COLLEGE OF ENGINEERING AND SCIENCE

DESIGN + RESEARCH CONFERENCE 2023

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WELCOME

I'm excited to welcome you back to the College of Engineering and Science Design and Research Conference!

Over the course of the conference, you'll have the opportunity to see first-hand what our students are capable of, beginning in their first year with Louisiana Tech. I invite you to join us for the Living with the Lab and Living with Cyber exhibitions, on Thursday, May 4, as well as our senior projects, which will be presented on Friday, May 5.

As you make your way through the presentations, you'll have the opportunity to engage with our students directly. I encourage you to do so. Many of you completed these same types of projects during your time as COES undergraduates and will undoubtedly remember the excitement that you felt presenting your work to professionals at the expos.

Interacting with the students will also give you the opportunity to see how your support has shaped their educational experiences. During the conference, you'll be able to learn about the innovative solutions they have developed for real-world problems, watch them demonstrate prototypes, and hear how they addressed problems you may encounter in your own fields.

Our faculty and students have worked extremely hard to create a fun, professional experience for you. I'm grateful for your attendance and hope you enjoy the conference.

Hisham Hegab, Ph.D.
Dean, College of Engineering and Science,
Max Watson, Sr., Professor

DIRECTORY OF PRESENTATIONS

BIOMEDICAL ENGINEERING

1:00 IESB 224

MODIFIED INTERNAL PELVIC FIXATOR PEDICLE SCREW

Internal pelvic fixators (InFix) are used to treat open-book pelvic fractures, a life-threatening phenomenon usually caused by car accidents. Pelvic fractures are expected to affect more than three million people each year by 2025. This project focuses on redesigning a pedicle screw for internal pelvic fixator surgery to address the limitations of the current system. Not all patients require the device to be at the same depth and angle, and it currently cannot be changed once implanted. This device will allow more adjustability to the angle and distance of the system during surgeries. This adjustability will allow more patients to be treated without experiencing further health complications from a life-saving device.

Team Members: John Daigre, Jeanne Dugas, Hannah Folse, Felicity Watkins
Sponsors: Dr. Giovanni Solitro, Louisiana State University Health Sciences Center - Shreveport
Advisor: Dr. Bryant Hollins

1:30 IESB 224

VITALITY HEALTH SYSTEM

The WHO and CDC estimate 11,000 annual deaths and hospitalizations attributed to heat-related illness. Those in physically demanding jobs, such as blue-collar or construction work, are especially at risk. Modern tools, such as wet bulb globe temperature thermometers, are used to define workplace policies that reduce incidences of hyperthermia, but these policies overgeneralize the worker-to-worker differences in aspects like core temperature. The Vitality Health System (VHS) is a wearable device that monitors core temperature and environmental factors related to hyperthermia in hot and humid environments to assess the risk of heat-related illness on a patient-by-patient basis and provide feedback to alert the user of their current health state. VHS is designed to be attached to hard hats and used by laborers (linemen and construction workers) but can be adapted to other areas such as sports.

Team Members: Benjamin Butter, Ethan Coker, Connor Haskins, Matthew LeBlanc
Sponsor: Dr. Randy Aldret, Edward Via College of Osteopathic Medicine, Louisiana
Advisor: Dr. Steven Jones

2:00 IESB 224

DEBRIS EJECTING KERRISON RONGEUR

Kerrison rongeurs are used by neurosurgeons to bite and remove small bone fragments from the skull and vertebral column. After each bite, the device must be cleaned manually by medical personnel before it can be used again. Manual cleaning may include the removal of debris such as bone fragments and tissue by hand. In this project, we aim to redesign the Kerrison rongeur by adding a self-cleaning mechanism that increases debris removal efficiency to decrease the tedious effort required from surgeons and other medical staff.

Team Members: Ivy Dugas, Tyler O'Con, Allie Smith, Sofia Urbina
Sponsor: Dr. Jamie Toms, Louisiana State University Health Sciences Center - Shreveport
Advisor: Dr. Teresa Murray

2:30

BREAK

BIOMEDICAL ENGINEERING

3:00 IESB 224

RETRIEVAL OF LARGE POLYPS (ROLPS) DEVICE

Around 15 million colonoscopies are performed each year in the United States to find and remove small clumps of cells, called polyps, from the colon. Roughly 40 percent of polyps found during colonoscopies are too large to be removed without increasing the time and risks for the procedure. The ROLPs device compresses polyps after they have been cut from the colon wall. The device is designed to pull polyps through the colonoscope so that the colonoscope does not have to be pulled out of the patient and reinserted for each polyp. Pulling the polyps through the colonoscope decreases the amount of time it takes to retrieve the polyp and increases the success rate for retrieving the entire polyp.

Team Members: Grace Cain, Adam Elsner, Elisha Olagbami, Bethany Williams
Sponsor: Leonel Lacayo, MD
Advisor: Dr. Louis Reis

3:30 IESB 224

THE ADULT QUE AROMATHERAPY NECKLACE

Anxiety disorders are among the most common mental health disorders in the United States. More than 30 percent of the population experiences these disorders at least once in their lifetime. The QUE Aromatherapy Necklace is a device that releases a calming scent in response to an increased heart rate. The scent release relieves anxiety symptoms by triggering the connection between the limbic system and the olfactory bulb.

Team Members: Gifford Courtney, Tyler Hight, Camryn Petrus, Daniel Prado
Sponsor: Dr. Cindy Bimle, MD
Advisor: Dr. Louis Reis

4:00 IESB 224

QUE AROMATHERAPY NECKLACE FOR CHILDREN WITH ATTENTIONAL ISSUES

According to the Centers for Disease Control and Prevention, approximately 62 percent of children from the ages of 2 to 17 that are diagnosed with ADHD take prescription medication. These medications can cause undesirable side effects that can affect children into their adult lives. The Que Aroma Therapy device is being proposed as an alternative treatment that will offer a therapeutic option to help attentional disorders to support positive behaviors and discourage negative behaviors. The aromas will be provided by separated scent chambers that include user-associated negative and positive scents. The device will be remote-controlled by a guardian, educator, or therapist. Additionally, the positive scent will be a "que" to continue a specific behavior on a constant interval. The negative scent will be released through a remote control to help redirect unwanted behaviors. The Que Aroma Therapy device will help decrease stress in children and avoid the undesirable side effects that current treatment offers.

Team Members: Alyssa Miller, Kinslee Spatafora, Melanie Tircuit
Sponsor: Dr. Cindy Bimle, MD
Advisor: Dr. Louis Reis

4:30 IESB 224

FEEDBACK SESSION WITH ADVISORY BOARD

CHEMICAL ENGINEERING

1:00 IESB 212

PRODUCTION AND OPTIMIZATION OF AMMONIA, UREA, AND AMMONIUM NITRATE

Using a simulation program, a chemical plant process to produce ammonia, urea, and ammonium nitrate was created. These products are used as components in fertilizer that help support agriculture. These teams researched production processes for all of these components to find data containing the operating conditions needed to simulate the process accurately. Each team established a base case using the methods found in the literature and set the net present value (NPV) to carry out each production. They then created various optimizations of the base case process to establish the optimal conditions that will increase the net present value of the plant to its highest potential.

Team Members: Jesutomisin Ajayi, Kaley Fontenot, McKenzie Walker
Advisor: Dr. James Palmer

1:30 IESB 212

DESIGN AND OPTIMIZATION OF AN INDUSTRIAL-SCALE FERTILIZER PLANT

On February 24, 2022, the Russian invasion of Ukraine resulted in the closure of a 2.5 million metric ton/year ammonia pipeline. This caused ammonia prices – which were already elevated – to increase even further. Around 70 percent of the ammonia produced globally is used to create fertilizer, meaning this pipeline closure could impact food availability across the world. In response to this metric, our group has been tasked with designing a 1.2 million metric ton/year synthetic ammonia plant. Additionally, we have designed downstream plants that synthesize urea and ammonium nitrate from the ammonia precursor. These compounds are among the most widely used nitrogenous fertilizers, with each having its own uses. Applying the principles of chemical engineering practice, our team has optimized our ammonia and fertilizer plants to be profitable, safe, and environmentally responsible.

Team Members: Kyle Deas, Brady Duplessis, Ethan Millet
Advisor: Dr. James Palmer

2:00 IESB 212

ECONOMIC EVALUATION OF UREA AND AMMONIA NITRATE PRODUCTION

For this project, we designed a chemical plant that uses syngas to produce ammonia, which will then be used for making the desired products: urea and ammonia nitrate. We then performed optimizations to maximize revenue and NPV for a realistic plant operation.

Team Members: Matthew Guillot, Lucas Lanier, Timm McNeese
Advisor: Dr. James Palmer

CHEMICAL ENGINEERING

2:30 IESB 212

FERTILIZER PLANT

Aiming to take advantage of fluctuations in the fertilizer market due to the Ukraine-Russia Conflict, our team was tasked with designing a plant that produces urea and ammonium nitrate from natural gas, nitric acid, and air. Natural gas and air are used to produce syngas (a mixture of nitrogen and hydrogen), which is fed to our ammonia plant. Our intermediate, ammonia, is then split into two streams. One stream is fed to our urea plant, and the other is fed to our ammonium nitrate plant. We determined the split ratio by whichever split maximized our profit. Our syngas plant produces a large amount of a harmful byproduct, carbon dioxide. In order to reduce its environmental impact, we use the syngas carbon dioxide product stream to feed our urea plant. We then optimized all three plants (ammonia, ammonium nitrate, and urea) to maximize our overall profit.

Team Members: Caylee Collier, Rose Emery, Cameron Folse
Advisor: Dr. James Palmer

3:00 IESB 212

SYNTHESIS AND OPTIMIZATION OF AMMONIA, AMMONIUM NITRATE, AND UREA PROCESSES

Ammonia, ammonium nitrate, and urea are the main components of nitrogen-based fertilizers. Russia and Ukraine are major exporters of fertilizers and as the war between these two countries continues, the supply decreases. The introduction of a United States-based fertilizer plant would mitigate the impact of the loss of Ukrainian and Russian fertilizers. Louisiana Tech Chemical Engineering students were asked to design a process that produced 1.2 metric tons per year of ammonia from synthetic gas. The ammonia was then used to form both ammonium nitrate and urea. The process was designed and simulated using ChemCAD and was costed in Excel with equations developed by Turton, Schaeiwitz, Bhattacharyya, and Whiting (2018). Research was done to find reaction rates, kinetics, and thermodynamics to validate each process. Optimizations were done to improve the overall process.

Team Members: Haeleigh Galliand, Ryan McKamie, Jasmine Sikand
Advisor: Dr. James Palmer

CHEMICAL ENGINEERING

3:30 IESB 212

SYNTHESIS AND ECONOMIC OPTIMIZATION OF AMMONIA AND UREA PRODUCTION PROCESSES

Ammonia and urea are two necessary constituents of nitrogen-based fertilizers. In 2022, Russian forces invaded and occupied parts of Ukraine. These two countries are major suppliers of both components in the global market, and, while the war rages on between them, the export of ammonia and urea decreases. In an effort to combat this rising issue, Louisiana Tech Chemical Engineering students were tasked with designing a process that produced 1.2 metric tons of ammonia per year from synthetic gas (syngas) containing the carbon and nitrogen necessary for the reaction. This syngas was created from natural gas through methane steam reforming while the nitrogen is created by separating it from the air. These two components are combined and are then sent to the ammonia process as syngas. This ammonia product was sent to the urea process along with carbon dioxide captured from the syngas production process. Research was conducted to determine the necessary kinetics and thermodynamics to validate these models. These processes were modeled using ChemCAD software, optimized using Microsoft Excel, and priced using equations from Turton, Schaeiwitz, Bhattacharyya, and Whiting (2018).

Team Members: Panayiotis Loizou, Leevi Morris
Advisor: Dr. James Palmer

1:00 IESB 214

THE PRODUCTION/OPTIMIZATION OF NITROGEN-BASED FERTILIZER PLANTS

Given a general simulation model for an ammonia syngas plant, we constructed and validated an ammonia synthesis plant to produce 1.2 million metric tons of ammonia to send to an ammonium nitrate and a urea plant. After we successfully design and validated an ammonia plant, ammonium nitrate plant, and urea plant, we conducted an economic analysis of the systems to determine the overall net present values of each process. Once we completed the accurate economic analysis, we implemented process optimizations to increase the economical net present value of each system. Using a benchmark of 1.2 million metric tons of ammonia production, we calculated the raw material, revenue, utility, and operating costs, along with the fixed capital costs for the equipment involved in each of the processes. We also calculated adequate sizing and costing values using values directly outputted from the ChemCAD simulation models for each of the systems. In addition to the economic analysis and process optimization, we analyzed environmental and process safety impacts to conclude the project.

