knowledge:** none

Heejin Jeong	**Human Systems Engineering**	**Polytechnic**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: eXtended Reality for Industrial and Occupational Supports (XRIOS) - over the past decades, XR technologies have been applied to various industries and occupational areas for maintenance, quality control, training, education, remote collaboration, and so forth. However, as workplace conditions become diverse, XR technologies should be adaptive and innovative to meet the new industrial needs. This project aims to support industrial and occupational tasks using XR technologies and perform the assessments from ergonomics and physiological perspectives. **Students will:** The primary duties include experimental prototype development (e.g., virtual objects in Unity via Oculus Quest/Pro or HoloLens), experimental design and data collection (e.g., online survey, video data, motion, and eye-tracking data), and data analysis (e.g., statistical analysis, machine/deep learning, and NLP). Students will also help write Institutional Review Board (IRB) documents, grant proposals, technical reports, and/or academic publications. The work assignment will be flexible depending on their interests and capabilities. **Prerequisite skills/knowledge:** Experience in human subject studies using experimental and physiological measurements; Experience in the use of AR/VR development platforms (e.g., Unity, Unreal Engine).

Faculty Name	Program/Expertise Area	Campus/ Worksite	Format	Student Eligibility
Heejin Jeong	**Human Systems Engineering**	**Polytechnic**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: Human-robot collaboration project - collaborative robots (or cobots) have assisted human workers in manufacturing and routine workplaces over the past years. Introducing cobots to the workplace is to maximize work performance and reduce industrial/daily accidents. However, occupational safety and trust issues must still be overcome to achieve an efficient human-robot collaboration. This project aims to explore the human-robot collaboration fluency and performance in the teleoperation of the mobile humanoid robot using an XR headset. **Students will:** The primary duties include experimental task development (via a mobile humanoid robot), experimental design and data collection (e.g., online survey, video data, motion, and eye-tracking data), and data analysis (e.g., statistical analysis, computer vision, machine/deep learning). Students will also help write Institutional Review Board (IRB) documents, grant proposals, technical reports, and/or academic publications. The work assignment will be flexible depending on their interests and capabilities. **Prerequisite skills/knowledge:** Background in statistical analysis and programming (e.g., R, SPSS, Matlab, Python, C#, ROS); background in data analytics (e.g., deep learning, computer vision, natural language processing)

Jia Zou	**Database Systems, Distributed Machine Learning Systems**	**Tempe**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**

Project Description: There are a lot of standalone data silos, e.g., medical organizations, internet operators, etc. It is important to join and union the datasets owned by these data silos and provide a unified view and high quality features in order to achieve high accuracy in AI/ML applications. However, such data integration is prohibited by various privacy concerns. To bridge the gap, we develop novel systems that integrate federated data management and federated learning on distributed data silos. The idea is to introduce a federated query optimizer to push down the learning computations to data silos and minimize the communications across the data silos that have to protected using an integration of new query optimization technology and various existing privacy-preserving mechanisms. **Students will:** Develop components of the proposed system. Read relevant literatures. Design new algorithms. **Prerequisite skills/knowledge:** C/C++ programming; or experiences in database systems; or experiences in federated learning systems/ML systems; or experiences in privacy/security.

Josh Hihath	**Electrical Engineering/Physical Electronics Nanoelectronics**	**Tempe**	**In person**	

Project description: Students would be involved in developing novel systems that are capable of measuring and controlling single-molecule level devices for electronic and sensing applications. We will work with nanoelectronic platforms that enable the measurement of single DNA and RNA sequences, and molecular memory units. **Students will:** Specific projects could include instrumentation development, including PCB layout and design, data analytics for data processing, and testing automation. **Prerequisite skills/knowledge**: Preferred to have experience in board-level circuit development and testing, LabView and python experience a plus.

Kailong Jin	**Chemical Engineering/Polymer Science and Engineering**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: Our group is currently developing future plastics with similar or better properties and improved chemical circularity compared to current polymers. One promising approach is to integrate renewable chemical building blocks with dynamic covalent chemistries (i.e., covalent bonds that can break and reform reversibly) to design sustainable polymers at the molecular level. Our primary targets are newly designed polyolefins with improved mechanical recycling efficiency and polyesters with inducible and fast biodegradability. Specifically, renewable building blocks can be derived from biomass feedstocks (e.g., algae) or waste plastics. Appropriate dynamic covalent chemistries will be selected toward targeted systems. **Students will:** Be working with Dr. Jin on synthesizing and characterizing chemically recyclable polymeric materials as well as processing these materials into 3D objects via additive manufacturing. More specifically, they will spend roughly 40% time on sample preparation, 30% time on experimental testing, and 30% time on data analysis and report in project meetings. **Prerequisite skills/knowledge:** The SURI student should have some lab experience such as wet-lab chemistries or material characterization skills.

