2018 Senior Design Conference Project Abstracts

Architectural Engineering

AE1 - Design of Energy Efficient Baseball Clubhouse
Team Members: Victoria Longoria, Christopher Hoch, Justin Mendoza, William Peterson

Our team is designing a new facility for the Nolan Ryan Baseball Field which is known as "the house that Nolan Ryan built." As one of the top baseball facilities in the Lone Star Conference, the Nolan Ryan Field has been the home for TAMU-Kingsville Javelinas since 1994. Although the team's performance has been exceptional, they do not have a proper facility that projects their success. Two main features lacking from the site are locker rooms for both the home and visitors' teams. Since there has already been interest expressed in building a baseball clubhouse, our team feels that we have the knowledge and capabilities willing to excel and succeed in this project. Our proposed design for Nolan Ryan Field will provide a home for the TAMU-Kingsville Javelina baseball team, as well as providing an attraction for alumni, donors, and scouts. The current condition of the Nolan Ryan Field does not provide many of the features that are a necessity for a baseball team.

Our design will include:

- The much-needed locker rooms with showers and restrooms on site.
- A film room to give the team a place to watch practice tapes and hold team meetings.
- A state of the art practice lab will allow them to record and review their performance.
- A training room to provide rehabilitation and treat injuries.
- The concession stand, and a newly added store will provide opportunities for more revenue.
- The suites on the second floor will provide a private area for the alumni, donors, and scouts.

Our design will provide the baseball team the tools they need to succeed and further their careers.

AE2 - Design and Renovations of the Student Union Building
Team Members: Loay Anbar, Sophia Calderon, Rose Leonard, Gabriella Trevino

Our project topic is to remodel and expand the university Student Union Building (SUB). The SUB is a popular building that serves as a multi-purpose building on campus. As our student population increases each year, it becomes difficult to fit a large quantity of people into one building.
Our first objective is to make the SUB bigger by closing in the courtyard and extending the second floor roof/ceiling that will change the shape of the front of the building. Next, we will expand the back of the main hallway by taking 5 feet away from the computer nook of the financial aid office. Since we are maximizing the hallway we will make the back door bigger, by adding automatic sliding doors. We will be removing the current game room out of the food court and building a new addition to the SUB across the bookstore that will be our TAMUK Arcade. This arcade will consist of the existing game room equipment and more. This addition will have similar properties and characteristics of the already existing SUB. Lastly, we will be remodeling the university food court. While observing the current dining/game room, our team noticed that there is a large influx of students between the subway portion and the alternative food partitions. It is heavy congested and uncomfortable for most students who are waiting in line to order and those who are sitting at the tables against the walls. We discovered that removing unnecessary walls will create a more efficient floor plan that would also maximize the seating space. We came up with our design based off what we thought would be more efficient for the SUB as students.

AE3 - Designing a New Engineering Complex

Team Members: Matthew Reyes, Jesus Trevino, Michael Watson

The current Engineering Complex is a three-story building, but cannot satisfy the increasing occupancy need today. To satisfy this need, a new engineering complex is needed, which will: (1) provide large, assembly-style lecture rooms so larger class sections do not have to look for suitable classrooms in different areas of campus; (2) add a service elevator and a skywalk conjoining our new design with the current engineering complex; (3) provide new classrooms, labs, and office spaces that not only rectify the current issue of overcrowding but allows and encourages growth in the future for the engineering department at Texas A&M University-Kingsville. In this design project, our group is considering implementing energy methods that will reduce the amount of energy consumption and incorporating into the new facility. We plan to ensure the building will be environmental friendly by incorporating innovation and various LEED (Leadership in Energy and Environmental Design) strategies "The five critical areas of focus, as laid out by the USGBC, are "sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality."

Civil Engineering

CE1 - Rehabilitation of Third Street

Team Members: Fahad Alahmari, Abdulmuhsen Alajmi, Mohamed Alameri, Abdullah Alazemi, Nawaf Aldossari

This project includes a renovation of the Third Street, which appears to have poor condition. A preliminary recommendation was provided for improvements. This report includes an identification of roadway damages and the required Engineer's opinion of probable cost.

E2 - Research about Tall Building

Team Members: Hamad Alghuwainem, Abdulmajeed Almutairi, Shaimaa Almutairi, Talal Alneghemesh, Nasser Alotaibi

This research was conducted with a greatest curiosity to learn how the tallest sky scraper could be built. Additional curiosities include: how to build a very tall building in the desert, how to keep it cool, how to resist a hurricane wind pressure, and more.

CE3 - TAMUK New Music Building

Team Members: Faisal Alqahtani, Justin Buchen, Gabriel Barrera, Gilbert Castelano, Walter Chaho

The new TAMUK music building project provided civil engineering students with practical experience in geotechnical and structural engineering. Students learned to use real data to conduct their design and analysis.

CE4 - New Utilities Room

Team Members: Christian Hinojosa, Neyra Linares, Othman Malallah, Edwin Manrique, Jarrah Mohammad

A new utilities room was simultaneously built with TAMUK new music building in order to supply electricity, air condition and lighting systems.

CE5 - Renovation of Mesquite Grove Facilities

Team Members: Clara Owinje, Marc Rybczynski, Christian Trejo, Lizeth Vazquez, Saul Yanez

This project includes the proposal to renovate the existing old Mesquite Grove facilities so that the new ones can accommodate more audiences for hosting an outdoor concerts and graduation parties.

CE6 - Rehabilitation of Santa Monica Street

Team Members: Mohammed Alazmi, Mohammed Aljedaie, Khalid Almutairi, Meshal Almutairi, Saad Alsaffar

A section of residential street was examined to show how runoff water could cause damage to the asphalt concrete roadways. The drainage area and runoff along this roadway were analyzed based on the Rational method to make a preliminary recommendation with Engineer's opinion of probable cost.