Team Members: Paul Macip, Grace Tichenor, Abigail Turner
Advisor: Dr. James Palmer

CHEMICAL ENGINEERING

1:30 IESB 214

PRODUCTION OF AMMONIA, UREA, AND AMMONIUM NITRATE FOR THE THRIVING FERTILIZER INDUSTRY

For this project, we created an industrial-grade fertilizer plant that produces ammonia, urea, and ammonium nitrate while prioritizing safety, sustainability, and cost-effectiveness. Our team has developed a comprehensive model of the plant, analyzed the chemical processes, and determined the optimal operating conditions. We have considered various factors, such as the cost of raw materials, energy, labor, and the environmental impact of the plant's operation. Our team has balanced these factors to optimize the plant's operation, ensuring that it operates efficiently and sustainably. We have also prioritized safety, minimizing the risk of CO_2 impact that could harm the environment. This project has provided valuable insights into the production of industrial-grade fertilizers while addressing the growing demand for sustainable and cost-effective fertilizers.

Team Members: Aaron Dougherty, Brennan O'Laughlin, Keith Watson
Advisor: Dr. James Palmer

2:00 IESB 214

AMMONIUM NITRATE AND UREA SYNTHESIS FROM NATURAL GAS

Natural gas is a naturally occurring fossil fuel that is composed primarily of methane (CH_4), along with small amounts of other hydrocarbons and impurities. Ammonia syngas, a mixture of hydrogen gas and carbon monoxide, is a crucial feedstock to produce ammonia, a derivation from natural gas. The production of ammonia syngas involves a complex series of steps, including gasification, purification, and compression. This process requires advanced technologies, expertise in chemical engineering and chemistry, and a commitment to sustainability and safety. The production of ammonia involves an intricate process known as the Haber-Bosch process. The team utilizes ammonia as a feedstock to produce nitric acid, urea, and ammonium nitrate. The production of ammonium nitrate is a multifaceted and highly controlled process that requires a deep understanding of chemistry and engineering. Ammonium Nitrate as a fertilizer provides essential nitrogen to crops and helps to increase yields and improve crop quality. Urea is a nitrogen-containing organic compound that is widely used as a fertilizer in agriculture. Despite its environmental and energy challenges, the production of urea remains a critical process for meeting the growing demand for food and other products around the world.

Team Members: Christopher Cambre, Brennan Hebert, Grace Landry
Advisor: Dr. James Palmer

CHEMICAL ENGINEERING

2:30 IESB 214

SOLUTION TO THE FERTILIZER CRISIS: AMMONIA, AMMONIUM NITRATE, AND UREA

Because of the war in Ukraine, fertilizer has become drastically more expensive. Why? Russia is the world's second-largest ammonia producer. In our presentation, we propose a solution to this issue. We have simulated, cost out, and justified four different production plants for different products - the first of which is taking natural gas and turning it into syngas. Next, we worked to take syngas and turn it into ammonia. Third and fourth, we took ammonia and turned it into different fertilizers, urea, and ammonium nitrate.

Team Members: Noah Beeson, Sean Caffery, Aaron Robinson
Advisor: Dr. James Palmer

3:00 IESB 214

DESIGN AND SYNTHESIS OF NITROGEN-BASED FERTILIZER PROCESS

The ongoing instability caused by the Russia-Ukraine war has led to a decline in the production of fertilizer and has increased the price of fertilizer worldwide. Nitrogen-based fertilizer is commonly made with a base component of ammonia; for this project, we focused on two common fertilizer products: ammonium nitrate and urea. Louisiana Tech Chemical Engineering students were tasked with designing ammonia, urea, and ammonium nitrate facilities to increase global fertilizer production. The ammonia plant must produce 1.2 million metric tons which will then be split into urea and ammonium nitrate plants, respectively. We designed the process using Microsoft Excel and ChemCAD, along with research completed to find kinetics and thermodynamics for each respective process. Once we created the process, we completed optimizations by changing raw material feeds, equipment costs, and materials chosen. We will present process hazards, economics, and overall systems.

Team Members: Caroline Jones, Meghan Nash, Adrienne Talbot
Advisor: Dr. James Palmer

CHEMISTRY

1:00 IESB 318

EXTRACTION AND CHARACTERIZATION OF SUGARS FROM BIOMASS USING DEEP EUTECTIC SOLVENTS

Climate change is a pressing issue that could soon lead to major problems for the global environment. Finding cleaner alternatives to traditional fuel sources can mitigate some of these effects. Biofuels are among the alternatives that researchers have focused on in recent years. Biofuels are made from biomass and are more carbon neutral than fossil fuels. The focus of this project is to isolate sugars from rice husks, sugarcane bagasse, and coffee chaff for use in biofuel synthesis. Using hydrothermal carbonization (HTC), researchers can separate the cellulose and hemicellulose from the lignin present in the biomass. To further extract specific sugars, a 2:1 acetic acid/choline chloride, a 10:1 lactic acid/choline chloride, or a 1:1 formic acid/choline chloride deep eutectic solvent (DES) is used as the solvent within the HTC process. Using high-performance liquid chromatography (HPLC), we successfully extracted glucose, galactose, and fructose from the biomass samples.

Team Member: Daniel L. Morris
Advisor: Dr. Joan Lynam

1:15 IESB 318

INVESTIGATION OF FLUORINATED ANIONS ENCAPSULATED BY CYANOSTAR USING NMR SPECTROSCOPY

Fluorinated anions are infamous for their utility as ligands to transition metal and lanthanide ions, as well as their persistence in the environment. By electrostatically binding with anions, size-selective macrocyclic ionophores effectively isolate anions from solution, allowing for a potential means of environmental remediation. Previously, we investigated the binding of 1,1,1,5,5,5-hexafluroacetylacetone (hfac) with the five-fold symmetric macrocycle Cyanostar (CS), which uses weak C-H bond donors to complex anions. Here, unusual 1H and 19F spectroscopic signatures for hfac in chloroform were observed as the alkene signal diminished at low concentrations and reappeared at high concentrations. We investigated the effect of solvent systems on the binding of fluorinated carboxylate anions by studying CS binding in chloroform, methylene chloride, and tetrahydrofuran. These studies will be conducted using 1H and 19F nuclear magnetic resonance (NMR) spectroscopy, and crystallographic data and infrared spectroscopic data will be used for comparison. From these findings, we can determine how CS binds fluorinated organic anions and whether decomposition, chemical exchange, or solvent effects affect the NMR spectrum. These results will assist others in investigating the binding of fluorinated species with macrocycles, and provide insight into the solution behavior of fluorinated species.

Team Members: Spencer Stelly
Advisor: Dr. Elisabeth Fatila

CHEMISTRY

1:30 IESB 318

EFFECTS OF ARGININE ON THE ANTIMICROBIAL ACTIVITY OF AMPS

The recent increase in multidrug-resistant bacteria poses a serious threat to public health. A promising alternative to combat antibiotic resistance is the use of antimicrobial peptides (AMPs). The most promising AMPs are those with shorter sequences and a cationic charge because they more easily bind to and penetrate the anionic cell membrane of target cells. Although AMPs tend to be less toxic than antibiotic therapeutics, they are still promising given their broader range of activity and lower potential for resistance evolution. To determine if the addition of cationic residues would increase antimicrobial activity, we added two arginine residues to the N-terminus (RRWLRRIKAWLRR [2(Arg)-RR] and RRWLRRIKAWLRRIKA [2(Arg)-RIKA]) of two recently characterized AMPs (WLRRIKAWLRR [RR] and WLRRIKAWLRRIKA [RIKA]). We then synthesized the modified peptides using solid-phase peptide synthesis and evaluated them for antimicrobial activity against Escherichia coli and Staphylococcus epidermidis using a minimal inhibitory concentration (MIC) assay. In this study, 2(Arg)-RR and 2(Arg)-RIKA demonstrated less antimicrobial activity with MICs that are 2-3x higher than observed by RR and RIKA. We believe this decrease in toxicity is due to a reduced ability of the peptides to destabilize the bacterial membrane and can be attributed to their hydrophobic profiles.

Team Member: Samantha Townsend
Advisors: Dr. Scott Poh and Dr. Rebecca Giorno-McConnell

1:45 IESB 318

UTILIZATION OF MECHANOCHEMISTRY FOR COMPLEXATION OF LANTHANIDES WITH INSOLUBLE POLYPYRIDYL LIGANDS

With the rising financial and environmental costs associated with solvent usage, more sustainable methods for conducting chemical reactions have been sought out. Mechanochemistry is a facet of green chemistry that can reduce the amount of solvent required for a reaction. Additional benefits of mechanochemistry include the discovery of compounds that are inaccessible through conventional solution synthesis and the ability to react with compounds that are insoluble. Using manual grinding via mortar and pestle as well as ball-milling, we determined the scope of mechanochemical coordination reactions with insoluble polypyridyl ligands. We followed the reactions using powder x-ray diffraction and Fourier-transform infrared spectroscopy and determined purity using differential scanning calorimetry. We obtained single crystal structures when possible and compared them to the bulk material. For further studies, we will include in situ monitoring of these mechanochemical reactions.

Team Member: Natalya O'Haver
Advisor: Dr. Elisabeth Fatila

CHEMISTRY

2:00 IESB 318

DETERMINATION OF PAH CONCENTRATION IN SOIL SAMPLES USING FLUORESCENCE SPECTROSCOPY

Polycyclic aromatic hydrocarbons (PAHs) are simple nonpolar compounds that are the result of energy production via the burning of organic compounds. The nonpolar characteristics of these polycyclic aromatic hydrocarbons make them liposoluble compounds. Absorption of PAHS by the human body through ingestion, inhalation, or dermal contact can lead to a variety of health problems, ranging from relatively minor symptoms such as dizziness and nausea, to things much more serious such as liver failure. With these effects, it is important to monitor PAH concentrations to protect the health of humans, as well as the conservation of ecosystems. Soil samples were collected from Baton Rouge and Ruston, Louisiana, and then analyzed via fluorescence spectroscopy. This analysis gave extremely low-intensity values for fluorescence at 400 nm and 424 nm, values so low that the calibration curves created using standard solutions with known PAH concentrations could not compute a concentration value. It was determined that this was due to the samples being collected in rural areas in each city that did not possess any industrial presence as well as fewer vehicles in transit, resulting in either no or minimal PAH accumulation in the soil.

Team Member: James Walker Hankinson
Advisor: Dr. Sven Eklund

2:15 IESB 318

BREAK AND PROGRAM AWARDS

2:30 IESB 318

ASSESSING POLYMERIC MEMBRANES FOR STYRENE OUTGASSING PREVENTION IN CIPP

We evaluated various polymeric membranes to use in cure-in-place pipeline (CIPP) liner storage for manufacturing facilities, as well as during refrigerated shipment to prevent the release of styrene outgassing, which can pose acute exposure hazards at levels of 80 ppm or more. To determine the rate of permeation, outgassing was measured through specially prepared glass vials, which were divided by the polymeric membranes into two chambers. We infused the chamber below the membrane with styrene monomer and sampled the gaseous atmosphere above the membrane. We injected the sample into a gas chromatograph with a flame ionization detector (FID) and calculated the permeation rate over 15 days by sampling the vial. We then created calibration curves by utilizing styrene monomer dissolved in benzene. Furthermore, we took scanning electron microscopy (SEM) porosity measurements on the membranes to establish a correlation between permeation rates.

