

# 2022 PROJECT DAY

April 9, 2022  
8:30 am - 3:30 pm  
Education Building



FACULTY OF  
**ENGINEERING &  
APPLIED SCIENCE**



# Welcome To PROJECT DAY 2022!

The Faculty of Engineering and Applied Science is proud to present **PROJECT DAY 2022!**

This conference-style event includes concurrent sessions where 4th year Engineering students present their final year design projects, and a Trade Show & Poster Session where projects will be on display.

The Trade Show & Poster Session gives you the opportunity to speak to students directly about the projects that interest you and/or your organization.

To learn more about each project, feel free to attend any presentation.

The University of Regina is situated on the territories of the nêhiyawak, Anihšināpēk, Dakota, Lakota, and Nakoda, and the homeland of the Métis/Michif Nation.

The University of Regina is on Treaty 4 lands with a presence in Treaty 6.

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*“I have no special talent. I am only passionately curious.”*

*- Albert Einstein*

# Sponsorships



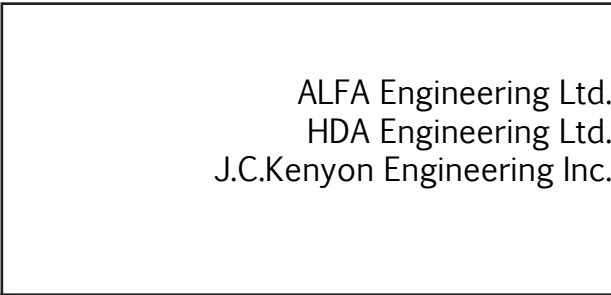
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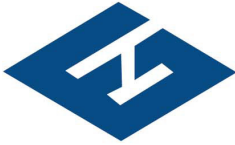


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A big thank you to the people who help make Project Day possible:

- Sponsors
- Industry Evaluators
- Student Volunteers

Thank You from the Dean of  
Engineering & Applied Science!

# Electronic Systems Engineering

## **ESE 1: Solar Powered Smart Bin**

Dumebi Okosa                      Jia Lin Sun                      Farukhnaz Faiz Mohammad

Vignesh Subramanian

The government is spreading awareness on recycling, promoting reuse, and sorting waste at facilities. Despite the government's efforts, contaminated waste is still prevalent in waste sorting facilities. This is a result of people lacking the will, or knowledge, to properly sort their waste. To reduce contaminated waste, proper waste management needs to be done at the source. Therefore, we came up with a solution to create a smart bin that sorts waste by identifying the waste item and placing it into the appropriate bin (Compost, Recycling, or Metal and Others). The bin uses computer vision to identify the waste item and a rotating servo to place the waste into the appropriate bin with 84% accuracy. The bin will have a sensor to trigger compaction when required. When the bin is full, it will automatically send a message to facility management to empty the bin. This bin will be powered through solar panels and a battery will be used to store energy. Having a bin that sorts waste helps alleviate the burden of sorting from the people; thereby reducing waste contamination.

## **ESE 2: COVID-19 Symptom Screening Station**

Shrey Shah                      Allan Cruz                      Tran Tran

With the risks associated with the COVID-19 pandemic, the screening device will serve to act as a barrier between an individual and an entry point as a first layer of safety to screen for some common symptoms of COVID. Our system utilizes sensors and other instrumentation interfaced to a single board computer to provide checks for temperature, blood oxygen levels, a QR code reader for vaccine checks, and a symptoms questionnaire. Once the user passes the symptom checking procedure, the system triggers an output representing the permissive entrance to a restaurant, classroom, or another facility.

# Electronic Systems Engineering

## **ESE 3: Smart Integration for Parking Lots**

Peixi Yi

Kay Chew

Zhuo Heng Li

The Smart Integration for Parking Lots (SInPL) is designed to replace the tedium of driving around a parking lot, looking for an empty spot to park your car. The SInPL is created to be easily installed in any parking lot, whether it is outdoors or indoors. An array of sensors are installed in each parking space and detect whether it is occupied, available, or reserved, which it stores both locally, and sends out through a Wi-Fi mesh network to a central database. This information can be viewed both locally, through an LED on the device, as well as remotely on a website. The website has a variety of features, such as being able to reserve a parking spot, see how many spaces are available at a glance, and what spaces might be taken. The devices transfer that information to the database using a Wi-Fi mesh system. The SInPL is designed to operate in the unlicensed spectrum of 2.4GHz and is designed to fit within all CSA regulations.