CE7 - Courthouse Parking at Eleven Street

Team Members: Anthony Arredondo, Jonathan Cabrera, Luke Herring, Victoria Longoria, Omar De La Rosa

Proposal of this project consists of 11th street and an all-around Kleberg County Courthouse parking facilities. This project involves an all-around knowledge of the related hydrology, survey, and pavement materials as well as construction process and procedure.

CE8 - TAMUK Jogging Track

Team Members: Abdulaziz Alothman, Jeremy Gallardo, Luis Hernandez, Hamza Saadi

The appropriation of building a TAMUK outdoor jogging track was exploring in order to improve student fitness.

Multi-Disciplinary

MD1 - Mars Sample Return System (MSRS)

Team Members: Lane Patterson, Jorge Lankenau, Russell Prophet, Samuel Dunlap, Robert Eledu, David Rodriquez

The team's mission is to design a Mars Sample Return System Rover (MSRS) capable of operating on Mars surface, retrieving a sample canister, and returning the sample to the rocket, per NASA requirements.

MD2 - Aquaris: A Solar Powered Water Filtration Unit

Team Members: Omar Cavazos, Jorge Medina, Brittany Rodriguez, Reneal Rodriguez, Javon Walker

One of the most pervasive problems afflicting communities of people around the world is contamination or disruption of clean water sources for drinking. The goal of this project was to design and build a portable solar powered water purification system called "Aquaris." Our team expects that the development of such a system will make a significant impact on communities of people across the world. Aquaris will consist of a 1 gallon per minute (gpm) pump that will generate flow through a sediment filter, carbon filter and ultraviolet filter. Performance evaluations will be conducted using turbidity, and contamination tests. The flowrate of the system will be monitored by using an inline flowmeter (rotameter). Aquaris will rival the purification capabilities of any water purification system of its kind in the market.

MD3 - Rockport-Fulton FEMA Dome

Team Members: Diego Andrade Tamez, Hector Leal, Macain Proske, Sara Cantu Williams

In August of 2017 the Rockport community was devastated by Hurricane Harvey. Among the buildings damaged were both of Rockport-Fulton High School's gymnasiums--one of which suffered irreparable damage. This project proposes a structure that would function as both a new high school gym, as well as provide a community safe shelter in the advent of a natural disaster. The design will feature an architectural layout befitting a high school gymnasium, a concrete dome, a post-tensioned concrete ring beam, a masonry exterior cavity wall, and a driven pile foundation. Our design conforms to FEMA P-361 & the ICC 500 which are the governing building codes for storm shelters.

MD4 - Mobile Suit: Vision

Team members: Juan Fernandez, Blanca Mendoza, Rafael Moya, Mario Ramirez, Haylee Reyna, Jesus Fasci

Our team's goal is to design and fabricate an "exo-skeleton" type suit that can be utilized by individuals for heavy lifting purposes. It will be "mobile" in the sense that it can move loads from one place to another. Some objectives are:

1. Seatbelts for safety purposes
2. Actuators on the arms and legs
3. Extending arms for reach
4. 8 tire system
5. Actuators to reach a higher height
6. Aluminum frame
7. Two wheels on each leg
8. Powered by DC Motors

MD5 - Minesweeping Robot

Team members: Avery Briones, Zachery Garcia, Alejandro Valencia, Emmanuel Vega, Sergio Zamora, Jacob Vichique

Our team's goal is to develop a rover to help detect land mines without injuring any human or animal life. The proposed minesweeper's primary purpose is to constantly seek landmines. We would like the vehicle to be multi-functional, autonomous, remote-controlled, and self-sustainable. Furthermore, it is desired that the device be able to give a detailed image of underground objects.

Mechanical Engineering

ME1 - Turbojet Engine

Team members: Aziz Abdullah, Veronica Alvarez, Victor Guzman, Darren Rhodes, Farid Solis

Problem Statement: Design and assemble a fully functional gas turbine engine and monitor the effect of a varying fuel flow rate on output and various operating variables. The gas turbine engine should resemble a thermodynamic Brayton cycle1 and consist of a compressor and turbine connected by a common shaft and separated by a combustion chamber. In the combustion process, fuel is to be injected into the hot pressurized air stream from the compressor, burned in the combustion chamber at nearly constant pressure, and then expanded through a turbine to produce the work necessary to drive the compressor.

Our team's goal is to design and fabricate a fully functional turbojet engine with the following features: Turbocharger, combustion chamber, exhaust nozzle, fuel injection system, and lubricating system.

Objectives:
1. Obtain a propulsive thrust of 150 lbf or 667.233 N
2. Maximize efficiency: 45 ~ 60%
3. Minimize size and weight
4. Minimize cost: $1500

Limitations:
1. Turbine blades can withstand no more than 2400 deg. F or approximately 1600 K
2. Mass flow rate of air is limited by the size of turbocharger inducer
3. Factor of Safety of 2

ME2 - Feedwater Heat Exchanger
Team members: Saad Alajran, Abdullah Alazemi, Ersheed Alkhatlan, Omar Almahjan, Khaled Almay

A U-Tube Shell and Tube heat exchanger is to be designed by our team as a feed-water heater for a power plant similar to the one shown below. High energy steam is typically extracted from high pressure turbine and run thru a heat exchanger to improve overall efficiency of the plant. The exchanger is to meet the following specifications:

1. Inlet steam conditions (extraction fraction from HP turbine): 400 degrees C with 50 degrees superheat)
2. Exit steam: saturated steam at 208 kPa (absolute)
3. Inlet feedwater temperature: 40 degrees C
4. Exit feedwater temperature: 110 degrees C
5. Extraction steam flowrate: 2 kg/s
6. Feedwater pressure from condenser (after pumping): 500 kPa (absolute)
7. Maximum pressure drop across tube side: 135 kPa
8. Overall Design Factor of Safety: per ASME or TEMA code

ME3 - Fusion Based Neutron Source
Team members: Juan Alvarez, Clay Blackwell, Moiz Butt, Miqueas Duran, Jeffrey Parks, Abdullah Weiss

The team's goal is to design and fabricate a neutron source that can be utilized for research purposes, as well as those listed below. Our thoughts are that, with our project, TAMU Kingsville may be the first university to have a usable fusion-based neutron source in the South Texas region.