Faculty Name	Program/Expertise Area	Campus/ Worksite	Format	Student Eligibility
Kenan Song	**Manufacturing Engineering, Polymer Science, Composites**	**Polytechnic**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: Our research focuses on (I) Advanced Materials and (ii) Advanced Manufacturing. Develop fundamental knowledge concerning (i) creation of new synthesis (nanoscale), processing (microscale), and manufacturing (macroscale) mechanisms, (ii) innovating tooling engineering design principles, (iii) manufacturing platform building-up, and, (iv) characterizing filler-matrix and device-environment interactions toward fabricating advanced nanocomposite materials and hybrid systems, where their structural features are established through bottom-up or top-down strategies and material properties are capable of matching theoretical predictions. The Advanced Materials Advanced Manufacturing Lab (AMAML) also explores the interfaces between traditional micromanufacturing and new additive manufacturing. These conventional manufacturing include machining, shredding, extruding, pelletizing, and molding. The AMAML also hosts 3D printers based on resins (stereolithography (SLA), digital light processing (DLP)), filaments (fused deposition modeling (FDM) and direct ink writing (DIW)), powders (selective laser sintering (SLS)), and inks (inkjet). PI Song and his team have been taking advantage of their expertise in materials and processing to understand manufacturing's role in supporting the circular economy. Examples include new polymers from biodegradable resources instead of petroleum, design freedoms from additive manufacturing free from limits in conventional fabrications, sustainable manufacturing with small-footprint machines that disrupt the reliance on supply chains, and new structure design lightening the weight or bearing load more efficiently, as well as solid waste recycling in hybrid manufacturing involving physics and chemistry. **Students will:** Conduct experiments or simulations regarding composites, electronic devices, sensors, actuators, and soft robotics. **Prerequisite skills/knowledge:** Engineering and basic math, chemistry and physics.

Kenneth Sullivan	**Construction, Supply Chain, Facility Management, Energy Management**	**Tempe**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: Facility performance analysis, optimization of energy management in the built environment. **Students will:** Collect data and test VR environment tool for building energy management. **Prerequisite skills/knowledge:** None - VR background and/or ML preferred.

Lalitha Sankar	**Theory and Practice of Machine Learning**	**Tempe**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: This project will involve exploring the role of federated learning in learning fair machine learning algorithms as well as post-processing techniques to ensure local fairness. **Student will:** Work on a publicly released breast cancer dataset with a strong and broad team at ASU, Stanford, and Univ. of Illinois, UC. **Prerequisite skills/knowledge**: A sound knowledge of Python, strong background in Mathematics and Statistics, as well as basic knowledge of machine learning methods is much desired.

Lalitha Sankar	**Theory and Practice of Machine Learning**	**Tempe**		**U. S. Citizen or non-U. S. Citizen**

Project description: This project will involve enhancing an existing deep learning GAN-based model for generating electric power system load data to enhance it in multiple ways. **Student will:** Work on a proprietary dataset and build on existing code. A good knowledge of electric power systems and a fascination and strong skills in data science and deep learning is essential. **Prerequisite skills/knowledge:** A sound knowledge of Python, strong background in Mathematics and Statistics, as well as basic knowledge of machine learning methods is much desired.

Lalitha Sankar/ Giulia Pedrielli	**Bayesian Machine Learning**	**Tempe**	**Virtual/ In person**	**U. S. Citizen only**

Project description: This research will focus on using Bayesian methods to enhance hyper parameter tuning methods. In this work, a prospective student will focus on tuning hyperparameters that are a part of many ML algorithms including and especially deep learning using emerging AutoML methods. **Student will:** Work closely with both faculty members on developing advanced verifiable techniques to enhance the state of the art techniques in hyper parameter tuning. Student will work closely with PhD students too. **Prerequisite skills/knowledge:** Strong knowledge of Python, ML and statistics.