## **ESE 4: Fuel Lock I/O Tester**

Carter Kent

Dawson Dressler

Justin Myles

IntraGrain Technologies Inc. produces a device called Fuel Lock, that enables businesses to lock and manage their fuel. After developing an update, IntraGrain must manually test the device to ensure proper operation before the update is released to customers. Our device, the Fuel Lock I/O Tester (FLIOT), automates the manual testing process to reduce the time and resources required when testing new updates. The FLIOT communicates with existing IntraGrain testing software to receive commands and respond with results. The FLIOT automates Fuel Lock testing by typing on its keypad, reading text from its LCD screen, simulating fuel being pumped, and interfacing with other Fuel Lock inputs and outputs.

# Electronic Systems Engineering

## **ESE 5: Automated Greenhouse System**

Brandon Morgan

Don de Jesus

Klaude Dungca

Canadian winter weather often spans over half a year with colder temperatures and frost occurring as early as October and lasting well into March and April. This results in the gardening season being significantly shortened which causes planting to be delayed or rushed, potentially resulting in an under-ripe harvest. It also reduces the options available to be grown in Canada's climate. Our design of an automated greenhouse will have the flexibility to be used both indoors and outdoors to achieve a maximized growing season without the stress of winter weather. Various sensors will monitor aspects of plant health such as the levels of sunlight, water, and fertilizer, as well as temperature and humidity. The data collected from the sensors will be indicated to a microcontroller to provide the requirements for optimal plant growth and yield potential. Our greenhouse will strive for conservational means to provide some of these requirements by making use of rainwater and natural sunlight as much as possible. Our design will also make use of IoT technology by communicating the data collected from the sensors to an internet server for a user display application so the user can observe the status of the greenhouse in operation and assume manual control, if necessary. With this automated greenhouse design, we aim to optimize the growing season in Canada without having to consider environmental changes. Allowing the system to be used both indoors and outdoors, will help increase the length of the growing season thus producing better yielding crops.

## **ESE 6: Automated Reptile Enclosure**

Lel Bartha

Zachary Philson

The Automated Reptile Enclosure controls three temperature zones and the humidity level in a reptile enclosure. Reptiles require warm and cold zones to regulate their body temperatures and a varying level of humidity. Our product allows the user to tune their enclosure to the requirements of their reptile. Four sensors placed throughout the enclosure monitor the temperature and humidity. The humidity is controlled by a mist maker and a fan which blows the mist into the enclosure from an external water tank. The temperature zones consist of groups of copper wire heating elements that warm up when the temperature gets too low.

# Electronic Systems Engineering

## **ESE 7: University of Regina Research Building Automatic Vent Frost Wiper**

Jin Jiang

Rolandtine Felicitee Sakou Amritpal Dhariwal

This system is an efficient, reliable, and effective tool that provides the University of Regina Research building facility manager the ability to adequately monitor and clean off the accumulated frost on the main vent of the building during the winter months automatically and remotely. Our design can sense when to clean and when to return to the idle state, using an independent subsystem; Optical Sensor (OPS) and Differential pressure sensors (DPS). DPS sends cleaning requests to the Frost wiper system and Self-monitoring system when the inside pressure  $P_{in} < P_{out}$ , else the system remains in an idle state while monitoring airflow. OPS uses reflective IR light to determine when the vent is blocked, and immediately sends the cleaning request if needed. Our system would be able to move the wiper horizontally and clean approximately 85% of the vent. The building manager/staff/user would be able to operate the system at a distance and more so, this remotely controlled system would have an inbuilt fault mode system. Additionally, this design would optimize the best possible cleaning outcome taking into consideration all safety measures given the weather under operation. Proper ventilation is an important aspect of any building and providing this is of utmost importance, especially during this COVID-19 pandemic.

## **ESE 8: Adaptive Solar Awning**

Wil Norton

Kaila Neigum

Large buildings such as office buildings and postsecondary institutions require a lot of energy to regulate internal temperature. This has not only environmental impacts but also economic ramifications. An adaptive solar awning that can be situated over an office window, or equivalent, provides a solution to combat these issues. This system will reduce the rate of heat transfer through windows and contribute power back into the grid thus reducing the net consumption from the utility for temperature regulation. This awning is an automated system with an option to be set at the desired angle by the room occupant. When in automatic mode, the awning will be deployed at an optimal angle which will generate the most amount of energy while shading the window thus reducing the rate of heat transfer through the window. In manual mode, the user can set the angle that allows them to be most comfortable in their space. During the evenings or certain weather events, the panel can be stowed against the building, insulating the window and thus again reducing the rate of heat transfer. A small-scale model of this system will be presented and the full-scale system is analyzed.