1. Radiation Therapy (ex. BNCT)
2. Material Testing
3. Material Composition
4. Radiation Resistance
5. Neutron scattering
6. Strain and Stresses of Pipes, Turbines
7. Carbon dating
8. Radioactive sources production
9. Petroleum well logging
10. Medical imaging

11. Explosives Detection
12. Nuclear detection equipment calibration

ME4 - Hand Powered Tricycle

Team members: Khaled Alanzi, Ammar Alghamdi, Hassan Alhulaili, Faleh Almlihi, Tariq Alotaibi, Basil Alsubaie

The team's goal is to design a hand powered (and steered) tricycle for use by wheelchair-bound individuals. The vehicle will allow these individuals to obtain greater mobility and upper body exercise simultaneously. Some of our desired features are: a reversing mechanism, a differential mechanism, steering and power delivery on the same column, and the ability to operate vehicle from one's own wheelchair.

ME5 - NASA Human Rover Competition

Team members: Aaron Balles, Josiah Gomez, Kevin Hill, Sheriff Oseni, Jason Rodriguez, Jaime Vargas, Susana Samayoa

To compete in the challenge, our team is to design a human rover vehicle under a certain amount of design constraints that has been provided by NASA. The design and build set-up of our rover is at the team's discretion; we have successfully built the hubs that fit seamlessly into our wheels, built and assembled the frame, and the front and rear drivetrain. Other completed parts include the U-joints and steering knuckles. These are the majority of the core components for the Rover

ME6 - Airborne Wind Turbine

Team members: Abdullah Alahmadi, Abdulaziz Aldaham, Fehaid Alhajri, Abdulaziz Almari

Our team's goal is to design a tethered, airborne, and wind driven generating system. Our intent is that the design satisfies the following specifications:

Parameter	Description/Value
Turbine Blade Specifications	
Material	Fiberglass
Number of Blades	3
Overall Turbine Specifications	
Power to Weight Ratio	6.2 kW/kg
Expected Efficiency (For power conversion)	90%
Weight	2300 kg
Operational Wind Speed Range	10-45 m/s
Operational Altitude range	100 - 3000 feet
Balloon Specifications	
Material	Rubber
Gas Used	Helium
Length	30 m
Diameter	10 m
Volume of Balloon	4000 m^3
Stability Mechanism	Ropes for anchoring
Tether Specifications	
Material	Carbon Fiber
Number of Tethers	3
Special Features	
Fins on Balloon	Enhanced Aerodynamic Characteristics
Control System	Coupled with ropes to alter height
Reinforced carbon fiber tether	Enhanced Strength and Conductivity
Novel Blade Design	Generated through Javafoil

ME7 - Automobile Collision Force Reducing Chair

Team members: Camren Bryant, Kale Karlen, Dave Pacheco, Thomas Soto, John Yarbrough, Andres Carrillo

Of the yearly 6 million car accidents, 40% are rear end collisions (NHTSA). Referred to as "whiplash accidents", rear end collisions can cause long-term injuries at low speeds due to spinal and neck areas. Damage is caused by a combination of impact speed and surprise.
Our team's goal is to design a device attached to the car seat that will reduce "g" forces on passengers involved in automobile collisions.

ME8 - Asparagus Harvesting Machine"

Team Members: Cassandra Carrizales, Albert Castro, Robert Sanchez, Jonathan Soto, Caleb Y. Wong

Our team's goal is to design a machine that can be towed behind a tractor and harvest asparagus shoots. Presently, much of this harvesting is done by hand, or requires very expensive equipment. We wish to achieve the following:

1. Improve harvesting rates
2. Cut three rows at a time
3. Improve cost to harvest
4. Appeal to smaller farms
5. Fit most agricultural vehicles

ME9 - An Improved Drilling Bit for the Petroleum Industry

Team Members: Mona Alsolmie, Malcolm Cameron, Utah Cox, Malcolm Davis, Mauricio Rivas, Alexander Lopez

Our team's goal is to design an improved diamond drilling bit that incorporates a second set of "teeth" such that rig time will be saved, i.e., less time will have to be spent "tripping the hole" to change bits.

Computer Science

CS1 - HomeArch VR

Team Members: Bradley Guerrero, Hailee Mrotek, Emily Saenz, Osakpemwokan Alonge

HomeArch VR (short for "Home Architecture") is an Oculus Rift application created in Unreal Engine 4. This software system, developed by TaryBird VR, is intended for individuals who want to design and create their own room, home, studio set, or even building in virtual reality. This helps the user visualize their creation in real time, as if they were there.

CS2 - Javelina Community

Team Members: Natalie Perez, Diane Montez

Javelina Community is a website that provides an alternative means of communication within the Texas A&M University – Kingsville (TAMUK) population. The website is an organized and safe way for TAMUK students and faculty to share information that can be accessible to the entire student body. Javelina Community allows communication through forum posts, calendar events, and direct messages, while also providing security by allowing only those with a tamuk.edu email address to join. TAMUK students, faculty, and organizations can contact various levels of the user population. Users can share announcements and events to the entire user population through the forum and calendar components. Alternatively, users can directly contact individuals using the messaging system. Javelina Community was created in the Cloud9 environment using the Ruby on Rails framework, HTML, CSS/SCSS, JavaScript,

and JSON. The Javelina Community website found success by completing the outlined functionality, support, and views discussed in the project's pre-proposal.