Leila Ladani	**Biomedical Implants and Devices, Additive Manufacturing**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: Student will be working with experts in additive manufacturing and Mayo clinic doctors to develop metal implants for patients. This includes, mechanical testing of these implants such as tensile test, bending test and others. Additionally, students will conduct finite element analysis to evaluate stresses developed in these implants due to mechanical and biomechanical loads. **Students will:** Developing CAD models for the implants, working with metal laser printer to build implants.

Faculty Name	Program/Expertise Area	Campus/ Worksite	Format	Student Eligibility
Leila Ladani	**Additive Manufacturing, Composite Materials**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: This project is focused on developing functional composite materials with high conductivity, high strength and high ampacity. This accomplished by additive manufacturing methods. We optimize the process to create optimum materials. The project involves manufacturing and characterization of the final material. **Students will:** The student will work with concept laser metal additive manufacturing machine to build the samples. The students will then characterize the samples using different microscopy techniques.				
Madeline Andrews	**Neuroscience, Developmental Biology, Bioengineering**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: The SURI project aim is to determine optimal culture conditions for human pluripotent stem cell (PSC)-derived neuronal populations during cortical development. By defining appropriate culture conditions, we can better model features of the human brain and disease. As current neural organoid culture methods have significant metabolic limitations leading to impairments in specification and maturation, this project will evaluate the consequence of altering oxygen levels to more closely mimic endogenous brain development. The student will learn how to culture and differentiate PSC lines along a stereotypical differentiation trajectory to produce 3D cortical organoids. PSC lines will be cultured in different oxygen conditions of either 4%, 8% or 20% O2 consistently or gradually transitioned into higher oxygen conditions. After different culture paradigms, cortical organoid-derived cells will be evaluated to determine the impact on gene expression. The student will learn engineering approaches for how to culture and analyze human cell types to more accurately study human brain development with application toward a range of neurological diseases. **Student will:** Lead a project where they will learn to culture stem cells and neural cell types under sterile conditions. They will also learn how to extract RNA from those cells and run q-RT-PCR to assess gene expression changes. **Prerequisite skills/knowledge:** Some cell culture experience is preferred. Interest in neural development is important, but no specific previous knowledge is required.				
Mark Naufel/ Robb Olivieri	**Luminosity Lab**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: Student's will work alongside ASU's premier R&D Lab, Luminosity, on either an existing project they are already working on their campus or be put on one of the Lab's ongoing projects. **Students will:** The Luminosity Lab's innovative learning and research model, is aimed at providing students with the opportunity to engage in real world innovation. Luminosity utilizes a systems engineering approach to project planning and design, using the Agile methodology of project management to allow the organization to quickly handle and adapt to change. Strategic design, systems thinking, and rapid product realization are foundational to the development and deployment of ideas, tools, and technologies that provide unconventional and effective solutions to the complex challenges Luminosity tackles. Students will have the chance to learn from experts through workshops, and network with Lab members and staff. **Prerequisite skills/knowledge:** Preference will be given to students already within the Luminosity Global Network, but other students will be considered on a case-by-case basis.				
Matt Green	**Chemical Engineering**	**Tempe**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: System design and process modeling to optimize energy consumption and operating parameters for novel systems to capture carbon dioxide from the ambient air and purify based on various downstream specification requirements. **Students will:** Build and optimize process models for carbon dioxide capture systems, analyze and optimize energy consumption. **Prerequisite skills/knowledge:** Process modeling is desired.				
Meng Tao	**Electrochemistry**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: You will work on molten salt electrochemical purification to achieve solar-grade silicon. It requires background in electrochemistry and/or vacuum systems. Students who are committed to pursue a PhD degree will have priority; **Students will:** This is a hands-on project. You will receive training on molten salt silicon electrochemistry and you will work with a graduating PhD student. You will spend most time in the lab conducting experiments and analyzing data. **Prerequisite skills/knowledge:** Electrochemistry, vacuum systems.				