# Electronic Systems Engineering

## ESE 9: Automated Satellite TV Dish Alignment System

Bradyn Giraudier

Mingxiao Li

Shuo Xu

An automated satellite dish antenna capable of finding satellites 91W and 82W used with Bell TV. The system will use DC motors to move all three axes (azimuth, angle, and skew) to align for optimal signal. The system utilizes a GPS, a magnetometer, and an accelerometer to determine the location and positioning of the dish. The automated dish system is useful in remote areas with limited internet connectivity and tools available to align the dish. It is effective in RV applications where the satellite antenna may not be reachable from the ground. By automating the alignment process, the user does not have to go through the trouble of manually adjusting the dish. This system offers the convenience of realignment. If an RV is moving around frequently, the user can realign the dish at will. Once the user runs the program, the dish will align itself regardless of location.

*“Education is the most powerful  
weapon which you can use to change  
the world.”*

*- Nelson Mandela*

# Environmental Systems Engineering

## **EVSE 1: Arcola Avenue Overpass Redesign**

Hunter Varga

Jayson Martin

Marley Kress

Ryder Varga

This redesign project explores five design alternatives for the Overpass on Arcola Avenue and Ring Road with objectives to increase the two intersections' level of service (LOS) and vehicle/capacity ratio (v/c ratio). Obtaining data from Synchro Software, a traffic signal timing software used by the city of Regina, a preliminary analysis is conducted for the following alternatives: (a) do nothing, (b) remove the median on the bridge and add a reversible lane, (c) add a lane on the north side of the bridge to implement dual turning lanes, (d) add a lane on both sides of the bridge creating three through lanes in each direction, and (e) implement a two-level interchange with slip roads, known as a cloverleaf interchange. Using a weighted decision matrix, each design alternative is evaluated based on its implementation cost, improved traffic flow, improved safety, and overall environmental impact. Upon analysis, the alternative with the greatest ranking for the given criteria is the three through lanes with a score of 6.5 out of 10. This alternative cost is feasible, provides a significant increase in safety, and has little environmental impact on the already disturbed ground. In addition, this implementation decreases the bridge's combined average signal delay for the AM and PM traffic peaks by 29.74% and 39.41% respectively. Within the project scope, limitations exist including restricted access to simulation software, unforeseen statistics including population and economic growth, traffic re-routing upon implementation, and limited time for alternative evaluation. Assumptions are made accordingly to accommodate these limitations and keep the scope within a reasonable and attainable range.

## **EVSE 2: Treatment and Reuse of Restaurant Dishwater Effluents**

Feifan Yang

Zifeng Li

Yangzhou Xu

Meet Koladiya

Restaurants consume a huge amount of clean water every day, and at the same time, the dishwashers produce a large amount of wastewater that has a high content of oil and grease, high temperature, high turbidity, high COD, high BOD, and high TSS. This design process aims to design three different wastewater treatment process trains specially to treat and reclaim the restaurant dishwasher effluents for reusing purposes. The three process trains have different essential unit processes which are depth filtration + carbon adsorption, nanofiltration, and reverse osmosis. The three process trains are evaluated based on advantages, disadvantages, cost, efficiency, and footprint. By conducting comparison tables and matrixes, the process train with nanofiltration unit process is determined to be the optimal process train. The final design process train contains screening, equalization basin, chemically dissolved air flotation, nanofiltration, and UV disinfection. The restaurant wastewater is alkaline, with a high content of oil and grease. As such, the aluminium sulphate is chosen to be the chemical for the coagulation and flocculation during chemically dissolved air flotation. The preliminary design is performed based on chemical selection, cost estimation, payback period analysis, and waste disposal regarding the optimal process train.



# Environmental Systems Engineering

## **EVSE 3: Combined Lake and Stormwater Irrigation System for University of Regina**

Aya Amer

Sayantan Paul

Iriny Moawad

Mahnoor Tajik

At the University of Regina, an irrigation system is composed of attaining potable water to irrigate campus lands. After calculated analysis, the University of Regina's highest utility cost is their hydro bill. The land is irrigated from May to September, with the demand increasing during the summer months. This utility cost has been increasing by an average rate of 4.5% per year over the last 10 years. Expecting by 2022 the price to reach \$2.18/cubic metre of supplied city water. When observing this system from an economic perspective, it is not viable as there are feasible design alternatives available. To solve this engineering problem, this project proposes a new system that can be implemented on campus that can explore both natural sources, lake, and stormwater, to better irrigate the area. The final design will be decided by using multiple decision matrices, watershed budgeting, and doing a cost and feasibility analysis to ensure the best engineering decisions are being made.