CS3 - Code Quality Checking Using Applied Neural Networks

Team Members: Christopher Cavazos, Ross Sullivan, Bryan Kolenda

When creating software, developers often run into design problems called anti-patterns. Anti-patterns make creating stable, flexible software more difficult. Developers often do not realize that these patterns are present in their code. Ergo is an IntelliJ (a popular IDE) plugin that helps developers identify anti-patterns in their code. The software uses machine learning to analyze Java source code, for anti-patterns. The Ergo system contains a neural network model on the cloud that allows it to be lightweight yet powerful. Ergo comes in the form of an IntelliJ plugin, written in Java, JavaScript, and Python. Our software can save companies time and money by finding anti-patterns quickly, allowing developers to be more productive.

Electrical Engineering

EE1 - Robo Coffee

Team Members: Anna Soto, Andres Aleman, Joseph LaCue

Many coffee makers purchased today can be programmed to have a pot of black coffee ready at a recurring time. This project is aimed at improving the smart automation of the coffee dispenser by offering weaker and stronger coffee, cream and sugar options. The purpose of this project is to create a coffee machine that allows multiple users to make user profiles, indicate how they take their coffee, and the time at which they would like their coffee ready. Thereafter, the coffee machine would continue to have coffee of the desired strength, cream and sugar amounts ready at that time. If multiple people wanted cups at the same time, the machine would be able to adjust so both cups were ready before the requested time had passed. The coffee machine would also alert users that it would be unable to prepare coffee if cups were not in place. For these reasons, the RoboCup coffee machine improves upon current machines available for purchase.

EE2 - Maritime Safety Switch

Team Members: Efrain Cortina, Derrick Waterman, Jeremy Law, Homero Quintanilla

In today's marine industry for recreational center consoles, the mechanical safety lanyard is often forgotten, neglected, or voluntarily chosen not to be worn. The increase in boating related injuries and deaths has risen over the last several years. If more individuals wore the safety device, many accidents and deaths can be prevented. The Maritime safety switch uses electronic sensors to reduce the amount of incidents by completely eliminating the need for a mechanical lanyard as well as taking the human error out of boating safety. Infrared sensors and weight sensors are the primary safety mechanism. In addition, a GPS and FM transmitter have been added to send out coordinates to the Coast Guard if a reset switch is not enabled after an individual is ejected from the vessel. The team has successfully designed and implemented a working prototype which achieves all the necessary objectives.

EE3 - Smart Sensor Car Seat

Team Members: Thomas Ramos, Rene Garza, Delanie Vidales

This project is aimed towards the goal of improving child safety in the manner of a smart car seat. Devastating outcomes can occur to a child left in a vehicle, like vehicular heatstroke, that can lead to death. With this smart car seat, an ideal decrease will be seen in these types of child related deaths. The car seat will be equipped with the capability of the following: GPS monitoring, Temperature and Humidity sensing, child sensing technology, child distress alerts via SMS and an autonomous backbone to control vehicle functionality such as windows and horns. Acquiring this car seat, parents and others in the child care field can gain a sense of composure knowing that this new design is a vastly improved product compared to the traditional car seat.

EE4 - Development of an Autonomous Lawnmower

Team Members: Alex Hernandez, M Omar Lopez, Alex Ortega, Arafat Hussain

An autonomous lawn mower is a mower that can roam and mow a yard without the need of being manually operated. These mowers currently work by randomly bouncing off walls and obstacles which results in a lawn that has been passed over multiple times before being completely mowed. The goal of this project is to create an autonomous lawn mower that can keep track of its location and map out its cutting path by means of sensors mounted on the hardware with custom-made software. To do this, simultaneous localization and mapping (SLAM) is utilized to map out an unknown area and then attempt to plan an efficient cutting path that does not pass over the same areas multiple times.

Environmental Engineering

EV1 - Electro Dewatering at the Owen Stevens Water Treatment Plant (OSWTP)

Team Members: Kevin Hunter Averitt, Jose Arman Soria, Christina Williams

To remedy the ever growing sludge build up problem taking place at the Owen Stevens Water Treatment Plant (OSWTP), a new kind of sludge treatment must be implemented to raise the sludge concentration rate higher than the current 28% .This report explores an emerging technology known as electro dewatering (ED) and the benefits it processes over its competitors. ASW Engineering found that ED would be the most optimal treatment process to peruse as other dewatering technologies such as centrifuges, geotubes, and membrane filter presses don't produce as high of a sludge concentration as ED and take much longer to treat water. It will be ASW Engineering's recommendation for the OSWTP to move forward with ED as this technology meets all the necessary objectives of the plant while exceeding the main goal of a sludge concentration higher than 28%.

EV2 - Landfill Final Cover Renovation

Team Members: Candice Valerio, Omar De la Garza, Courtney D. Davis

The purpose of this project is to study the properties of mulch, sludge (WTR), and topsoil, and develop two sustainable final cover ratios (King 4, and King 6) that are in compliance with the Environmental Protection Agency (EPA), and the Texas Commission on Environmental Quality (TCEQ). In order to obtain this design, the following parameters were measured: Macronutrients, Micronutrients, pH, Conductivity, Hydraulic Conductivity, Moisture Content, Bulk Specific Weight, Cation Exchange Capacity (CEC), and the Organic Matter Content. The results pertaining to these parameters, demonstrated that the two ratios (King 4, and King 6) do indeed meet the compliance regulations. All landfills in the state of Texas that have reached their full capacity can benefit from this design.