Team Member: Mark Hesser
Advisor: Dr. Sven Eklund

CHEMISTRY

2:45 IESB 318

SYNTHESIS AND CHARACTERIZATION OF FRONTALLY POLYMERIZED GEOPOLYMER CEMENT WITH ORGANOSILANE CROSSLINKERS

Ordinary Portland cement (OPC) is one of the most widely used construction materials. OPC is produced by heating limestone ($CaCO_3$) to produce calcium oxide (CaO) and carbon dioxide (CO_2). Thus, OPC production causes the release of large quantities of CO_2. Our research focuses on a sustainable alternative to OPC, which is class-F fly ash-based geopolymer cementitious (GPC) material. Making geopolymer (fly ash, NaOH, and Na_2SiO_3) currently requires continuous heating at 70°C for five hours in an oven. In this research, we attempt to eliminate the oven by producing heat through the frontal polymerization (FP) process. For our experimentation, we blended inorganic geopolymer materials with an organic monomer (MMA), crosslinker (TMPTA), solvent (DMSO), and an initiator (Aliquat persulfate) to produce cement material through thermal FP. Through the thermal FP, heat was applied on a single spot or surface long enough to initiate polymerization and then removed. This novel cementation process serves as a rapid repairing material in construction operations and may open the possibility of new 3-D printable cementitious material. However, in the current frontally polymerized GPC (FPGPC), no chemical bonding exists within the inorganic and organic components. Studies have shown that the inclusion of organosilane has the potential to create a crosslink between the inorganic and organic components of FPGPC. We expect these organo-silane crosslinkers to improve the bonds between the organic polymers and inorganic GPC. We will use IR and NMR spectroscopy plus a compression testing device to test and evaluate the results and ensure bonding and the newly produced cementitious material's compressive strength compared to the regular OPC.

Team Member: Adam Soileau
Advisors: Dr. Sven Eklund and Dr. Shaurav Alam

3:00 IESB 318

DISCOVERY OF NOVEL CENTRIFUGAL THIN LAYER CHROMATOGRAPHY REVERSED STATIONARY PHASE

Centrifugal thin-layer chromatography (CTLC) is a useful process for the separation and purification of biologically active molecules from natural product extracts. Presently, the only commercial discs used for CTLC separations are made of silica gel with a water-soluble gypsum binder. This type of disc can only be used for normal phase chromatography, which limits the types of molecules that can be separated. The availability of reversed phase chromatography discs would offer the ability to separate a wider range of molecules, which include many nonpolar natural product extracts. In this research, we have studied the use of 3-methacryloxypropyltrimethoxysilane (MPTMS) to improve the bonding between silica particles. The particles were further functionalized with octyl silane (C8) to make the particles nonpolar for reversed-phase CTLC. The particles were characterized through FTIR, SEM, DLS, and CNMR.

Team Member: Jacquelin LaBerteaux
Advisor: Dr. Sven Eklund

CHEMISTRY

3:15 IESB 318

ISOLATION OF MAGNOLIA GRANDIFLORA PARTHENOLIDE VIA REVERSED PHASE FLASH CHROMATOGRAPHY

Parthenolide is a sesquiterpene lactone used in drug research due to its uses in treating many ailments such as fevers, migraines, arthritis, etc. The natural product is commonly extracted from the feverfew plant (Tanacetum parthenium L.), and, more recently, from magnolia leaves (Magnolia grandiflora), which have a higher concentration of parthenolide than feverfew and are in large abundance in Louisiana. In this study, we obtained parthenolide from magnolia leaves from a previously optimized Soxhlet extraction using 95 percent ethanol for two hours. We then separated the extraction products using a C-18 flash chromatography column with a 45/55 percent water/acetonitrile mobile phase and collected them in 30-second intervals. Each extraction fraction was then dried, and the products were characterized using FTIR and NMR spectroscopy.

Team Member: Natalie Stewart
Advisor: Dr. Sven Eklund

3:30 IESB 318

BREAK / PROGRAM AWARDS

3:45 IESB 318

ADVANCED WOOD PRODUCTS INFUSED WITH HALLOYSITE FOR INCREASED NATURAL RESISTANCE

Halloysites are nanotubes made of aluminosilicate; the formula is with Al-$(OH)_3$on the inside and Si-O bonds on the outside. This unique molecular configuration of halloysites allows them to be positive inside and negative on the outside of the tube. We will load silver acetate into the halloysite nanotubes (HNTs) and impregnate these natural nanotubes in wood by spraying the halloysite onto the wood surface with a high-pressure spray gun. The silver halloysite coating would show an increase in the wood products' durability, flame resistance, and mold resistance.

Team Member: Akeena Obaze
Advisor: Dr. Yuri Lvov

CHEMISTRY

4:00 IESB 318

INVESTIGATION OF METAL-ORGANIC COMPLEXES DOPE IN POLYMERS FOR SCINTILLATIONS USES

For this LaSpace-sponsored project, we worked to develop scintillation polymers for use on extended missions in space. Scintillators are needed to detect radiation and keep astronauts safe. For this project, we synthesized metal-organic complexes with europium, cerium, and terbium. Since lanthanides absorb light poorly, we coordinated ligands to the metal center for greater light absorption. In addition, we investigated simple carboxylate ligands including trifluoroacetate and pyridine carboxylates as ligands to lanthanides as luminescent dopants. We characterized our products using Fourier-transform infrared spectroscopy (FTIR), multi-nuclear NMR spectroscopy, powder, and single x-ray diffraction (XRD). We determined the optical properties using UV-Vis and fluorescence measurements. Differential scanning calorimetry (DSC) was used for the determination of thermal stability and purity. We tested these compounds for solubility in organic solvents prior to doping. For the polymerization of MMA (methyl methacrylate), we dissolved our metal-organic complex in MMA with a thermal initiator and cured it at 80 °C. The polymerization procedure resulted in optically clear plastics suitable for scintillation measurements that luminesce cyan to red under 365 nm light. Future work in collaboration with the Physics program will involve investigating the performance of these scintillators to ionizing radiation sources and cosmic events.

Team Member: Treylan Steveson
Advisor: Dr. Elisabeth Fatila

4:15 IESB 318

SYNTHESIS AND CHARACTERIZATION OF MONOLAYER-PROTECTED NICKEL NANOPARTICLES

We synthesized nickel nanoparticles protected by a self-assembled glutathione monolayer by dissolving a 1:1 mole ratio of Ni(II) Br_2 and glutathione in water and adding a concentrated solution of $NaBH_4$ dropwise while degassing the solution of oxygen through the use of N_2 gas. This allowed the ligands to bind to the nickel clusters before they were able to aggregate or oxidize. We chose glutathione as the ligand material to allow the particles to be water-soluble and analyzed the particles using H-NMR, IR, UV-Vis, Raman, DLS, and TGA.

Team Member: Bailey Parr
Advisor: Dr. Sven Eklund

4:30 IESB 318

FACULTY MEETING WITH ADVISORY BOARD

CIVIL ENGINEERING

1:00 IESB 124

ISSUES WITH LA 5 IN DESOTO PARISH

Louisiana Highway 5 (LA 5) in DeSoto Parish is experiencing a high number of run-off-the-road accidents along a 90° curve in the roadway. Motorists are driving too fast, driving off the road, and crashing when they encounter the curve and cannot slow down enough to safely navigate it. This location needs to be investigated to provide the most cost-effective solution to reduce the number of accidents. We investigate the location and crash history to determine the cause of the run-off-the-road accidents, and the most cost-effective way to reduce these crashes (Using Louisiana Department of Transportation and Development Guidelines). The project includes pavement design, watershed design, replacement, and resizing of the existing drainage structures.

Team Members: Asaph Camillo, Bailey Gonzales, Amanda Gordon, Tedris Smith
Team Sponsor: LA DOTD, District 04
Advisor: Dr. Nazimuddin Wasiuddin

1:30 IESB 124

MANTRA INC. OFFICE & WAREHOUSE PROJECT IN WEST MONROE, LA

Our team was put in charge of fabricating two building designs: a 25,000-square-foot, two-story office building and a 19,000-square-foot warehouse. The request for proposal (RFT) for the office building states that the first floor should be 15 ft. tall and the second floor should be 14 ft. to the roof deck. Steel beams are required for both the floor and frame. The second floor should have a 5-inch, lightweight concrete slab on a metal deck. The exterior walls should consist of non-load-bearing metal studs spanning between floors, and brick veneer will also be used over metal studs. The RFP for the warehouse states that the size should be 127 ft. by 150 ft. The biggest aspect of this design is the 35-ton overhead bridge crane. Also, we will need to design the slab to 500-psf uniform load, which will need to hold the Linde H45D lift truck. Our team is expected to do all the structural steel designs such as framing and connection designs for this project. We are also expected to do all the foundation and slab-on-grade designs.

Team Members: Pierce Althoff, Reed Edwards, Colton Gordon, Darby Ryland
Team Sponsor: Aillet Fenner Jolly McClelland, Inc (AFJMc)
Advisor: Dr. Shaurav Alam

CIVIL ENGINEERING

2:00 IESB 124

MULTIPLE DESIGNS WITH LA 818 @KCS RAIL

For this project, our goal is to improve the intersection at the railroad of KCS Rail and Louisiana Highway 818 (LA 818). This railroad crossing poses a heightened risk of pedestrian and vehicular accidents due to a ninety-degree curve that makes a steep and sudden increase in slope over the railroad tracks. This design presents drivers with limited visibility over the tracks. The area contains very little reflective signage and roadway striping and lacks appropriate lighting. These factors create a dangerous situation for even the most experienced drivers. The Louisiana Department of Transportation and Development has closed this crossing to trucks and large vehicles due to safety concerns. Our goal is to make the intersection safer by using the engineering design process. We have divided our project into three phases. During the first phase of the project, we will assemble geotechnical explorations, survey data, LiDAR data, crash report history, and traffic studies data to make the appropriate engineering decisions. After we have collected all of the necessary information, we will move to the preliminary design. In this phase, we will follow engineering standards to determine the feasibility of our design options. Once we complete the preliminary design phase, we will begin the final design. In this phase, we will choose a singular option to produce a full set of deliverable plans, which will include full topographic and LiDAR maps of the site, drainage plan, utility coordination, full construction plans, specifications, and details.

Team Members: Jeffree Chapa, Sophie Kubicek, Mason Macaluso, Mallory Mankins
Team Sponsor: LA DOTD, District 05
Advisor: Dr. Nazimuddin Wasiuddin

2:30 IESB 124

CARPOOL LANE PAVING AT FAIRFIELD ELEMENTARY SCHOOL (FAIRFIELD ELEMENTARY MAGNET PROJECT)

Fairfield Elementary Magnet School's pickup line is causing traffic congestion on the street running next to the school. In order to fix the traffic congestion, the team has been tasked with designing a carpool lane and canopy in the unused acre of land next to the school. During the design of the carpool lane and canopy, we will introduce new impermeable surfaces, and to account for the added runoff, we will design and construct a detention basin. The basin will hold up to 1356 ft^3 of water for the 25-year storm scenario and will release water at a rate of 5.07 ft^3/s to match the existing site drainage discharge. The watershed area that drains into the detention basin is 2.51 ac, and the proposed conditions should not introduce any bypass flow to the site. The pavement design was largely informed by a geotechnical report done on the site. It will consist of 7" of portland cement concrete over the aggregate base and fill material. Additionally, 6" curbs will be used to ensure proper water flow throughout the carpool lane. The walkway canopy is being designed as a steel structure with an aluminum roof and will be built in three sections each measuring 11' by 52'. Having multiple sections of the canopy will minimize the amount of fill added since the land is sloped. Using the maximum LRFD loading scenario, the total canopy load was determined to be 20 kips, which is a distributed load of 12 pcf. The canopy will be supported by 18 steel beams and 36 steel columns.

Team Members: Reed Bennet, Robert Dixon, Noah Savoie, Gloriana White
Team Sponsor: Civil Design Group, LLC.
Advisor: Dr. Nazimuddin Wasiuddin

CIVIL ENGINEERING

3:00 IESB 124

DESIGN OF US 165 PEDESTRIAN BRIDGE

Our project concerns a pedestrian bridge at the intersection of US Highway 165 (US 165) and Renwick Street that users have complained is not Americans with Disabilities Act (ADA) compliant. It was originally built in the 1970s but has undergone recent updates. Tiered stairs occupy both sides of the bridge, which stands at a height of twenty feet and gives pedestrians a safe walk across a bustling highway. However, the tiered stairs are fairly steep and can be treacherous for disabled users to climb. To address this issue, we were tasked with making recommendations for safer ADA-compliant alternatives. ADA was signed into law in 1990. The bill "guarantees equal opportunity for individuals with disabilities in public accommodations, employment, transportation, state and local government services, and telecommunications." The client overseeing the pedestrian bridge is the Louisiana Department of Transportation and Development (DOTD), which is responsible for ensuring projects adhere to ADA guidelines. Our senior design group was given specific requirements from the DOTD to resolve the disability issue. The only access point to the bridge is the tiered stairs. The department issued some ADA-compliant alternatives including concrete spiral, concrete zig-zag, aluminum, and wheelchair lift. The design process includes examining these four alternatives to come up with the best recommendation. We will include a cost estimate for our alternative along with a pedestrian study to see whether undertaking the project would be a beneficial use of state funds.