## **EVSE 4: Pilot Project: Design of Soil Farm for Mosaic Potash Belle Plaine**

Josephine Craig Penner

Tommy Lien

Justin Peterson

Due to a lack of regulations from the 1960s to 1990s, previous mining practices did not implement environmental protection measures against used soil storage areas, therefore contaminating the surrounding soil. Oil contaminated soil is a developing problem in society due to the risks it poses to public health, wildlife, and land usability. The objective of this project was to design a soil farm pilot program for a site at Mosaic's Belle Plaine potash mine that will target hydrocarbon impacted soil. An analysis of soil contamination on-site (hereby referred to as Cluster #2) indicated the following list of petroleum hydrocarbon levels are above Saskatchewan guidelines: Benzene, Toluene, Ethylbenzene, Xylenes, F1-BTEX, F2, F3, and F4/F4-HTG. Therefore, the design of this soil farm targets these contaminants specifically. Then, a decision matrix was used to evaluate bioremediation methods suitable to the site and used criteria of maintenance, the environmental impact of equipment, performance, and cost. This resulted in the selection of bioventing and conventional landfarming as the best-suited methods for the soil farm. Finally, after preliminary design considerations using Canadian Federal and EPA Guidelines, conventional landfarming was selected as the best-suited method for design. The soil farm design includes dimensions, operations, and monitoring requirements. To justify recommendations, a map of contamination levels was created using ArcGIS software at Cluster #2, aerial photos were analysed for land availability, and costs were estimated for the entirety of the treatment process.

# Environmental Systems Engineering

## **EVSE 5: Design of a secure bike storage facility in Downtown Regina to meet demands for improved safety/security**

Quinn Andrew Taylor

Mason Dawn Babey

Kristopher Ryan Kringle

Lois Temiloluwa Arokoyo

The primary aim of this project is to provide commuters to the downtown area with a safe and convenient area to store their bikes. The City of Regina has begun to invest in the downtown area to promote cycling as a primary form of transport through their Cross-Town Bike Lane project, which will provide a comprehensive network of bike lanes to cyclists. We look to complement this project as bike theft in the downtown area is rampant and will likely deter many people from biking even if bike lane infrastructure is available. As part of the project, we will be evaluating a number of factors to ensure the proper design of the facility. The level of safety of the facility will be a primary concern of our project as that is the main service it provides. We will be analyzing all relevant factors through weighted matrices to help us determine the best design.

## **EVSE 6: Algal Control and Prevention Technologies in the Lake**

### **Diefenbaker Canal**

Elizabeth Millan

Emily Froehlich

To promote agriculture and mining activities within Saskatchewan while maintaining economic strength, projects that support their processes have been created. The Lake Diefenbaker irrigation project is one example of this. The Lake Diefenbaker irrigation project is divided into three phases and makes up an extensive 500 km of canals. These canals contain pumps for the purpose of increased and enhanced irrigation throughout Saskatchewan. However, efficiency is being hindered by the growth of filamentous algae, which is blocking the pumps. The current control of the filamentous algae is a synthetic chemical called Magnacide H, costing \$1 million per year. The purpose of this project is to recommend alternative design options for filamentous algal control and prevention. The criterion for deciding the best design alternative is, cost-effectiveness, highly suitable for the location, exhibiting substantial results for the reduction of algae, and of low impact to the environment. The engineering problem that constitutes this report presents the following question: what are algal control and prevention technologies that could decrease the concentration of filamentous algae in the Lake Diefenbaker Irrigation Canals in a safe and cost-effective manner? Designing a solution to this engineering problem is significant because the efficiency of the canals directly supports agricultural practices throughout Saskatchewan.