EV3 - Achieving Class-A Biosolids through Thermal Drying

Team Members: Brooke Schalm, Andrew Medrano, Alexandra Arrazola

Sludge disposal is something that many wastewater treatment plants take advantage of in today's society. Rather than dispose of the sludge, this paper will take in consideration the addition of a

heat treatment to the sludge treatment system to eliminate pathogen and vector attraction. This will transform the sludge from an Environmental Protection Agency (EPA) Class-B biosolids to EPA Class-A Exceptional Quality (EQ) Biosolids. These solids are suitable for any usage, whether it be home application or land application for agriculture. This is a good option rather than disposing of the sludge and spending money annually. Usage over disposal allows this addition to be a sustainable way to not only make use of the sludge but also turn around a profit by selling the sludge. Using the best options for this process will allow the Greenwood Wastewater Treatment Plant to take a step forwards to advancing their technology and overall improving the plant.

Chemical Engineering

CH1 - Production of Ethyl Acetate from Ethanol and Acetic Acid
Team Members: Yash Bhakta, Danielle Escalante, Celine Garcia, Jacqueline Molina

The chemical process presented is the production of ethyl acetate from acetic acid and ethanol. An ion-exchange resin, Amberlyst 15, is used, in substitution of sulfuric acid, to improve the reaction by providing the necessary catalytic material. Through the use of a reactive distillation column and the packing material of Amberlyst 15, a conversion rate of 97% was achieved. This process consists of four azeotropes between all chemical involved; however, by utilizing various separation units, the product was successfully isolated with a purity of 97% and a production rate of approximately 12,100 tons/year.

CH2 - Production of Oxalic Acid from the Oxidation of Ethylene Glycol
Team Members: Anthony Montez, Carla Centeno, Christian Falcon

This project focuses on the production of oxalic acid from the oxidation of ethylene glycol. Using a target production rate of 44,000 tons per year, we were able to simulate this process using the Aspen Plus V10 software. This process produces two product streams that provide a total recovery rate of 99%. From this recovery rate, our production rate is 43,466 tons per year. A safety analysis was performed which looked at any hazards associated with the primary reactor. All waste streams were observed and a plan of action was implemented for treatment in an effort for proper waste and environmental control. An economic analysis was also performed which includes the capital costs for the unit operations as well as all operating costs. These costs were compared with the revenue of selling oxalic acid and a payback period was calculated.

CH3 - Acrylic Acid from Propylene and Oxygen
Team Members: Thomas Castanon, Yatziry Martinez, Jose Quintanilla, Liliana Vela

Acrylic acid is a valuable chemical widely used as an intermediate for textiles, polymers, and other chemicals. It is commonly used in industry to produce a plethora of household goods. Acrylic acid will be produced by the partial oxidation of propylene using a molybdenum-based catalyst in a jacketed-plug flow reactor. From our created model, the project yields about 80% conversion rate of the desired product with a byproduct of acetic acid also sold. In this research we have designed a chemical process using ASPEN Plus V10 to produce a target of 60,000 metric tons per year of acrylic acid. An economic analysis was performed by calculating the price of each unit and the utilities for each major unit uses using CAPCOST. Major units for the project also include a flash separator, absorber, acid extractor tower, and two vacuum distillation towers. We have also implemented sustainability methods such as a recycle stream and heat integration to maximize product yield while simultaneously maximizing savings in utilities. The total initial investment required will be just under $38 million. The plant will be built over

the course of two years near the Mississippi River for the port convenience as well as the feedstock ease. Acrylic acid is sold at $1.918/kg and will generate about $110 million gross per year. Approximately $20 million per year will be made in profit after discounting utilities, feed cost, labor, and administrative expenses. Once the investment is made, the discounted cash flow will become positive just before the fourth year of operation.

CH4 - Production of TAME from Olefins and Alcohols

Team Members: Miguel Zamora, Dominic Homs, Jade Redublo, Christian Villarreal

Tert-amyl-methyl-ether (TAME) is a fuel additive used to increase the oxygen content in fuel. It was made as a more environmentally friendly version of methyl-tert-butyl-ether (MTBE), but even so, TAME does still have a few environmental concerns and could be replaced with other eco-friendly alternatives in the future. Our process utilizes a reactive distillation column to increase our product yield, as well as pressure swing columns to break the azeotrope between the C5 mixture and methanol to make selling the remainder of the C5s possible.

CH5 - Production of Acetone from the Dehydrogenation of Isopropanol

Team Members: Daniel Diaz, Jose Franco, Rodney Garza, Juan Hernandez

Acetone is a widely used chemical that can serve as a constituent for many applications. Such applications may include, active ingredient in nail polish remover, cleaning agent for glassware in a chemical laboratory, utilized to produce methyl methacrylate, etc. Acetone may be produced through the dehydrogenation of isopropyl alcohol. This process is endothermic and may be more favorable in the presence of a catalyst. The catalyst that was chosen for this study is a mixture of zinc oxide and 6-12 wt. % of zirconium oxide. The end result of this reaction will produce acetone and hydrogen gas, which will be separated in a flash drum, and scrubbed with water in an absorption tower to maximize the collection of acetone. A mixture of acetone, isopropyl alcohol, and water will then be introduced to a distillation tower to produce a 99.9 mole percent distillate stream of acetone. The bottoms mixture of isopropyl alcohol and water will be introduced to a second distillation tower to recycle both the isopropyl alcohol and water. The isopropyl alcohol will be directed to the beginning of the process and mixed with the initial feedstock of isopropyl alcohol, and the water will be directed to the absorption tower. The production value of this proposed plant is to meet 100,000 tons of acetone/year. This production value is based on the total annual capacity of chemical plants that produce acetone; a value lower than the average on an Independent Chemical Information Services report was chosen to obtain a production value. With the approximate price of isopropyl alcohol at $0.34/lb., acetone approximately selling for $0.42/lb., and the ability to use hydrogen as a fuel gas for a fired heater or selling at $3/m3, this proposed process will be profitable.