Team Members: Michael Hargroder, Zach Hill, TK Kittisubcharoen, Ryan Phillpott
Team Sponsor: LA DOTD, District 05
Advisor: Dr. Hadi Salahi

1:00 IESB 126

JEFFERSON PAIGE RD BRIDGE REPLACEMENT IN CADDO PARISH

For this project, we aim to design a bridge crossing over the tributary to Page Bayou on Jefferson Paige Road in Caddo Parish. The Parish has requested a new design for this bridge due to the condition of the bridge. There have been many repairs done to the timber piles, and it is expected that if the bridge doesn't get replaced, repairs will continue to be needed. The Parish wants the replacement to be a three-span concrete bridge supported by concrete piles, with a 2:5:1 revetment slope. A hydraulic analysis was completed for the area to determine the creek flow beneath the bridge which allowed us to analyze the conditions of the water flow to create a channel design to prevent flooding over the bridge. The team has started the preliminary deck and girder design of the bridge. The deck will be three concrete simple spans of 20 feet composed of transverse and longitudinal reinforcement to ensure that there will be enough strength to withstand all trucks and cars using the bridge. For each span, the 32-foot-wide deck will be placed on top of 4 LG concrete girders that have 9-foot spacing.

Team Members: Guillermo Arellano, Peyton Forester, Blaine Holloway, Will Perilloux
Team Sponsor: Parish of Caddo
Advisor: Dr. Roya Solhmirzaei

CIVIL ENGINEERING

1:30 IESB 126

BRIDGE OVERPASS ISSUE ON US 80 IN WEBSTER PARISH

Highway US 80 in Webster Parish has a bridge overpass that restricts the clearance of over-height loads and the ability of trucks carrying them to drive underneath. For this project, we investigated how to provide a unique way to increase the clearance between the roadway and the bridge, allowing for taller, over-height loads to travel under the bridge. The Louisiana Department of Transportation and Development (LA DOTD) has been asked to design this project. The design must obtain a minimum clearance of 17.5 ft. We must create a pavement design to determine the typical section for the newly proposed roadway and need to account for drainage after adjusting the roadway profile grade elevation. DOTD Minimum Design Guidelines, American Association of State Highway and Transportation Officials Policy on Geometric Design of Highways and Streets, DOTD Pavement Design Guidelines, and DOTD Hydraulics Manual are a few of the guidelines and manuals that we will follow. We will accomplish our goals by lowering the existing roadway by approximately 3 feet, implementing new drainage, improving aesthetics, and constructing new guardrails to meet the new standards of DOTD Minimum Design Guidelines.

Team Members: Brooke Edmondson, Rachel Moffett, Sam Pitts
Team Sponsor: LA DOTD, District 04
Advisor: Mr. Reginald Jeter

2:00 IESB 126

160 AC GREENFIELD SITE DEVELOPMENT (DFW AREA, TX) – BRIDGE AND ROAD DESIGNS

For this report, the focus will be on the development of the 160 AC Greenfield Site. This area is located in the town of Grand Prairie, Texas, at the intersection of Highway 161 and Arkansas Lane. The goal of this project is to develop a greenfield by designing the plans for a parking lot, connecting roads and tie-ins, as well as a bridge with an appropriately designed channel below. Surface drainage must be calculated for the planned parking lot. Topographic and geological data have been collected by the consultant for the site and were used to develop current and future drainage conditions. We will utilize several different software packages to plan out the parking lot, road, and bridge design. The major software will include Civil 3D and RISA 3D. All data required for drainage calculations have been obtained. Pavement design will be a crucial part of the parking lot and roads as the team will be using concrete pavement design manuals for this endeavor. The bridge spans about 120 ft long and 35 ft wide.

Team Members: Stuart Hender, Tanner Hines, Gerardo Velazquez, Chandler Warren
Team Sponsor: Halff Associates, Inc.
Advisor: Dr. Elizabeth Matthews

CIVIL ENGINEERING

2:30 IESB 126

160 AC GREENFIELD SITE DEVELOPMENT (DFW AREA, TX) – WATER RESOURCES DEVELOPMENT

This project was initially a master plan design with multiple buildings and facilities. Our group is turning Warrior Creek into a stage of ponds with spillways that reduce the water flow rate and then release the water back into the Grand Prairie drainage system. There will also be a parking lot that will increase the water runoff either into the lakes or into a separate drainage system. Throughout this project, our overall objective is to successfully design a way to reduce the flow rate of water draining through warrior creek by designing detention ponds with spillways. This process requires us to evaluate warrior creek, calculate the surface drainage across the site, and determine flow rates from one pond to another. Our group is also designing a parking lot to accommodate a 60,000-square-foot building that will be used for a senior citizen workout recreational facility. Depending on the difference in elevation from the water's edge to the downhill slope, there is a possibility of a retaining wall design. However, there are a few design constraints that we must be mindful of while designing this. There is an existing FEMA floodplain that runs along the Warrior Creek basin that must be protected as well as designed for. The preexisting discharge rate measured for Warrior Creek was 1650 ft^3/s, which is another parameter that the lakes must either match or slow down the flow rate to prevent flooding. Parking becomes another parameter that we must design for. The parking lot is being designed for a senior citizen building, so the building will need more parking that conforms to the Americans with Disabilities Act than a normal parking lot would call for. Throughout this project, our overall objective is to successfully design a way to reduce the flow rate of water draining through Warrior Creek by designing retention ponds with spillways and/or culverts. This process requires us to evaluate Warrior Creek, calculate the surface drainage across the site, design a parking lot to accommodate a 60,000 sf building, and potentially a retaining wall design.

Team Members: Luke Bell, Camden Cowart, Bryce Fuller, Christopher Swedburg
Team Sponsor: Halff Associates, Inc.
Advisor: Dr. Elizabeth Matthews

COMPUTER SCIENCE

1:00 IESB 216

U-MARKET

U-Market is an e-commerce platform for university students to purchase, sell, or exchange goods with others with the peace of mind that every user is a fellow student. Students can choose either in-person or online transactions. U-Market provides a layer of security for in-person transactions by sending the seller a QR code that only the correct buyer can scan to verify a transaction. Online transactions utilize PayPal, a 3rd party payment processor, to provide a secure online checkout experience. With U-Market, we aim to connect sellers and buyers through meaningful interactions and unique goods in a secure platform.

Team Members: Jacob Craver, Daniel Etkind, Tyler Kranz, Leandro Londin, Zachary Uson
Advisor: Dr. Andrey Timofeyev

1:30 IESB 216

CLAB

CLAB, short for collab, is a music songwriting tool to make learning, transcribing, and creating music notation easier for musicians and musicologists. CLAB uses artificial intelligence algorithms to detect notes and rhythms in audio files. CLAB is targeted toward professionals in the music industry as well as intermediate musicians looking for a way to create music notation from audio recordings. Users can create and store music notation with the click of a button using CLAB.

Team Members: Aaron Earp, Samuel Evans, Nathan Granade, David Jara, Thomas Nguyen
Advisor: Mr. John Spurgeon

2:00 IESB 216

MELLO

Starting off as an independent adult can be overwhelming, and it can be challenging to manage newfound responsibilities. Mello is a tool targeted toward young adults to help manage different aspects of their lives efficiently. The app offers features that help users plan out their day-to-day life. Mello users can plan their schedules by utilizing the app's time management and grocery features to create an agenda with upcoming events and reminders, meal plans for each day of the week, and grocery and recipe lists. In addition to the life management features, Mello users can complete objectives around the app and earn experience points and coins that can be used to level up their personal character as a way to incentivize engagement.

Team Members: Reid Trisler, James Vieux, Thien Vu
Team Sponsor: Mark Morris, Fenway Group
Advisor: Dr. Kevin Cherry

COMPUTER SCIENCE

2:30 IESB 216

LOCKED OUT

Locked Out is a cybersecurity-themed virtual reality game in which every level is an office-themed escape room designed with specific security challenges that introduce and reinforce cybersecurity lessons and themes, such as common security exploits. The game is being developed alongside Dr. Brad Glisson as a part of a grant to create a virtual reality game that will increase high school and early college students' interest in cybersecurity. Our goal is to fill the ever-growing demand in the cybersecurity workforce.

Team Members: Mary Nations, Ty Pederson, Benjamin Sanguinetti, Matthew Tucker
Advisor: Dr. Brad Glisson

1:00 IESB 218

PARKING OCCUPANCY DETECTION SYSTEM (PODS)

PODS is a mobile web application that detects whether parking spaces on campus are occupied in real-time to determine the most efficient and time-saving parking lot to use. The current state of Louisiana Tech's parking availability is inconvenient for students trying to park on campus at peak times. The system control flow begins with a camera equipped with power over ethernet (PoE) to capture an image at specified intervals. The backend runs the image through a trained computer vision model using TensorFlow. The data is stored in a MySQL database, where an API handles the communication of data between the database and the web server. The web server communicates that information with the API to present the parking availability on a mobile web application with the frontend and backend created using NodeJS and React. The client-facing web application gives the user multiple options to view information. The "Available Parking" webpage displays a map of the lot and the number of spots available based on their role. The lot activity web page displays trend data for a selected parking lot over a period of time. This system provides students, faculty, staff, and even visitors the ability to locate available parking spaces with ease from anywhere.

Team Members: Corey Belk-Scroggins, Garrett Jones, Brianna Stewart, Landon Tomkins
Advisor: Dr. Brad Glisson

COMPUTER SCIENCE

1:30 IESB 218

JOURNAL TOGETHER

Journal Together is an innovative and intuitive application designed for journaling enthusiasts. Written in Dart using Flutter, this app offers a seamless experience with its user-friendly interface, ensuring that every user can easily document their thoughts, feelings, and experiences. What sets Journal Together apart from other journaling apps is its use of GitHub as the backend storage for all entries. For this feature, users only need a GitHub account to store their data. With Journal Together, users can easily access their journals across multiple devices without the fear of losing their valuable content. In addition to its robust storage capabilities, Journal Together offers a wide range of customization options, allowing users to personalize their journaling experience. From choosing different fonts to inserting blocks of code, users can make their journals truly their own. Whether you want to keep a daily record of your thoughts, track your personal growth, or simply express yourself creatively, Journal Together is the perfect app for you. With its powerful features, seamless interface, and unparalleled ease of use, Journal Together is the ultimate journaling app for anyone and everyone to use.

Team Members: Joshua Bailey, John Doherty, Kennedy Ford, Brendan Guillory
Advisor: Mr. Ron Lewis

2:00 IESB 218

AUTOAID

AutoAid is an Android app that provides mechanical assistance for vehicles. Once the user creates an account, they can enter their VIN (vehicle identification number) and any current troubles they are experiencing with their vehicle. AutoAid will then access the CarMD API to provide a detailed analysis of the vehicle in relation to the reported issues. The user will receive suggestions on how to fix the problems, along with a cost analysis. If the issues cannot be reasonably identified or resolved by the user, they can also search for local auto shops. The app also includes a feature that allows the user to set reminders for routine maintenance, such as oil changes and tire rotations. This helps the user stay on top of vehicle maintenance and avoid costly repairs down the road. AutoAid is a simple and intuitive resource for those with limited knowledge of vehicle mechanics and troubleshooting, helping them fix their car at home and avoid being overcharged by mechanics. Whether you are inexperienced or an expert, AutoAid gives drivers the confidence to make informed decisions when it comes to vehicle repair.

Team Members: Keiser Dallas, Daniel Davis, Amiyah Frierson, Frankie Lavall, Dylan Weaver
Advisor: Dr. Miguel Gates

COMPUTER SCIENCE

2:30 IESB 218

SAVE ME A ROOM TODAY (SMART)

Save Me a Room Today (SMART) is an Android application that allows users to request room reservations across campus based on which college they are admitted to. Users create an account with a username, password, email, and college information. This account is designated as a general user and can be given extra permissions upon request. Upon account creation, the app allows users to request reservations, update, cancel, and keep track of them at any given time. For a user to request a reservation, they have to provide a list of information that the app guides them through. The user selects a building, date, time range, and occupancy. Then, the app provides them with a list of rooms that fit their criteria, allowing them to request the room they wish to reserve. Admin accounts have privileges over a given college and, thus, are able to manage reservations for that college's buildings. These admins can accept or deny incoming requests as well as view all already accepted requests. The app is programmed in Kotlin and contains two external components: a database hosted through MySQL Workbench, and a custom-built API coded using NodeJS hosted through an AWS EC2 instance.