# Environmental Systems Engineering

## **EVSE 7: Solar-Driven Water Treatment System for Agricultural Dugout**

### **Water Quality Improvement**

Badi Haghighi

Shourya Singh

Mark Hellman

Johannes Mutyanda

Dugouts are primary sources of water for livestock and farm households in drought-prone regions across Saskatchewan. Dugout water has a collection of harmful contaminants from farm spray, algae, and livestock waste. This proposed design is an environmentally friendly solution to cleanse dugout water using a mobile treatment system as a means of allowing ranchers to improve the quality of their dugout water, and entice livestock to drink more clean and healthy water. The mobile unit will pump water from one end of the dugout through an initial screen, activated carbon adsorption, ultrafiltration, and then be discharged back into the opposite end of the dugout as treated effluent. Additionally, farmers have the option of diverting a portion of water through a UV disinfection cylinder, following filtration, to be treated further for human consumption. With the average dugout volume within our sample pool being 5100 cubic meters, this mobile unit will have the capacity to filter and clean this volume within a few weeks, using solar panels as the power source. This compact unit will not only assist rural farmers in cleaning contaminated dugouts but also serve as an opportunity to improve the health and quality of livestock throughout Saskatchewan.

## **EVSE 8: Options for Controlling Nutrient Runoff on Lake Diefenbaker's**

### **Canal**

Elden Inot

Dave Montiano

The project involves a design alternative to control the nutrient runoff coming from livestock operations near the Lake Diefenbaker canals. The main consideration is to design a holding pond after all the site assessment and literature review has been conducted.

# Industrial Systems Engineering

## **ISE 1: Design & Implementation of a Portable Ice Storage Demonstration**

### **Apparatus**

Joshua Zimroz  
Jacob Schenher

Randi Debert

Joshua Spelay

The purpose of this capstone project was to design and construct an interactive learning apparatus for students to explore the fundamental principles of refrigeration and thermal storage systems for use in the undergraduate HVAC; R laboratory, ENIN 463. The apparatus itself was constructed as a portable, scaled-down version of an ice hockey rink in which the ice surface is created and maintained by a direct vapor-compression refrigeration cycle. The project includes the design of a vapor-compression refrigeration apparatus including the layout, overall configuration, equipment selection, table frame, and other supplementary features. In practice, the scaled-down refrigeration system simulates thermal ice storage for building cooling operations, as well as the interaction between supply water to an AHU or fan coil and refrigerant in a chiller. The design was optimized regarding heat transfer capability, laboratory compatibility, safety, and cost-effectiveness. In the future, two preceding projects, the current refrigeration project, and a future Building Management Controls System project, will integrate to simulate a realistic HVAC; R building automation system including all major mechanical equipment generally present in commercial buildings.

## **ISE 2: Historic Building Energy Audit and Retrofit: Holy Rosary Cathedral**

David Samayoa

Reece Wolf

Paul Tokarz

The Holy Rosary Cathedral, constructed 1912-1917, is a significant landmark in the City of Regina. The cathedral has had various improvements throughout its 110 year history and received heritage status in 1989. The team was tasked with completing an energy audit of the Holy Rosary Cathedral and providing recommendations to improve the current state of the Cathedral. Commercial energy audits are a process that is used to analyze the building's energy consumption and to determine improvements that will reduce the building's electricity and natural gas usage. The process includes meeting with the Holy Rosary Cathedral buildings and grounds committee, building walkthroughs, reviewing past utility bills, creating a whole-building energy simulation using building energy modelling software, conducting an economic analysis to determine ideal energy efficiency measures, and providing an energy assessment report for the building owner. Improvements to the Holy Rosary Cathedral will improve the building energy efficiency while ensuring occupant health and comfort requirements are met. The methods used throughout this project support UN sustainability goals (3, 7, 9, 11, and 12), and contribute to Canada's 2030 carbon emissions target for buildings.

# Industrial Systems Engineering

## **ISE 3: Rotating Test Stand for Accelerated Wear on Seed Opener Tips**

Noah Sampson

Ashley Balzer

Jayden Morris

Jesse Stringer

A redesigned Rotating Test Stand was developed to produce a standardized test to model wear patterns on various styles and geometries of seed opener tips designed by Dutch Industries. The design is to produce constant conditions including speed, soil composition, compaction level, and moisture content to ensure that results are comparable and accurate. The new test bench is to provide efficiencies and cost savings over the current test bench and produces accurate and comparable results. Data acquired from the test is expected to be utilized by Dutch Industries in new product design and marketing material. The test bench design includes a four-armed carousel connected to a rotating shaft driven by a hydraulic drive. Full construction drawings and bill of materials for the hydraulic power transmission, shaft design, bearings, as well as all structural components. Other design components include a safety cage, bearing supports, attachment arms, arm attachment mechanisms, and shelving to contain all accessories for the hydraulic power unit. Final deliverables provided to Dutch Industries included a complete bill of materials, construction drawings, wiring, hydraulic diagrams, safety recommendations, and a standard operating procedure to safely manufacture and operate the newly designed test bin.