CH6 - Production of Styrene from Ethylbenzene

Team Members: Cassandra Gomez, Ivan Morin, Joel Wilson, Rudy Flores

Through this project, styrene will be produced by dehydrogenation of ethylbenzene through an adiabatic process, with an approximate production amount of 520 million kg/yr. It is a reaction limited by equilibrium and is endothermic. The process has low pressure, runs at a temperature of 620° C, and steam is added in the reactant to supply heat. We calculate revenue of about $842 million per year, a profit of $30 million per year, and a payback on the capital investment of 2 years.

CH7 - Production of Ethylene Oxide from Ethylene and Oxygen

Team Members: Joe Castillo, Marc Cruz, Fares Diqnah, Jesus Garcia

In the fall of 2017, our group decided to pursue the production of ethylene oxide as our senior design project. Two popular methods used to produce ethylene oxide were discussed in group project four from Design II. One of the earliest methods used was production via the chlorohydrin process, and the most recent, more common industrial method is production via direct oxidation of air and ethylene. Our group originally chose to pursue the direct oxidation method, simply because it has proven to be the most successful method in industrial ethylene oxide production. That pursuit was followed into our senior design, except instead of the use of air, our group decided to use pure oxygen. In group project four, we speculated that using air would be best, because of its cost effectiveness, being that air is easily obtained via the atmosphere that surrounds us, but upon researching the topic more; we discovered that running the process with air would require a longer residence time in the reactor over a larger area of catalyst. Amongst the issues of long residence time and a larger catalyst, there was also the issue of needing to separate the oxygen from the air, which is a mixture. With these issues in mind, our group decided to use pure oxygen instead of air; even though it will initially cost more, we will have a better reaction that utilizes the catalyst more and creates a high purity product. Our process design has changed immensely since the completion of group project four. We were initially very confident in the process design because of how seemingly simple it was. One of the contributing factors to our current PFD becoming more complex than the original is the implementation of recycle streams, and the chemicals used as additions for absorption/separation. In group project four, we knew that there would be recycling, but we did not anticipate them to be as challenging as they actually are. The recycle stream that has given us the most challenge is the stream that recycles MEA+, which is being used to absorb CO2 in order to purify ethylene and oxygen in order to feed unused reactants back to the inlet. We found out that by using MEA+, we would need to include the constituent ions that are associated with it, so we had to use a method in ASPEN called “ELEC-NRTL” in order to properly account for the electrolytic chemistry in the system. This proved to be a difficult challenge because we have no previous experience with this thermodynamic method. To attempt to overcome this challenge, we exhausted our resources by asking our project manager for tips, searching through as much literature as we could find, purchasing a book over ASPEN, and even by submitting a help ticket to ASPEN-help. Another aspect of our project that we did not really consider during group project four was the reactor itself. We realized quickly that finding proper reaction kinetics was very difficult. Although process plants that produce ethylene oxide are fairly common, finding the process controls under which these plants run is not as common. We spent many hours attempting to implement kinetics into a plug flow reactor, and after much trial and error, (and many other components of the project) were able to have successful runs with a working reactor in ASPEN. This led to us having a complete simulation, where we are producing the target amount of ethylene oxide at 99.9% purity. The specifics of the technical work we have completed will be discussed in this report.

CH8 - Production of Synthetic Gasoline from Natural Gas

Team Members: Trevor Allen, Daniel Garza, Fernando Martinez, Carlos Rivas

Production of synthetic gasoline from natural gas is a gas-to-liquid process that produces products of liquefied petroleum gas (LPG), gasoline, diesel and hydrogen. The design consists of two

reactors and a product separation unit. The first reactor is a steam methane reformer (SMR) that requires feed streams of natural gas and steam. The product of the SMR is synthetic gas, which consists of hydrogen, carbon monoxide and trace amounts of carbon dioxide. The current ratio of H2/CO is 3:1. The second reactor is modeled as a Fischer-Tropsch reactor (FTR), which takes the synthetic gas and produces hydrocarbon chains of paraffins and olefines ranging from C2-C20. The products are then sent to the process separation unit which consists of two flash separators and two distillation columns. After separation our final products consist of 3,657 barrels/day of LPG (C2-C4), 9,971 barrels/day of gasoline (C5-C12), 7,947 barrels/day of diesel (C13-C20), and 10,701 kg/day of hydrogen (H2).

CH9 - Production of Adipic Acid from Cyclohexene

Team Members: Julian Reckord, Herbert Nnadi, Orlando Ruvalcaba, Michael Taiwo

Adipic acid (ADA) is a major intermediate used in the preparation of nylon 6.6 which is further used in the manufacture of fibers for textiles and carpets, upholstery, tire strengthening, automobile parts, 3D structural objects, and many other useful products. Ninety five percent of all the adipic acid produced in the United States yearly is used in the production of nylon 6.6. ADA is therefore considered a commercially important product. About 2.5 billion kilograms of adipic acid is produced per year in the United States. We plan to produce 0.003% of the annual production in the US, which amounts to about 7.5 million kilograms per year (856 kilograms per hour). This production target is somewhat not reasonable when compared to the annual production rate of top ADA producers in the United States, but we target smaller consumers.