Faculty Name	Program/Expertise Area	Campus/ Worksite	Format	Student Eligibility
Nick Rolston	**Renewable Energy Materials and Devices; Photovoltaics; Batteries**	**Other**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: ***Title:*** Robust and Lightweight Printable Thin-Film Solid State Batteries ***Description:*** A compelling opportunity for higher energy density batteries is solid-state electrolytes (SSEs), which offer a host of advantages over the liquid electrolytes that dominate the market today: they are leak-proof, energy-dense, flame-resistant, contain no toxic organic solvents, and can charge faster. A challenge to the commercialization of solid-state batteries is the development of a stable SSE that can support the film stresses that develop from significant expansion during cycling and can be processed with low-cost manufacturing processes. The objective of this work is to two-fold: to improve the thermomechanical reliability of SSEs and to subsequently produce safe, durable, and high-specific energy solid state batteries with a robust thin film SSE. The overarching questions that will be investigated are the material (ionic and electronic conductivity) from thin-film processing of ceramic-based SSEs and mechanical properties that develop in SSEs for understanding of chemomechanical degradation modes. **Students will:** Students will learn how to make battery materials and devices from solution using printing processes and characterize them with electronic and ionic conductivity measurements. **Prerequisite skills/knowledge:** Knowledge of electrochemistry, materials science, and mechanical properties is a plus (although not required).

Nick Rolston	Renewable Energy Materials and Devices; Photovoltaics; Batteries	Other	In person	U. S. Citizen or non-U. S. Citizen

Project description: ***Title:*** Robust and Scalable Perovskite Solar Cells Produced with Open-Air Plasmas. ***Description:*** Atmospheric pressure or open-air plasmas can be directly integrated with in-line production. We have focused on using spray coating as a technique for liquid precursor delivery of numerous types of materials. We have shown that stoichiometry, composition, growth rate, density, and defectivity can be controlled through this process for chemistries such as silica, titania, tin oxide, and perovskites without additional annealing to form high-quality, scalable device layers. There is also a clear path for transparent conducting oxides, semiconducting charge transport layers, battery electrode materials, and even tandem module fabrication. This project will focus on the processing of scalable perovskite thin films and associated charge transport layers in open-air with improved operational and mechanical properties for a path toward commercializing this next-generation photovoltaic technology. **Students will:** Learn how to make photovoltaic materials and devices from solution using scalable printing processes and characterize them with mechanical and optoelectronic measurements. **Prerequisite skills/knowledge:** Knowledge of materials science and mechanical properties is a plus although not required.

Nidhin Kurian Kalarickal	Physical Electronics/Semiconductor Devices	Tempe	In person	U. S. Citizen or non-U. S. Citizen

Project description: TCAD Modeling of advanced electric field terminations for vertical ultra-wide band gap semiconductor transistors. **Students will:** Field terminations are essential components of vertical transistors enabling breakdown voltages to approach near 1-D theoretical limits. Due to lack/difficulty of p-type doping in ultra-wide band gap semiconductors like Ga2O3, new field termination designs and approaches are necessary. In this project, the student will look at the termination efficiency of novel field termination designs using TCAD based 2-D device modeling. **Prerequisite skills/knowledge**: Students in electrical engineering, materials science or physics. Should have completed a course on semiconductor devices.

Nidhin Kurian Kalarickal	Physical electronics/Semiconductor devices	Tempe	In person	U. S. Citizen or non-U. S. Citizen

Project description: Investigation of pre and post annealing treatments for low defect density dielectric interfaces in -Ga2O3. **Students will:** Dielectric interfaces with low density of interface traps are necessary for reliable operation of lateral field effect transistors in -Ga2O3. In this project, the student will look at annealing treatments performed both pre and post deposition of gate dielectric using ALD as well as post gate metallization. The objective of the project is to find the optimal anneal condition in terms of temperature and process gas that can provide the lowest interfacial trap density in -Ga2O3 MOSCAPs. **Prerequisite skills/knowledge:** Students in electrical engineering, materials science or physics. Should have completed a course on semiconductor devices.

Pat Phelan	Energy Efficiency & Thermal Engineering	Tempe	In person	U. S. Citizen or non-U. S. Citizen

Project description: The ASU Industrial Assessment Center (https://iac.engineering.asu.edu/) provides free energy efficiency audits to qualifying manufacturers, commercial buildings, and water treatment facilities. These audits involve on-site visits and extensive analysis of energy, greenhouse gas emissions, and cost savings for potential energy efficiency improvements. Training will be provided. **Students will:** The students will be trained in energy efficiency assessments and will participate and (hopefully) lead energy efficiency assessments as part of an extensive team. Additional related research opportunities will be identified, and the student will have the opportunity to engage in additional research. **Prerequisite skills/knowledge:** Any undergraduate engineering student with a strong interest in energy efficiency and carbon reductions is eligible.