Team Members: Andrew Redfield, David Riser, Zachary Surla, Terence Tugwell
Advisor: Mr. Ron Lewis

3:00 IESB 218

CODE TRATHER

Code Trather is a Python Integrated Development Environment (IDE) that addresses the issue of cheating during in-class coding assignments. Our IDE is equipped with essential features such as Python syntax highlighting, command line input, and the ability to upload Python unit test files for auto-grading. With our application, students can write, debug, and test their code all in one place, providing convenience and efficiency. To ensure academic integrity, our IDE logs student keystrokes, monitors their window activity, tracks running processes, and encrypts all submitted assignments to prevent unauthorized access. The app comes in two parts: one is the student version that is distributed to students, and the other is the teacher version. The student version includes all the features above while the teacher version is designed to help the teacher access/manage the students' work. Our C# Windows Form app is built in Visual Studio and is designed to help instructors maintain fair evaluation and promote academic integrity. Our project provides a valuable tool for students and educators alike, enabling a better learning experience, and paving the way for a more honest and equitable academic environment.

Team Members: David Anthon, Brendon Burd, Meagan Kropp, Jonathan Trahan
Advisor: Mr. Kyle Prather

COMPUTER SCIENCE

3:30 IESB 218

STICKIT

Stick-It is a web annotation Chrome extension designed to enrich the learning experience and foster collaboration among open-source textbook users. Users can highlight critical or intriguing points within the text. Additionally, this innovative extension enables users to actively participate in discussions by leaving comments, sparking conversations, and exchanging ideas with others. The extension's main features provide users the ability to create and manage annotations, explore notes and comments from fellow users, and engage in ongoing discussions. It allows users to personalize their learning experience by posing questions on specific sections of texts or responding to others' inquiries. We've utilized AWS RDS for database management to bring this extension to life, ensuring a scalable and dependable storage solution for user-generated content. The backend is powered by Node.js, providing a swift and efficient platform for managing requests and interactions between the extension and the database. By leveraging these technologies, we address challenges such as creating a user-friendly interface, safeguarding data security, and ensuring optimal performance in a collaborative learning environment. Our project aspires to transform how users interact with open-source educational materials, promoting a sense of community and fostering knowledge-sharing among learners.

Team Members: Evan Goodman-Blue, Emily Hollis, Seonghoon Yi, Drew Young
Team Sponsor: Steven Galloway, Fenway Group
Advisor: Mr. Kyle Prather

4:00 IESB 218

FLYING BURGER APP TEMPLATE

The Flying Burger & Seafood app is a mobile device template modeled after the Flying Burger & Seafood restaurant in Ruston, Louisiana. This app is compatible with mobile devices running operating systems such as Android and iOS. The mobile app template represents the straightforward navigability and use of many other highly-rated food applications while being faithful to the Flying Burger & Seafood franchise and structured, more specifically, after the Ruston, Louisiana, location. This is accomplished by displaying the menu and prices for the local restaurant and providing many choices for customizing the vast catalog. Patrons can also browse the menu quickly, examine featured items only available in their area, and keep track of their most recent meal orders. The inspiration for the application came from the client's desire to find a more cost-efficient method of food delivery or pick-up without sacrificing convenience since the establishment has been paying expensive fees to DoorDash. The ultimate objective has been to develop an application enabling customers to improve browsing and communication with the Flying Burger & Seafood franchise while relieving the restaurant of any additional burdens.

Team Members: Cori Allbritton, Joshua Authement, Ryan Callicott, Christian Evans, Sara Grey
Team Sponsor: Ruston Flying Burger and Seafood
Advisor: Mr. Kyle Prather

CONSTRUCTION ENGINEERING TECHNOLOGY

WOBC BRIDGE OVER UPRR

Teams will act as highway/heavy contractors that will bid on this project. Each bid will include information as if the team will perform the construction of the Walter O. Bigby Carriageway Bridge over the UPRR themselves and subcontract all other work for the project. Teams must consider the delivery and erection of the long steel girders while working over an active railroad.

1:00 IESB 220

Team Member: Brandon Clouatre, Hayden Hensley, John-Michael Johnson, Tyler Kincaid, Austin Wilson
Advisor: Mr. Reginald Jeter

1:30 IESB 220

Team Member: Jamie Brown, Calissa Miller, Peyton Murphy, Jared Offord, Adams Uwimana
Advisor: Mr. Reginald Jeter

2:00 IESB 220

Team Member: Kailyn Borne, Ethan Brantly, Shaylee Puls, Abigail Raley, Lucas Smith
Advisor: Mr. Reginald Jeter

2:30 IESB 220

Team Member: Emile Armand, Madison Coats, Schaffer Cobb, Jada Lewis
Advisor: Mr. Reginald Jeter

3:00 IESB 220

Team Member: Tanner Bush, Eric Fisher, Martin Ninh, Harrison Smith
Advisor: Mr. Reginald Jeter

3:30 IESB 220

Team Member: Jacob Hanson, Zachary Harrell, Sam Jusselin, Christian Marsh, Carson Massad
Advisor: Mr. Reginald Jeter

CONSTRUCTION ENGINEERING TECHNOLOGY

I-10 BRIDGE OVER KCSR

The design-build contractor for this project has recently been awarded a contract for an emergency repair project that has the potential for a very good profit margin and requires their bridge construction crews for it. Each team will act as a subcontractor and will submit a bid to the general contractor for this challenging project. Teams have to consider how to construct the bridge with live traffic close by, a high-voltage power line above, and an active railroad below the middle section of the bridge.

1:00 IESB 222

Team Member: Kody Bryant, Nick Gauthe, Shalvin Richard, Brin Wilson, Nial Wilson
Advisor: Mr. Reginald Jeter

1:30 IESB 222

Team Member: Harris Downer, John Flores, Garrett Foreman, Josh Simmons, Jack Trageser
Advisor: Mr. Reginald Jeter

2:00 IESB 222

Team Members: Caroline Bishop, Matthew Guion, Bryce Moon, Collin Richard, Gabe Theiss
Advisor: Mr. Reginald Jeter

2:30 IESB 222

Team Members: Jarrett Camp, Avere Doles, Brandon Eads, Austin Jones, Nick Shows
Advisor: Mr. Reginald Jeter

3:00 IESB 222

Team Members: Carson Fields, Lane Gagnard, Kyler Hill, Emily Nolasco, Craig Waxley
Advisor: Mr. Reginald Jeter

3:30 IESB 222

Team Members: Jed Dailey, Jake Gray, Jordon Mazzeno, Ryan Snow
Advisor: Mr. Reginald Jeter

CYBER ENGINEERING

1:30 IESB 226

THE SPOT

This parking spot detection project, known as The Spot, is designed to detect open parking spots in a specific parking lot by utilizing two small cameras connected to a Raspberry Pi. Once pictures are taken, the Pi utilizes advanced encryption standard encryption to send the images to a computer containing object detection software that detects the number of cars in the lot and outputs that result to a mobile application. The mobile application will use GPS to determine the user's location and will give users the option to select which parking lot to look at (right now there will only be one option). Within the parking lot selection, there will be an aerial view of the parking lot, or at least a diagram of the lot, as well as a display of how many spots are available.

Team Members: Claire Aydell, Joseph Brown, Calvin Domangue, Nikolas Morgan, John Norris
Advisor: Dr. Miguel Gates

2:00 IESB 226

SRRS - STUDY ROOM RESERVATION SYSTEM

The objective of SRRS is to design and develop a system for efficiently managing and reserving study rooms at the Louisiana Tech Integrated Engineering and Science Building. The project team thoroughly analyzed existing reservation systems and technologies to identify best practices and potential improvements. Implementing these ideas, our team developed a website from the ground up that would handle a reservation system using Louisiana Tech's credential software, Central Authentication Service, providing a secure and efficient service that blends seamlessly into the suite already in use by the University. This website provides a user-friendly system with a pleasing design to ensure ease of use, as well as an intuitive backend design that handles API requests and reservations.

Team Members: Jeremy Edgin, Averie Hardy, Abigail Jernigan, Christopher McElroy, Stephanie Orellano
Advisor: Dr. Miguel Gates

2:30 IESB 226

DACTYLOMANCY

The objective of our project is to address the limitations of traditional password authentication systems, such as vulnerability to brute-force attacks and password guessing, by leveraging users' typing behavior. The project involves collecting data on users' keystroke dynamics, including keystroke timing and duration, from which we derive individualized keystroke profiles. These profiles are used to authenticate users by comparing their typing behavior during login with their previously recorded keystroke dynamics.

Team Members: Lathe Allen, Joshua Brack, Andrew LeBlanc, Luke McMillan, Brandon Rogers
Advisor: Dr. Miguel Gates

CYBER ENGINEERING

3:00 IESB 226

MODNS - A MODULAR DNS FRAMEWORK

DNS, or Domain Name Service, is an integral part of the Internet. As the technology has developed, users have found numerous uses for customizing the behavior of their local DNS resolver. These customizations come with the drawback that they are typically distributed as standalone servers -- meaning that utilizing multiple DNS services requires a daisy chain of containers, virtual machines, or physical machines, increasing latency and network overhead. DNS requests will be required to traverse up the stream to be inspected and handled by each of the individual DNS services. MoDNS seeks to solve this problem by allowing a single DNS server to perform multiple functions. To accomplish this, MoDNS uses a framework that allows user-defined plugins to modify the way DNS requests are handled in a modular fashion.

Team Members: Timothy Huhn, Bronson Jordan, Aankit Pokhrel, Carter Ray, Seth Warren
Advisor: Dr. Miguel Gates

3:30 IESB 226

GTTX - TABLE TOP EXCERSIZE PLATFORM

In today's world, cyber preparedness is a necessity. One way to prepare is to use tabletop exercises to evaluate the capability of an organization. Tabletop exercises are simulations of real-life scenarios that help organizations identify gaps in their cybersecurity plans and improve their response capabilities. The Cybersecurity and Infrastructure Security Agency (CISA) has developed a set of tabletop exercises called the Cyber Exercise Program (CTEP) to help organizations prepare for cyber incidents. CTEP provides a series of exercises that simulate different types of cyber incidents, such as ransomware attacks or data breaches, and helps organizations test their incident response plans. We, GTTX, have developed a platform to help organizations conduct CTEP exercises more easily through a friendly web user interface. The platform provides a way that makes it easy for organizations to conduct tabletop exercises and evaluate their cybersecurity plans. By using GTTX's platform, organizations can identify gaps in their cybersecurity plans and improve their incident response capabilities.

Team Members: Joy Brown, Zachery Hoover, Joshua Iselin, Kevin Oubre, Nolan Yelverton
Advisor: Dr. Miguel Gates

ELECTRICAL + NANOSYSTEMS ENGINEERING

1:00 IESB 210

ANALOG MULTIPLEXER

This project stems from the U.S. Army Engineer Research and Development Center's (ERDC) desire to increase the magnitude of their electrochemical analysis which is used to identify chemical compounds. A commercially available potentiostat device currently performs the electrochemical analysis. However, the ERDC has developed its own version, the ACEstat which is currently limited to only two detection channels due to bandwidth limitations. Our aim is to develop a modular circuit that increases the number of channels and easily integrates into larger systems. This new circuit will increase the efficiency of the ACEstat by eliminating the need for duplicate subsystems for each chemical being measured. Our goal is to design a multiplexing system on a printed circuit board (PCB) to condense data from 32 inputs to 1 output through a single transmission line. To accomplish this, our team has designed a multiplexer circuit that has 32 inputs and 5 select lines on the PCB, soldered external components, and written the Serial Peripheral Interface (SPI). The final design can control the 32 inputs with 5 select lines by toggling through each possible combination of the select lines at a set time.

Team Members: Samuel Greer, Donald Martin, Chord Ramsey
Sponsor: US Army Corps of Engineers
Advisors: Dr. Matthew Hartmann and Dr. Sandra Zivanovic

1:30 IESB 210

TIRE BLOWOUT PREVENTION SYSTEM

The Tire Blowout Prevention System is an automated control system that uses multiple sensors to detect a possible tire malfunction before the tire blows out. These sensors record the temperature, pressure, vibration, and load associated with the tire. This recorded data is relayed wirelessly via Bluetooth to a control module that processes the current values being read by the sensors. The control module will then trigger an alarm to notify the user if the sensor data being recorded is outside of the set range of acceptable values determined by the user. The data is then sent to a digital interface that displays the sensor values for the user.