CH10 - Process of Sulfur Recovery

Team Members: Orlando Pena, Jared Quintanilla, Yalitza Diaz, Nicholas Rodriguez

The process to recover sulfur in industry has now become known as the Sulfur Recovery Unit. The unit as a whole consists of the sour water stripper, amine gas regenerator, Claus process, and the SCOT process. The process we chose to highlight for our project is the Claus process. This is the main process where elemental sulfur is recovered using the “waste streams” from the amine regenerator and sour water stripper units. Our process consists of a series of PFR reactors that simulate the Claus furnace. After this, it goes through a series of condensers and catalytic reactors to further purify the “tail gas” being produced, which includes the hydrogen sulfide and sulfur dioxide. Our process is producing around 114 L-tons/day with around 93.1% conversion of hydrogen sulfide. The capitol cost calculations seem lower due to the fact that our process is just one part of a larger process. The costs of our units are around two million dollars, with utilities costing around four hundred thousand per year. Even though the sulfur we are producing is priced over three and a half million dollars per year, only a small fraction of it will be sold for retail. The large sum will be mainly stored, or paid to be hauled off.

CH11 - Production of Urea

Team Members: Robert Bazan, Jacob Cann, Rohan Joseph, Jose Raya

Urea is a nitrogenous compound that is typically known for being made in the liver of organisms by using toxic ammonia in their systems. 90% of urea is used for agriculture, typically used as prills. This helps with fertilizing the fields by acting as a nitrogen source for the plants or vegetables. The team utilizes the Snamprogetti process to synthesize urea from ammonia and carbon dioxide. By utilizing the overall equation the team was able to successfully simulate a reaction with 65% fraction conversion of

carbon dioxide. Since the current U.S market produces 4.21 million tons per year, the team decided to replicate 10% of the total productions. However, it is important to note that the team was able to successfully synthesize 12% of the U.S market, 0.52 million tons per year. The team estimated the total capital cost to construct the plant to be $142,000,000 and based on a two year construction period, the team expects a return on investment in two and a half years. This calculation is after the team took into consideration the total utility cost of $25,441,067 to operate this plant. The construction site proposed for this plant in in Corpus Christi, TX. This location was chosen because of the ready access to the port for easy shipment of the reactants and the products.

CH12 - Production of Formalin from Methanol and Oxygen

Team Members: Zach Antosko, Veronica Medrano, Jose Garcia, Shelby Porter

Formaldehyde is an organic compound used in a variety of chemical manufacturing processes. It is commonly produced and sold as formalin, a 37-weight percent aqueous solution of formaldehyde. This project is aimed at designing a plant that will produce 37-weight percent formalin from methanol and oxygen using ASPEN PLUS. The production goal for our process is 50,000 tons of formalin per year, where the solution contains sufficient methanol (2-5%) by weight to prevent polymerization under ordinary conditions of transportation and storage. In our process, we are using an iron-molybdenum (Fe-Mo) oxide catalyst, which produces formaldehyde from an exothermic reaction. The process includes a tubular plug flow reactor, an absorber, a distillation column, and a network of heat exchangers, pumps, and compressors. We will be discussing the manufacturing process, design and sizing of equipment, sustainability methods, capital cost estimations, profit, and return on investment.

CH13 - Converting Orange Rinds to Ethanol

Team Members: Katherine Gonzales, Castulo Morales, Cesar Lopez

Fuel production is a process that usually damages the environment. However, citrus peel fermentation is one of the environmentally friendly processes used for fuel production. In this research, citrus peels were collected from Texas A&M University-Kingsville Citrus Center at Weslaco, TX. A distillation technique was applied on the orange-water blend for the removal of D-Limonene, a component that inhibits the fermentation process. The distillation of D-Limonene produced a water-D-Limonene mixture, which was processed by a liquid-liquid extraction method to separate the D-Limonene as a pure component. After the extraction of D-Limonene, yeast was added to the remaining mixture prior placing it in a controlled environment (30°C) for 36 hours until the distillation of ethanol could take place. A controlled environment is needed for better results and comparison between experiments. Another distillation step was performed to extract water and ethanol from the fermented mixture. The extracted water-ethanol mixture was analyzed through Gas Chromatography Mass Spectrum (GCMS) to ensure ethanol was produced and track any traces of methanol. The results were positive. Ethanol production was around 1.91% of the water-ethanol mixture while Methanol was less than 0.02%. Although the results show low ethanol contents compared to the water contents in the water-ethanol mixture, researchers have shown that the citrus peels can produce 7-10% of ethanol from the weight of the used citrus peels. Future work is needed to separate the water-ethanol mixture, which could yield about ~8% of ethanol from the weight of the citrus peels used as raw materials.

Natural Gas Engineering

NG1 - Drilling prognosis: Conventional Deviated Well, Hankamer Basin, Liberty County, Texas
Team Members - Nahum Carr, Nicholas Gaither, Andrew Landry, Wayne Norfleet, Cameron Weese

The project presented is a conventional, deviated well that is being proposed for the Hankamer Field in the Houston area. There are currently 220 existing wells located within the Hankamer Field. The team chose this field for its reputation of being a high producer of oil and natural gas. Upon searching for background information of the field, the group encountered Gaither Petroleum Corporation. Gaither Petroleum Corporation is located in Houston, Texas with gas and oil wells spread throughout Texas and Louisiana. It was suggested by Douglas Gaither, President of Gaither Petroleum Corporation, that we look specifically at site E.W. Boyt 221, a proposed site that is being considered for development. In January of 2018, Mr. Gaither had provided well logs and seismic data so that the project could begin.

The Hankamer field produces most of its oil and gas in the Miocene sands, which are five to twenty three million year old sediment deposits that are entrapped in sandstone. The proposed directional attic development well will produce from the Miocene sand layer 3 at approximately 2950ft true vertical depth through the Miocene sand layer 16 at a true vertical depth of 3600ft.

Data from already completed offset wells will tell us an idea of what our well will produce. This will give us rough estimates of completion design, future production costs and profits, and even completion economics. Our proposed well should deliver eleven different pay zones in the Miocene sands. Most of the offset wells in the area produce these Miocene layers for multiple years each.