Faculty Name	Program/Expertise Area	Campus/ Worksite	Format	Student Eligibility
Rakibul Hasan	**CS/Privacy and Security**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: The aim of this project is to identify the privacy and security threats posed by technologies used in educational contexts, such as learning management systems and remote tutoring/proctoring apps. **Students will: W**ork in collecting and analyzing data from online sources. **Prerequisite skills/knowledge:** Good programming/data analysis skills. Knowledge of statistical methods is a plus.

Ram Pendyala	**Civil, Environmental, and Sustainable Engineering**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: The project involves analyzing transportation data sets and understanding travel patterns of residents in different socio-economic groups and communities. **Students will:** Analyze data and prepare statistical summaries and charts of trends and patterns in the data. **Prerequisite skills/knowledge**: Basic knowledge of working with data in Excel and statistics would be desirable, but not required.

Ravi Yellavajjala	**Metal Additive Manufacturing**	**Tempe**	**In person**	**U. S. Citizen only**

Project description: The goal of the research project is to additive manufacture steel connections (castings) that will accelerate the modular construction of steel buildings and bridges. The modular construction of steel structures using castings reduces the structural weight, construction time, and erection costs. Steel castings also offer exceptional architectural freedom and high seismic and blast resistance. However, they are often large and geometrically complex, hence traditional mechanical testing is not commonly feasible, which prevents structural engineers from exploring their full potential. We will address some of these issues in this project. **Students will:** The student will be responsible for a literature review in the first 2 weeks, designing a novel steel connection in 2 weeks, 3D printing the connection in one week, and performing mechanical testing of the connection in one week. The student is expected to submit a report at the end of the visit. **Prerequisite skills/knowledge:** Creativity, imagination, willingness to learn, civil/ mechanical engineering background and familiarity with a 3d modeling software.

Rebecca Muenich	**Water Quality, Nutrients**	**Tempe**	**Virtual/ In person**	**U. S. Citizens or non-U. S. Citizen**

Project description: Mapping and digitization of pollutant sources in the landscape. **Students will:** Work on a range of digital work, from GIS to remote sensing, to data analysis. **Prerequisite skills/knowledge:** prefer students to have experience with programming (R, Matlab, Python, etc.) and/or geospatial software (ArcGIS, QGIS, google earth engine, etc.).

Rong Pan	**Digital Manufacturing, Data Analytics & Machine Learning**	**Tempe**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: The project is about to build and validate a cyber-coordinated analytical platform for the efficient scale-up of a future manufacturing. A digital twin of physical system is envisioned, which can synthesize, analyze and predict manufacturing system performance via cloud-edge computing. **Students will:** A student will be assigned the task of building a digital model of 3D printer, taking parameter readings of both the machine and its environment to predict the production efficiency. Another student will be assigned the task of machine learning with physics-informed neural networks (PINNs) or Gaussian processes (GPs), which are basically a data-driven approach to approximating partial differential equation solutions. **Prerequisite skills/knowledge:** The first task could be done by an undergrad or grad, better in mechanical, aerospace, industrial or system major. It requires the student could participate in person. The second task needs a grad student, with strengths in python programming and ML/AI knowledge. It can be done in a remote mode.

Sarah Stabenfeldt	**Biomedical Engineering**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**

Project description: Traumatic brain injury affects millions of people each year. The Stabenfeldt lab develops novel strategies to deliver small molecule drugs to the injured brain - including nanoparticle therapeutics. The project will center around current efforts to characterize blood-brain barrier disruption and drug delivery pharmacokinetics from nanoparticle systems. **Student will:** Wet lab techniques that range from nanoparticle fabrication, protein assays, and immuohistochemistry analysis. **Prerequisite skills/knowledge:** No prerequisites - only ask that there is a curiosity to learn hands-on wet laboratory skills applicable to the biomedical engineering field.