Team Members: Wesley Granger, Kelly Walker, Austin Webre
Advisors: Dr. Matthew Hartmann and Dr. Sandra Zivanovic

2:00 IESB 210

SOLAR FOLLOWER ENERGY STORAGE DEVICE

There has been a steady decline in student interest in electrical engineering. In the United States, the graduation rate of engineers was down in 2020, and Louisiana Tech University's undergraduate enrollment rate for Electrical Engineering has followed this decline. Our project is a portable demonstration device that will be taken to recruiting events for Louisiana Tech. The device takes energy from the sun using a dual-axis solar follower, stores the collected energy in batteries, and outputs energy through USB ports. Our project demonstrates the branches of electrical engineering and gives prospective students an overview of different electrical engineering disciplines like power, integrated circuits, communications, and controls. Our goal with this device is to give prospective students insight into what Electrical Engineering is about at Louisiana Tech. Allowing prospective students to engage with electrical engineering before entering college will generate more interest and expand the program.

Team Members: Annabelle Broussard, Ashlee Stafford, Bailey Ziegel
Team Sponsor: Gayle Red
Advisor: Dr. Matthew Hartmann

ELECTRICAL + NANOSYSTEMS ENGINEERING

2:30 IESB 210

INDUCTION WATER HEATER

Through the Induction Based Water Heater project, we aim to provide a tankless, electric alternative to gas-powered water heaters and to reduce the space required for water heating. The design is environmentally friendly, reducing the production of greenhouse gases. Our goal is to have a higher efficiency than natural gas tankless water heaters and greater dependability than traditional electric water heaters due to the removal of the "element" commonly associated with electric heating. By using induction heating to heat an iron alloy pipe, the estimated maintenance cost for our product is minimal as there are zero moving parts or physically connected, heated metal to weaken over time. Using a programmable logic controller to control the heating circuit our product can provide water heated to a safe regulated temperature that is optimal for single-family households.

Team Members: Logan Bailey, Abdullah Banajah, Jacob Paulk, Luke Warlen
Advisors: Dr. Matthew Hartmann and Dr. Sandra Zivanovic

3:00 IESB 210

W.A.R.D.D.-N. SECURITY

Our project, the Wireless, Autonomous, and Rapidly Deployable Drone Network (W.A.R.D.D.-N.) is a portable and independent drone network security system designed to constantly monitor a specific area. Our current system design includes an automated drone, a landing platform, a charging system, and a camera system with human detection capabilities. The drone is equipped with a flight controller and GPS to fly along a predetermined path, land at a charging station, and recharge independently. A laptop is used to set the path and serves as the communication hub for the drone. The charging station is designed to minimize the precision required for the drone to land by mechanically directing it to the precise location needed for charging. The system is highly portable and easy to transport, making it an ideal solution for a wide range of applications, including private, military, and corporate use. The system's ability to operate autonomously for extended periods with minimal user intervention provides reliable and continuous surveillance of the target location making it an invaluable asset for those seeking to enhance their security measures without additional personnel or infrastructure.

Team Members: Gregory Boyle, Gracson Byrd, Andrew Steen
Sponsors: Force Robotics, LLC. and US Army Corps of Engineers
Advisors: Dr. Matthew Hartmann and Dr. Sandra Zivanovic

ELECTRICAL + NANOSYSTEMS ENGINEERING

1:00 IESB 228

THREE-DIMENSIONAL BIOPRINTER FOR LOW-GRAVITY ENVIRONMENTS

Over the past decade, the American public has become fascinated with the idea of landing astronauts on Mars. However, human space exploration is currently hindered by the limitations of medical treatment during prolonged low-gravity travel. Three-dimensional (3D) bioprinting has been studied as a possible solution for regenerative medicine in microgravity. Despite 3D bioprinters already existing on the International Space Station, the art of microgravity printing has yet to be perfected. When bioprinting in space, printer operators must worry about product displacement due to a lack of gravity. Furthermore, present techniques of containing bio-inks either result in a low product resolution or a decrease in cell viability. Our senior design team has designed and optimized a custom 3D bioprinter that employs embedded printing to prevent product displacement in microgravity. By using the Freeform Reversible Embedding of Suspended Hydrogels (FRESH) bioprinting methodology, we expect our bioprinter to be capable of both high-resolution and high-viability bioprinting in space. Current testing on Earth has indicated that our bioprinter can achieve a sub-100 μm resolution while printing a 1 cm3 cube of cell-laden sodium alginate.

Team Members: Gabriel Peterman, Gavin Sylvan, Race Wicklund, Robert Woodrum
Sponsor: Louisiana Space Consortium
Advisor: Dr. Adarsh Radadia

1:30 IESB 228

AUTOMATIC LARGE GAME FEEDER

Although automatic large-game feeders are available, current models have several problems: short battery life, lack of remote detection of feed moisture and level, and unoptimized feed output and distribution. Large game hunters must invest additional time and money to mitigate these difficulties. The proposed Autonomous Large Game Feeder is an innovative device that will solve these issues without aftermarket products and add-ons. The device will combine a power, communication, and control system, which will include humidity, temperature, barometric pressure, and ultrasonic sensors to create a smart device that gives hunters the ability to efficiently feed large game and monitor feeders from the comfort of their homes. The Autonomous Large Game Feeder implements solar panels to increase the longevity of the feeder's battery life, a method of notifying the user of low feed levels and the presence of moisture through SMS, and a process to automatically optimize the amount of feed distributed based on temperature and barometric pressure conditions. The Autonomous Large Game Feeder is an innovative approach to providing remote monitoring, autonomous control of feed output, and an efficient battery recharging system for hunters.

Team Members: Kaylee Bourgeois, Cameron Dreher, Julia Everett, Reece Veron
Advisors: Dr. Matthew Hartmann and Dr. Sandra Zivanovic

ELECTRICAL + NANOSYSTEMS ENGINEERING

2:00 IESB 228

ANALOG SYNTHESIZER

Synthesizers produce sounds through purely electronic means rather than mechanical or electromechanical means as other musical instruments do. Broadly, they can be split into analog systems in which sounds are represented and manipulated as electrical signals in circuits, or digital systems in which sounds are represented and manipulated numerically before being converted into electrical signals at the output. Our synthesizer uses a mixed analog-digital architecture to create musical sounds based on commands from a musical instrument digital interface (MIDI), the industry standard protocol for digital music systems. The user forms these sounds by configuring digital settings through a keypad and adjusting analog parameters using knobs. The device produces sounds starting with square waves generated by the microprocessor. These square waves are copied and divided to create harmonics, which have weights that may be adjusted to change the sound. These sounds are further refined through a series of digitally controlled filters and envelope generators, then mixed and sent through line-out.

Team Members: Preston Debetaz, Jordan Savoie, Hayden Thigpen
Advisors: Dr. Matthew Hartmann and Dr. Sandra Zivanovic

2:30 IESB 228

ORGANIC SOLAR CELL

At present, the high cost and complicated manufacturing process of solar cell technology pose significant challenges to its widespread adoption. Organic solar cell technology provides a possible alternative. Utilizing the resources available at Louisiana Tech's Institute for Micromanufacturing, our team fabricated prototypes for such a device. The techniques included spin-coating, photolithography, sol-gel derived zinc-oxide deposition, sputtering, and analyzing electrical and physical characteristics using 4-point probe tests, optical profilometry, and optical microscopy. The resulting solar cells function similarly to conventional silicon-based devices, with layers consisting of indium-tin-oxide (ITO) as the cathode, zinc-oxide as the electron transport layer, poly(3-hexylthiophene) (P3HT), and [6,6]-phenyl C61-butyric acid methyl ester as the active layer, poly(3,4-ethylene-dioxythiophene) - poly(styrene-sulfonate) (PEDOT: PSS) as the hole transport layer (HTL), and silver as the anode. Notably, the structure of the solar cells investigated deviates from the more common ITO/PEDOT-PSS/P3HTPCBM/Al configuration. Additionally, one of the project's objectives was to explore the feasibility of depositing the silver layer using sputtering, a technique that is more readily available than thermal or electron beam evaporation. Overall, this project demonstrates that organic solar cell technology can offer an alternative to conventional solar technology's cost and complexity barriers.

Team Members: Joshua Cantrell, Neel Patel, Lezly Sierra
Advisor: Dr. Sandra Zivanovic

INDUSTRIAL ENGINEERING

1:00 IESB 110

LINCOLN PARISH SCHOOL BUS NETWORK OPTIMIZATION

The Lincoln Parish School Board oversees bus transportation for about 3,000 students. Bus routes, in their current state, are at the discretion of each bus driver. Mapping software is only used to add students to a bus roster: Bus drivers have established routes through experience and familiarity with the area. The main problem with the current system is variability among routes. A majority of drivers will stop in front of each student's house, but there are several drivers that have established stops to unload multiple students at a time. There are regulations for how far from a student's house a bus can unload. Drivers are aware of this rule and a majority choose to abide by stopping in front of every house. Our objective was to develop a system that could create concentrated bus stops in accordance with current regulations and find the shortest distance between stops to limit the amount of time a student spends on the bus. As a group, we collected data from specific bus routes from the 2021-2022 school year to compare against a system with limited stops and optimized routing.

Team Members: Kosi Anadi, Wes Brady, Hayden Scaff
Team Sponsor: Lincoln Parish School System
Advisor: Dr. Jun Ing Ker

1:30 IESB 110

PUMPWORKS INVENTORY IMPROVEMENT SYSTEM

For this project, we developed a solution to improve the time and efficiency of assembling pumps, focusing on the inventory for PumpWorks in Shreveport, Louisiana. Our primary tasks were to provide an improved inventory marketplace for all standard parts for the assembly department, standardize the parts that are used for the pumps, and implement a system to maintain an accurate inventory.

Team Members: Shelby Brooks, Sophie Fijneman, Ana Moscoso, Ifunanya Onwuchuluba
Team Sponsor: PumpWorks
Advisor: Dr. Jun Ing Ker

2:00 IESB 110

SIMULATIONS OF STAFFING, STAGING, AND EFFICIENCY OF AN ASSEMBLY LINE

Hardware Resources in Bossier City, Louisiana, produces a variety of kitchen cabinetry. In this project, we focus on drawer boxes, specifically the standard box, high-back rollout, and rollout. Currently, the manufacturing plant is not meeting the production goal consistently. Many factors, such as being short-staffed, lacking a designated staging area for each station, frequent bottlenecks at various stations, and using work standards that are not based on a time study affect the production goal. In this project, our goals are to improve the production output, propose staging area and expected work in process levels, optimize efficiency and output, and determine more accurate production standards. To achieve these goals, we have created an Arena simulation to better understand the staging, a scheduling spreadsheet to maximize output and productivity, and time studies for production rates. We recorded and analyzed the outcomes.

Team Members: Jacob Bouton, Sarah Petersson, Caihren Wood
Team Sponsor: Hardware Resources
Advisor: Dr. Jun Ing Ker

INSTRUMENTATION AND CONTROL SYSTEMS ENG. TECH.

1:00 IESB 128

MINI-LATHE CNC CONVERSION

Our goal for this project was to implement a computer numerical control (CNC) system on an existing Sherline Mini-Lathe while maintaining its manual ability. The project included the implementation of a Raspberry Pi 4 Model B to serve as the primary controller, the installation of NEMA 23 Stepper Motors to control the axial motion of the lathe, an overhaul of the existing electrical controls of the lathe, and the fabrication of the various necessary components to achieve the end goal of a fully automated CNC Machine. With our methods of control implemented, the lathe can be used as a totally automated CNC machine, and parts can be machined to a high degree of quality, with a minimal degree of user intervention.

Team Members: Joshua Bass, Thomas Casey, Hunter Henderson, Djimon Hill
Advisor: Dr. Will Long

1:30 IESB 128

ROCK TUMBLER

For this project, our goal is to create a fully functional and automated tumbler/deburrer that has tunable input parameters and speed control. The project includes a proportional–integral–derivative motor controller with parameters determined by readings taken from a rotary encoder and weight measurements from a load cell.

Team Members: Jansen Jones, Jacob Powell, Cameron Richmond, Will Martin
Advisor: Michael Theodos

2:00 IESB 128

C.A.L.M: CASTING AUTOMATION FOR LOST MATERIALS

For this project, we implemented a human-machine interface (HMI), thermal controls, monitoring, and safety circuits for the lost-materials casting process in the Bogard Hall Prototyping Lab. Each system is connected to the programmable logic controller and supervisory control and data acquisition system in which all the data has been collected and displayed for temperature control and monitoring. The system also provides an HMI interface to guide the user through each step to a finished cast product. None of these systems interfere with the manual use of the machines as standalone products.