NG2 - An Onshore Drilling Program for Hydrocarbons in Duval County Texas
Team Members: George Andrade, Victor Beltran, James Schmidt, Chance Sharpe, Alejandro Vera

The study presents an onshore drilling program for hydrocarbons in Duval County. The drilling program includes five main sections: (1) permit process procedure, (2) well design, (3) mud program, (4) bottom hole assembly and bit program, and (5) cementing program. The correlation and interpretation of geophysical, geological, and well logging data have been implemented to select the best location for a well in the La Huerta Field in Duval County. The information generated from our correlated data sources has allowed us to construct a complete well program that abides by environmental regulations, safety standards, and economic feasibility.

NG3 - Well Production Optimization using an Artificial Lift Method
Team Members: Jesmin Chavez, Ramon Cid, Alberto Hernandez, Joe Maldonado, Adrian Reyna

This project will comprise of evaluation of five wells in the Frio/Vicksburg formation. One well seems to be underperforming in comparison of the other four wells. In order to increase the production of this well, we analyze the well and reservoir behavior by running calculations to determine its critical velocity and inflow performance curve. Analysis of the critical velocity values of the underperforming well shows us that its high liquid loading is due to its low actual gas flow rate. Then, we determine that an adequate artificial lift method to get this well back to its normal production decline by taking into account its liquid loading at the bottom of the well. We select plunger lift because there is gas available, its moderate oil production rate and it is implemented in neighbor wells in the same oil field with positive results. The simplicity of the design and operation of the plunger lift system seems to be a practical way in solving liquid loading. There are two mini production stations installed in this area that feed two separated DCP Midstream pipelines. In this area, each well has a line heater, to prevent hydrates formation, a high-pressure two-phase separator and a low pressure three-phase separator. There are also two storage tanks for condensate and one for water in each mini-station. The low pressure gas goes through a compressor to bring its pressure equal to the high pressure gas. Then, the high pressure gas passes through a glycol dehydrator to reduce its humidity upstream of the sales

pipeline. Economics of how the well is preforming and the cost of installation will be evaluated to see if this project is economically attractive.

NG4 - Production Optimization through Gas Lift Design

Team Members: Sarah Gilbert, April Gonzalez, Alejandro Palacios, Daniel Torres, Eduardo Gonzalez

Three main divisions define the oil and gas industry, upstream, midstream, and downstream. Each one of these divisions has its own methods in which they contribute to the oil and gas process which involves finding potential underground/ underwater crude oil and natural gas fields, in the upstream. While in the midstream it's linked to both upstream and downstream. Midstream operations deal with the transportation and storage of the natural gas through pipelines/ gathering systems. The downstream works with turning crude oil into gasoline, fuel oils, and petroleum- based products in refineries. As for this project the objective will be focused into the upstream division and how the continuous gas lift system is going to be installed to well(s) to increase the production rate of the wells. The concept to this project is to re-inject the producing gas back into the well(s) with the use of an external source of high pressure. This high pressure helps supplement the formation gas to lift the well fluids back up the well at higher production rate. The injection gas mixes with the production fluid and decreases the density and the flowing pressure gradient of the mixture from the point of gas injection to the surface. As the decreasing flowing pressure gradient reduces the flowing bottom hole pressure that is lower than the static bottom hole pressure by creating a change in pressure that allows the fluid to flow into the wellbore.

Working with four wells located in Karnes County in Eagleville field having the availability of the gas from four wells only two of the wells will be for injection to increase their production because the gas available is not enough to inject on the four wells

NG5 - Converting water injection wells into CO_2 injection wells in an enhanced oil recovery process

Team Members: Eutiquio Guerrero, Bryan Lopez, Daniel Ritz, Jesus Fabela

CO_2 reinjection is a tertiary EOR method. Once a secondary method like water flooding production decline to near economic limit, other recovery methods are taken into consideration. One of the recovery options is CO_2 injection considering that the pressure maintenance in the reservoir is still effective. The difficulty is to overcome the viscosity of the oil that is still in the reservoir. So, developing a plan to convert water injection wells into CO_2 injection wells is the main idea of this process. Each of the CO_2 injection well candidates must be checked to ensure that their mechanical conditions are technically acceptable to prevent undesirable problems before starting injection of CO_2 and during the remaining life of the well. One of the main problems that these wells may encounter is CO_2 corrosion of the casing and forming acidic environment with negative effects on the well cement sheet. Corrosion may cause bad bondage and possible leaks which might cause environmental damage and eventually temporary stoppage or final cancellation of the project. We selected a well in good mechanical conditions to use it as CO_2 injection well. The project includes well completion and surface facility design. The economic analysis includes investment cost and revenue estimation based on the oil production increase in a five to ten years period.

NG6 - Natural Gas Dew Point (DPC) Plant Design

Team Members: Alejandro Gonzalez, Erik Sanchez

NGEN Energy set out to design a natural gas (NG) dew point control (DPC) plant that will produce a spec pipeline production gas as well as a pipeline raw mix liquid product (Y-Grade), known as natural gas liquid (NGL). After analyzing the socio-economic and environmental feasibilities for this project, Baytown, TX area was chosen for commissioning of the new DPC plant. In general, DPC plant is designed to inhibit the formation of solid hydrates in gas streams and to achieve certain level of

dehydration depending on stringent water content specification for NGL fractionation. This is achieved through the mixing of a liquid Hydrate Inhibitor directly with the gas stream. In this project, Tri-Ethylene Glycol (TEG) is used as it has gained almost universal acceptance as the most cost-effective choice. The plant will process 100 MMSCF per day dry gas saturated with reservoir water and will separate the product NG and NGL by depressing the dew point to 15 ^{o}F and dehydrating the feed gas. Water and heavy hydrocarbon liquid dropout can cause a number of problems in gas transmission lines, including increased pressure drop, reduced line capacity, and equipment problems, such as compressor damage.