Faculty Name	Program/Expertise Area	Campus/ Worksite	Format	Student Eligibility
T.-W. Lee	**Mechanical and Aerospace Engineering**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: Involve students in analytical/computational study of spray cooling. We have developed a unique and powerful method to simulate complex flows, by incorporating theoretical advances in spray atomization. This allows for fast and efficient computations of spray flows in any injection geometries with appropriate modifications. I have worked with Brno University of Technology on spray cooling applications, and this opportunity will serve well to enhance collaboration by directly immersing their graduate student(s) in this work. **Students will:** Modify the current computational protocol/algorithm for spray cooling geometry. Optimize the heat transfer analysis components. Compare with Brno university lab's experimental data. **Prerequisite skills/ knowledge:** Math, engineering knowledge of convection heat transfer, basic knowledge of turbulent flows and simulation methods.				
Vidya A. Chhabria	**Machine Learning (ML) Applications in Electronic Design Automation (EDA)**	**Tempe**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: The project aims to build novel ML-based solutions for very large-scale integrated circuits (VLSI) design automation. The project will explore the applications of deep neural networks (DNNs) in the areas of timing analysis, gate-level optimization, and power estimation. **Students will:** Develop software and explore various DNN models using PyTorch/Tensorflow for the above applications. **Prerequisite skills/knowledge:** Proficiency in python programming and basic knowledge of digital circuit design and machine learning is necessary. Prior experience in VLSI design automation, Cadence physical design tools, and building DNNs in PyTorch/Tensorflow is a plus.				
Xiangfan Chen	**Additive Manufacturing, Composite**	**Polytechnic**	**In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: Design, print, and test of bio-inspired nanocomposites with superior mechanical properties and thermal conductivity. **Students will:** Manufacturing platform assembly. **Prerequisite skills/knowledge:** Engineering in manufacturing or mechanical.				
Xiangfan Chen	**Additive Manufacturing (Machine Learning, Data-Driven Optimization)**	**Polytechnic**	**In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: Developing machine learning approach to accelerating the discovery of additive manufacturing materials with optimal trade-offs in mechanical performance, and design gradient materials. **Students will:** Be working on machine learning approach to accelerating the discovery of additive manufacturing materials with optimal trade-offs in mechanical performance. **Prerequisite skills/knowledge:** Mechanical Engineering, machine learning				
Xiao Wang	**Synthetic Biology, Systems Biology**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: Gene circuit construction, RNA design and testing, and microbial consortia construction, genome engineering. **Students will:** One of the topics listed above that suits student's background and interests. **Prerequisite skills/knowledge:** At least BS in biology, math, physics, or related fields				
Xusheng Xiao	**Computer Security, Software Engineering**	**Tempe**	**Virtual/ In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: We are currently recruiting students to help out with the research project that focuses on building knowledge base of cyber threat intelligence (CTI). We are collecting online articles of CTI and have developed techniques to automatically cluster these articles and build knowledge graphs of these articles. The built knowledge base can support security applications such as attack campaign discovery and attack step summary. **Students will:** The recruited students will help collect open source data of CTI articles and help with the data analysis to build the knowledge base. **Prerequisite skills/knowledge:** Knows Python or Java and data mining/machine learning techniques				
Yan Shoshitaishvili	**Cybersecurity**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: The project will explore novel cybersecurity issues in real-world software and systems. Project phases will include the analysis of both source code and compiled binaries for vulnerabilities and, once vulnerabilities are identified, the creation of Proof of Concept exploits to demonstrate the severity of each flaw. This information will be responsibly disclosed to software authors for remediation. **Students will:** Develop tools to analyze software and then manually analyze the results of those tools. Prerequisite skills/knowledge: The students should have expertise in software security and program analysis. The concepts taught by https://pwn.college are well-aligned with this project.				

Faculty Name	Program/Expertise Area	Campus/ Worksite	Format	Student Eligibility
Yong-Hang Zhang	**Semiconductor Optoelectronics, Solar Cells, Photodetectors, LEDs and Lasers**	**Tempe**	**In person**	**U. S. Citizen or non-U. S. Citizen**
Project description: We have several on-going federal funded large research programs. The research areas include Si photonics, solar cells, IR photodetectors, and materials research for future quantum electronic and optoelectronic devices. We also have several on-going programs funded by domestic industrial sponsors to address use-inspired device applications. Our research is very well aligned with industrial needs and real-world challenges. We're looking for several self-motivated PhD students with excellent academic records and enthusiasm to take on all these challenges. **Students will:** Mainly experimental work in well-equipped labs. More details can be found here: https://mbe.engineering.asu.edu/. **Prerequisite skills/knowledge:** Solid knowledge of semiconductors or solid-state physics. Hands-on experience in electrical engineering will be a big plus.				