Team Members: Everett McKeller, Hugh Oliver, Shawn Clark
Advisor: Dr. David Hall

MATHEMATICS + STATISTICS

1:00 IESB 205

FIREFIGHTER SAFETY

There are close to 1.2 million career and volunteer firefighters across the United States. In the year 2020 alone, 62 of these firefighters died and 64,875 were injured. I performed the following research to determine whether the firefighter profession has become safer due to new standards and regulations. Each year the National Fire Protection Agency (NFPA) and the Federal Emergency Management Agency (FEMA) collect data on the number of firefighter deaths and injuries to determine whether the standards and regulations are keeping firefighters safe. Statistical hypothesis testing and linear regression were performed on the data to show if, in fact, the profession is safer. In this paper, I use a t-distribution hypothesis to test the correlation coefficient and the slope parameter and determine that over the last 40 years, firefighter deaths and injuries have significantly decreased.

Team Member: Haynes Mandino
Advisor: Dr. Jonathan Walters

1:30 IESB 205

PREDICTING STATE GDP USING TIME SERIES FORECASTING

I conducted this research to determine the weight certain taxes and expenditures have over state US Gross Domestic Product (GDP) as well as how accurately these data points can predict future GDP. The motivation behind this project comes from a desire to find the most efficient way to increase the GDP of states with poorer economies. This will improve the quality of life of citizens of these states. To come to a consensus as to what data points are most influential, hierarchical clustering will be used to split the states into four groups. The average of each tax, expenditure, and GDP from 2015-2020 will be calculated for each group. This data along with Time Series Forecasting Analysis will indicate which data point is most influential for each group. The Time Series Forecasting will result in an equation that can be used to predict the GDP of 2021 utilizing the GDP of 2020. I will then compare the predicted GDP to the actual GDP for each group. The results will lead to future works in which I will allow for more data points and groupings to make more accurate predictions.

Team Member: Austin Neitfeld
Advisor: Dr. Xiyuan Liu

MATHEMATICS + STATISTICS

2:00 IESB 205

DOES THE THREE-POINT SHOT AFFECT WINNING PERCENTAGE?

The three-point shot, introduced in the late 1970s, is a shot that occurs typically 24 feet away from the basket at the professional level. Strategically, the game of basketball was originally based on two-point field shots within 10 feet of the basket. Recently, there has been a noticeable trend in the popularity of the three-point shot among professional teams. Nowadays, three-point shot attempts account for more than a third of the average NBA shot selection. Statistical analysis is becoming an integral part of athletics. Multiple studies use linear and logistic regression models to form a prediction algorithm for the outcome of games. Many have statistically characterized the increase in three-point shooting on a year-to-year basis. The purpose of this research is to analyze this statistical jump and determine if three-point shooting is statistically significant to winning probability before and after the jump. By progressing from linear to logistic regression, the three-point shot was found to be statistically insignificant to the winning probability. However, the performance of the model is better than the interpretability.

Team Member: Marcamus Winn
Advisor: Dr. Xiyuan Liu

2:30 IESB 205

EXTENDING THE RADIUS OF CONVERGENCE OF DRINFELD LOGARITHMS

Drinfeld modules are, in essence, a way to create a function field analog to complex multiplication. With these modules, we can define a logarithm function analogous to the natural logarithm by virtue of a power series. Similarly to how we extend the radius of convergence of the natural logarithm with complex numbers, we can extend the radius of convergence for these Drinfeld module logarithms. While there are proofs for extending the radius of convergence of the Carlitz module, the simplest form of a Drinfeld module, there is no proof for a generalized Drinfeld. In this paper, I examine a method of extending the Carlitz logarithm's radius of convergence using Newton polygons. Afterward, a way to apply this proof to a general Drinfeld logarithm function will be walked through.

Team Member: Ethan Clapp
Advisor: Dr. Nathan Green

MATHEMATICS + STATISTICS

3:00 IESB 205

REGRESSION ANALYSIS OF INJURIES ON NFL QUARTERBACKS

Risk assessment is important in many careers such as those of first responders and the military. Its importance for these fields is no different for people who play sports, especially people who are engaged in contact sports such as football. These players' lives can be changed forever with one bad hit. This research is designed to analyze the risk of an injury for the National Football League's (NFL) quarterbacks. It is hard to predict when, what, and where an injury will occur. Because of this, very little work has been done on the subject in a general form. This paper is designed to research what variables play a role in factoring into a player being injured. The data was collected using NFL combine data as well as historical injury reports. A binary logistic regression analysis with the variables and using a success if the player was injured and a failure if not. This general model can be used for quarterbacks within the NFL to determine whether they should keep playing or end their careers based on their data during that time.

Team Member: Julie Weems
Advisor: Mr. Stan McCaa

3:30 IESB 205

FOUR COLORFUL METHODS FOR FINDING THE CHROMATIC POLYNOMIAL

Mathematicians apply algebraic graph theory to address and interpret problems arising out of data structures and optimization. For example, graph coloring problems have intrigued mathematicians and computer scientists alike. The chromatic polynomial was created to help solve such problems. This research is designed to create a greater understanding of the underlying structures behind chromatic polynomials by analyzing the algebraic, deletion-contraction, and color partition methods. Each method has differing applications, but by viewing them all together, this research hopes to show the depth of this most interesting subject in a condensed manner.

Team Member: Emerson Statom
Advisor: Dr. Galen Turner

4:00 IESB 205

EFFECTS OF TOPOGRAPHY ON TORNADO PATHS

Tornadoes are relatively common in Louisiana, which has an average of 55 tornadoes per year. Predicting tornado paths has been extremely challenging due to the many factors that play into the formation of a tornado, such as speed, pressure, and atmospheric conditions. According to the Smithsonian Astrophysical Observatory's NASA-funded Astrophysics Data System, topography can have a significant influence on tornado direction. For this research, I analyze tornado patterns to determine if local topography has an effect on tornadic activity. Navier-Stokes partial differential equations will be used to model data collected from the National Weather Service and the finite difference method will be used to solve the partial differential equations. This method will analyze the trends in the tornadic activity around Mount Driskill by using Microsoft Excel®.

Team Member: Kayleigh Smith
Advisor: Dr. Brian Barron

MATHEMATICS + STATISTICS

4:30 IESB 205

TIME-FREQUENCY ANALYSIS OF DISPERSIVE SYSTEMS

The signal processing technique of time reversal is used for various purposes in electromagnetic interference testing, radar, communication, sonar, and medicine. This paper models the impulse response of reverberant chambers that might be used for a time-reversal cavity (TRC) using time-frequency methods. Reverberant chambers have chaotic delaying phase responses that cause the majority of the distortion seen in their impulse response. Time reversal cancels this, creating a focused signal from a dispersed one. Most research modeling the behavior of TRCs is more concerned with their physics, so there is relatively little comment on the form of their signals. This paper is focused on how the chaotic phase response of the impulse response corresponds to the short-time Fourier transform, which appears to be an exponential decay across its bandwidth. Data of a real impulse response was measured using an acoustic reverberant chamber.

Team Member: Jordan Savoie
Advisor: Dr. Jonathan Walters

MECHANICAL ENGINEERING

GREEN SESSION - MODERATOR: DR. YUN CHEN

1:00 IESB 112

POWER COAT PATTERNING MACHINE

Gordon Incorporated, located in Bossier City, Louisiana, specializes in powder coating panels suitable for interior and exterior applications. Gordon Incorporated is expanding its product line to include weathered patterns. Currently, our sponsor manually disrupts the surface using a Swiffer duster to create the desired pattern. This manual process is inconsistent, time-consuming, and not cost-effective. We aim to fully automate this process without sacrificing quality. Our team designed a system to replace an employee and replicate the manual disruption process. Our design easily meshes with the preexisting manufacturing line and offers pattern variability. We focused on artificially resembling a rusted metal pattern but designed a device that can be easily adapted to implement other naturally occurring patterns. To deem this project a success, the device needs to reproduce a rusted metal pattern, be easily implemented, include pattern variability, and meet all design constraints. We have produced a product that meets these measures of success and will be an asset to Gordon Incorporated's growing market.

Team Members: Kade Brady, Evan Ellis, Connor Hollis, Stewart Hopper
Sponsor: Steven Shugarts, Gordon Inc.
Advisor: Dr. Shafiqur Rahman

1:30 IESB 112

B52 DROGUE PARACHUTE DELIVERY STAND

The Air Force Global Strike Command (AFGSC) is a major command whose headquarters reside at the Barksdale Air Force Base in Bossier City, Louisiana. They are responsible for handling the United States' three intercontinental ballistic aircraft, which includes the B-52. The B-52 utilizes a parachute housed in its tail to slow it down during landing, which also reduces mechanical wear on the brakes. A scaffold-type rolling stand is used to load the parachute into the tail of the aircraft. The disadvantages of the current stand include long assembly/disassembly time, a large shipping footprint, and many points of stress failure. The proposed design is a scissor lift platform that reduces the shipping footprint and assembly/disassembly time by reducing the number of parts to assemble and their complexity. This design provides a factor of safety of 2 against yielding and reduces the shipping footprint by 44 percent. This design will also allow the scissor lift to be transported quickly and will improve the readiness of the B-52.

Team Members: Cade Miller, Luke Suarez, Josiah Taylor, Trent Terminie
Sponsor: Air Force Global Strike Command
Advisor: Dr. Henry Cardenas

2:00 IESB 112

30 MINUTE BREAK

MECHANICAL ENGINEERING

2:30 IESB 112

LOW CURRENT CRACK ARREST TREATMENT ELECTRODE

The sponsor for this project is American Electric Power (AEP). AEP is a large-scale energy company that provides power to customers in eleven states. One of the problems with power plants is that cracks can develop in boiler tubes due to the natural use of the system. The current method of dealing with these cracks is to replace the affected section of piping. Our goal is to deliver an alternative method for mitigating crack growth by electroplating the boiler tubes to stop cracks from propagating. Electroplating is a process of depositing metal ions onto a metal sample using an electric current. The main deliverable of this project is an electrode assembly that can navigate curves in the boiler tubes and perform the electroplating process with a relatively low amount of electric current.

Team Members: Anthony Copeland, Jacob Gingles, John McDonald, Jake Odom
Sponsor: American Electric Power (AEP)
Advisor: Dr. John Matthews

3:00 IESB 112

COMPOSITE ROLLER LUBRICATING SYSTEM

The sponsor of this project, Bill Sawyer, runs Sawyer Plastics of West Monroe which manufactures a variety of products for the paper industry, the food service industry, and others. Sawyer Plastics produces a sealing component called the "silencer" that functions within the Suction Roll machine in a paper mill. The machine sucks water out of a passing roll of paper. Our goal is to extend the life span of the silencer by decreasing wear. We proposed utilizing the water being sucked out to help lubricate the silencer's surface. By modifying the silencer's profile to include several grooves and fillets, the water already being sucked out can form a friction-reducing boundary layer on the surface. A scale model suction roll was built that could experimentally determine the friction coefficient of our silencer to gauge its efficacy. The reduction in friction means a longer-lasting silencer and a lower energy cost to operate the suction roll machine.

Team Members: Charles Rink, Clausius Sama, Eric Smith
Sponsor: Sawyer Plastics
Advisor: Dr. Yun Chen

3:30 IESB 112

META-MATERIAL LANDING PAD SYSTEM

The sponsor for this project is Gill Athletics located in Champaign, Illinois. They are the world's largest manufacturer of track and field equipment. Some of Gill's popular products are pole-vaulting and high-jump landing pads. For years the entire pole-vaulting/high-jump industry has used the same internal pad construction. The goal of this project is to improve Gill's current pad design by decreasing its weight, without increasing the peak acceleration experienced by the athlete when they fall onto the pad. As a result, the pad will be cheaper to ship and easier for the user to move, while still being safe for athletes to use. The chosen design uses meta-material concepts to decrease the weight of the pad without increasing the peak acceleration. The new design also has fewer pieces composing the internal structure, ultimately reducing the cutting and assembly costs for the product.

Team Members: Brett Ezernack, Noah Head, Luke Griego, Tanner Mayo
Sponsor: Greg Luebbering, Gill Athletics
Advisor: Dr. Timothy Reeves

4:30 IESB 112

COMBINED SESSION AND BARNWELL AWARDS

MECHANICAL ENGINEERING

SAFETY SESSION - MODERATOR: DR. ETHAN HILTON

1:00 IESB 114

HYDROGEN COOLER COVER KEEPER

CLECO's Brame Energy Center is a power plant located in Lena, Louisiana, which produces over 1,600 megawatts of power for central Louisiana. Within this power plant, there are hydrogen heat exchangers that help maintain the safe and efficient production of electricity by cooling turbine-related machinery. On each hydrogen cooler, there are a total of four bolted access covers with each cover weighing 150 pounds. The current maintenance process requires that the covers be lowered to the ground (approximately 10 feet below) and then hauled back up at the conclusion of this work. This lowering and lifting process is time-consuming and requires heavy machinery with certified crane operators. CLECO has tasked our team with making the cover removal process more efficient. Our project design helps drastically reduce the cover removal time, removes the need for certified crane operator support, and removes the need for the covers to be lowered to the ground. The design will also be easy to operate, with only two operators required to move the covers using up to 13 pounds of manual force.

Team Members: Grant Amerson, Jared Arnold, Mitchell Austin, John Cook
Sponsor: Jeremy Brimer, CLECO
Advisor: Dr. Ethan Hilton

1:30 IESB 114

TANK HEAD FLIPPING APPARATUS

Union Tank Car Company (UTLX) is a railway equipment leasing, rail car maintenance, and rail car manufacturing company headquartered in Chicago, Illinois. For our project, we worked with the tank heads that are welded onto the end of each rail car. UTLX required an apparatus to reorient multiple tank heads safely and simultaneously. This apparatus enables their team to cut off the excess metal that inhibits proper welding of each head to the car. Our design is a cage mounted on support legs that can rotate the stack of tank heads about their center of gravity. This design was needed to enable this operation to occur in less than 30 minutes with no damage/alterations to the tank heads. The design also had to accommodate various standard sizes of tank heads while making the process safer and easier. In our project, we ensured that the heads could be supported by the new apparatus, employing numerous safety measures around and in the apparatus, and allowing the UTLX team to load/unload the stack efficiently from just one access point. Our design will virtually eliminate any possible damage to the tank heads, as they will be reoriented with a controlled and safe process.

Team Members: Austin Barton, Mike Castro, Jordan Holcombe, Anton Razepine
Sponsor: Austin Phillips, Union Tank Car Company
Advisor: Dr. Timothy Reeves

2:00 IESB 114

30 MINUTE BREAK

MECHANICAL ENGINEERING

2:30 IESB 114

COOLING TOWER FILTER SYSTEM

Calumet Lubricants located in Shreveport, Louisiana, sponsored our project. Calumet produces a variety of products from oils to solvents to fuel. Cooling tower water entering a series of pumps must be filtered to remove debris to be used in different stages of production. When the current cooling tower filters are removed for cleaning the process allows debris to fall back into the stream causing expensive damage to the pumps. Our new design uses an insert to slide over the face of the current filter and "sandwich" the debris between the faces. Now, when the filter is removed the new design forces the debris to be enclosed within the assembly. To ensure the simplicity of our design, we stayed with the same method of operation utilizing the overhead pulley system that was already in place. The new design provides clean removal of debris which increases the longevity of the pumps by decreasing the need for repairs.

Team Members: Austin Irons, Aaliyah Jackson, Dylan Gray, Davis Sutton
Sponsor: Calumet Lubricants
Advisor: Dr. Michael Swanbom

3:00 IESB 114

MEA ACTUATOR REMOVAL TOOL

Cleco Corporate Holdings LLC is an energy production and distribution company. The project is taking place in Cleco's Brame Energy Center located in Lena, Louisiana. Multiple corporate brand MEA actuators are located inside the Rodemacher Unit 2 section of the energy center. Each actuator unit is roughly 4 feet tall by 2 feet square and weighs ~1700 pounds. Once a year, these devices need maintenance. This maintenance requires removal from its holding structure and transportation to a maintenance facility. The current removal and replacement process takes up to 4 hours and is potentially unsafe. The enclosed space where the actuator units are housed is generally too small for a forklift to be used. The newly designed solution to this problem is to use a short pallet jack with a tilting mechanism attached. This will allow the actuator unit to be removed from its holding structure and passed through all the adjacent spaces that have limited clearances. With this design, the safety of the workers involved is improved and a significantly faster removal time is achieved.

Team Members: MeiLan Hardin, Austin Marlar, Michael Snodgrass
Sponsor: Cleco
Advisor: Dr. Ethan Hilton

MECHANICAL ENGINEERING

3:30 IESB 114

RAPID LOCKING MANWAY COVER

Union Tank Car Company (UTLX) is based in Alexandria, Louisiana. It manufactures and leases railroad tank cars. Each tank car has a manway cover that seals an opening that is periodically accessed for interior cleaning. We are tasked with redesigning the traditional 8-bolt manway cover located at the top of these cars. The issue with the 8-bolt design is the time it takes to open and close it and the human error associated with the tightening pattern. Our design has one center bolt that actuates eight lever arms simultaneously. This arrangement evenly distributes the sealing force and provides a mechanical advantage when closing. We eliminated the need for laboriously following a bolt-tightening pattern. This design change reduced the closing time by over 50 percent. The financial benefit of this design comes from the elimination of costs and safety hazards associated with improperly sealed tank cars.

Team Members: Kennedy Abshire, Mattew Gennaro, Dale Lasseigne, Stuart McLoughin
Sponsor: Union Tank Car Company
Advisor: Dr. Michael Swanbom

4:30 IESB 112

COMBINED SESSION AND BARNWELL AWARDS

MECHANICAL ENGINEERING

PERFORMANCE SESSION - MODERATOR: DR. HENRY CARDENAS

1:00 IESB 122

AUTOMATED BAG FITTER

Hayes Manufacturing is a custom and industrial manufacturer located in Pineville, Louisiana. The company provides high-speed, high-precision machining, welding, and fabrication services for heavy industry. There is a need for a tool that assists in the placement of garbage bags into waste cans without having to reach into the can and without the nuisance of entrapping air between the inside of the can and the outside of the plastic bag. The design uses a DC blower-style fan, a 9V battery, and other electronics enclosed in a housing unit. A custom tube attached to the unit evacuates the trapped air while keeping the housing unit located on the outside edge of the trashcan, thus maximizing the fit and capacity of the bag. The measures of success for this project can be summed in the following: complete operation within 2 minutes, minimum bag conformity of 80 percent, and total hardware that does not exceed a weight of 3 lbs. This product can impact the everyday consumer by reducing the time and hassle that comes with inserting trash bags and fitting them into the can.

Team Members: Avereigh Barras, Morgan Manuel, Ezekeial Webb
Sponsor: James Hayes, Hayes Manufacturing
Advisor: Dr. Arden Moore

1:30 IESB 122

FLIGHT PROVING GROUND

Sci-Port Discovery Center is a science and space center, partnered with NASA, and located in Shreveport, Louisiana. Sci-Port's goal is to increase involvement and interest in STEM-related fields. Sci-Port has reached out to Louisiana Tech to technologically innovate the Flight Proving Ground exhibit. This exhibit is a fun activity for individuals to launch paper airplanes through hoops. Our goal is to improve the educational and technological aspects of this exhibit. Our design includes two targets: one stationary and one in motion. The hoop targets sense when an airplane passes through. The hoops then emit lights to illustrate success. At the start of the exhibit, a screen monitor assigns users to selected historical characters that have influenced the history of the flight. A brief description of each character is provided to educate the users. The monitor displays the number of points they achieve based on the success of their airplane's flight. The moving target points are awarded depending on the distance. Our design increased plane detection to 95 percent accuracy, improved user feedback using flashing lights and a displayed score, and improved the educational aspect of this exhibit via an interactive and formational screen.

Team Members: Claire Cazedessus, Yves Cucinella, Cle' Sanchez, John Weinell
Sponsor: Sci-Port Discovery Center
Advisor: Dr. William Long

MECHANICAL ENGINEERING

2:00 IESB 122
30 MINUTE BREAK

2:30 IESB 122
TANK CAR INSULATION APPLICATOR
The Union Tank Car Company (UTLX) owns the largest tank car fleet in North America and assembles each tank at its factory in Alexandria, Louisiana. A critical step in the production process involves applying insulation between the car's inner and outer shells. The current method of insulation application is an entirely manual process utilizing four technicians. UTLX desires an automated process to reduce the number of technicians, and thus, the total number of man-hours. The team developed a process that uses an overhead crane/trolley system to pull the insulation around the tank car. A pneumatic piston system suspends the insulation above the tank car's surface until it is ready to be lowered. The pistons then release pressure to conduct a controlled lowering of the insulation onto the tank car. The implementation of this design will reduce the number of required technicians by two. With an estimated labor cost of $76,987.50 per technician per year, the projected labor savings per year will be $153,975.

Team Members: Ben Leethy, Blake Fagan, Kameron McKnight, Michael Morgan
Sponsor: Scott Enger, Union Tank Car Company
Advisor: Mr. Roger Danzy

3:00 IESB 122
GASKET SEALING SYSTEM
Located in Broussard, Louisiana, Step-Ko Products is a provider of corrosion protection products for the oil and gas industry. Currently, the company is working to increase the speed and efficiency of the assembly process of the gaskets that they produce. This process consists of applying an adhesive into the groove of one side of a gasket and then placing a solid sealing element into the groove. Once this is completed, the process is repeated on the other side of the gasket. Currently, this process is done by hand, causing the assembly rate to vary depending on who is performing the task. Our design consists of a rotatable platform that holds the gasket. A dispenser for the adhesive is attached to a rack and pinion and supported by linear guide rails. A plunger used for compressing the sealing element is also attached to the rack and pinion. The sealing element will be placed by hand. Our design will increase the speed of the assembly process and reduce any bottlenecks in the process.

Team Members: Sahr Alhejaili, Wesley Goldstein, Ben Grice, Devin McCartney
Sponsor: Step-Ko Products LLC
Advisor: Dr. Prabhu Arumugam

MECHANICAL ENGINEERING

3:30 IESB 122

INTERACTIVE TEST FLIGHT STATION

Sci-Port Discovery Center is a science and entertainment center with interactive science exhibits that is located in Shreveport and is open to all age groups. Our project, the Interactive Test Flight Station, is designed mainly for children to learn about paper plane flight patterns. The main focus of our project is to create a more intuitive test flight station with sufficient laminar airflow. The second goal is to create a more interactive interface with which children can control the airflow and select which type of paper plane they want to create. Lastly, we need to create a system that will indicate plane flight distress and a guide system that will provide a remedy for the distress. Our design fits several selected styles of paper airplanes and is balanced when fitted according to the instruction provided. The airflow in the wind tunnel is straight and consistent throughout the test flight of the paper planes. Our wind tunnel design is based on the existing NASA wind tunnel principle which is simple to replicate, and we have provided electronic files for the 3D printed stands to replace when necessary.

Team Members: James McPherson, Dustin Miller, Sujan Paudel, Rhett Perkins
Sponsor: Sci-Port Discovery Center
Advisor: Dr. Kelly Crittenden

4:30 IESB 112

COMBINED SESSION AND BARNWELL AWARDS

PHYSICS

1:00 IESB 308

THE SEMICONDUCTOR-TO-METAL TRANSITION OF W1-XTAXS2

Transition metal dichalcogenides (TMDs) are a type of two-dimensional materials notable for their widely tunable electronic properties, making them valuable components for transistors, solar cells, sensors, and other important applications. While TMDs are widely studied as semiconductors, some TMDs, like TaS_2, have metallic properties. Heterogeneous monolayers with two or more transition metals have been studied; however, the effect of combining transition metals of different periodic groups has not been fully explored. This study examines the effect of doping WS_2 with a transition metal adjacent to tungsten, namely tantalum, as a function of the concentration and the relative position of the doping atoms. To obtain this data, density functional theory calculations were performed using the software, QuantumATK. Band structure and density of states were used to understand the electronic properties of the monolayers. The data showed that doping WS_2 with tantalum resulted in band structures consistent with p-type doping with concentration-dependent electronic properties. In addition, we observed that the band gap depends on the relative position of the dopants. The semiconductor-to-metal transition of W1-xTaxS_2 occurred between x = 0.04 and 0.10, depending on the locations of the Ta atoms. The effect of the relative position of doped atoms has not been discussed in the literature, so these findings will improve the understanding of heterogeneous monolayer TMDs and potentially impact the design of heterostructures with uniquely tailored properties.

Team Member: Elizabeth McDowell
Advisor: Dr. Pedro Derosa

IMMEDIATELY AFTER THE PRESENTATION

PHYSICS PROGRAM AWARDS


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