## **ISE 4: Sulfur Iodine Hydrogen Production**

Ali Iftikhar

Abid Zaman

Kordell Yee

Rutvij Bhatt

The project aims to efficiently produce hydrogen using a sulphur-iodine thermo-chemical water-splitting cycle. The process chosen for this project intends to decrease CO<sub>2</sub> emissions in the atmosphere as well as aid the transition to a cleaner energy source. The design chosen for this research is based on three different components which are sulphur dioxide (SO<sub>2</sub>), iodine (I), and water (H<sub>2</sub>O). The test simulation was conducted using ASPEN PLUS V.12, in which three sections were created; the Bunsen reactor section, the hydriodic acid (HI) section, and the sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) section. The Bunsen reactor provides enough heat to produce HI and H<sub>2</sub>SO<sub>4</sub> from the reactants. The reactants then undergo two-phase liquid-liquid separation, separating the two immiscible liquids. The upper phase contains the H<sub>2</sub>SO<sub>4</sub> liquids and the lower phase contains the HI liquids. Each section has its purpose, the H<sub>2</sub>SO<sub>4</sub> section produces oxygen (O<sub>2</sub>) as a by-product, whereas the HI section produces hydrogen (H<sub>2</sub>) as its by-product. Along with the simulation, a techno-economic analysis has been conducted to weigh the economic benefits of the project while trying to implement the process at the lowest cost possible.

# Industrial Systems Engineering

## **ISE 5: Small Scale Natural Gas to Methanol Production: A Solution to Decreasing CO<sub>2</sub> Emissions with Existing Infrastructure**

Jordan MacLeod

Jack Gehring

Hongwei Bi

Saskatchewan vented approximately 5.2Mt of CO<sub>2</sub>eq, while also producing approximately 160 billion ft<sup>3</sup> of natural gas in 2020. To help decrease Saskatchewan's carbon footprint while fully utilizing the province's natural resources, this study investigates the use of a small-scale gas-to-liquids (GTL) facility converting surface gas to methanol. The produced methanol could then be used in downstream blue hydrogen reforming systems for incremental hydrogen production. The proposed process would be conducted in two steps. First, an autothermal reforming reactor would be used to partially combust the gas stream, generating the heat required for methane steam and CO<sub>2</sub> reforming within the same reactor. Second, the synthesis gas produced will be routed to a methanol synthesis reactor to produce crude methanol as a product. This will capture the produced hydrogen in a chemical liquid form allowing for less costly and far safer transportation. The process is designed and simulated in Aspen Plus V.12, methodically selecting oil and gas wells from the Bakken oil field using AccuMap to validate the process stream. The gas production values from the treater are used in the GTL process simulation. In addition to its core components, the GTL process considers balance-of-plant components including C<sub>3</sub> + hydrocarbon removal from the initial gas stream as liquids. The overall process is optimized to utilize waste heat rejected from synthesis gas cooling, methanol synthesis, etc. to increase efficiency and lower cost. The remaining hydrogen-depleted gas that follows from methanol synthesis will be analyzed for the possibility of reinjection back to formation without requiring additional carbon capture infrastructure. A techno-economic analysis will study both immediate and long-term benefits, as well as possible implications and challenges. Producing 5m<sup>3</sup> to 20m<sup>3</sup> of crude methanol per day to achieve a payback period of no more than five years and an ROI of no less than 5%.

## **ISE 6: Modular Cube Farm**

Jasim Chaudhry

Kevin Zong

Krushna Dave

The Modular Cube Farm will be the most affordable and easy-to-use vegetation growing tool for the average Saskatchewan user/resident. Vegetables will be able to grow in this cube outdoors even while the temperature dips to -45 degrees Celsius. Its compact design makes it easily transportable while its angled polycarbonate top panel will be perfect to absorb the maximum amount of sunlight. Multiple Arduinos will be connected inside to monitor the temperature, water, humidity, etc. while also maintaining a 22 degrees Celsius room temperature in the interior. The plywood frame of the cube will be treated with epoxy while also having a 2-inch thick Durofoam EPS Rigid insulation to ensure the heat loss is minimized when exposed to the outside environment. A heated water tray underneath the soil will collect the excess water after it has been soaked in by the vegetables and evaporate the water till it condenses at the highest point of the cube. The condensation will be picked up by the water tanks and the process may begin again. A shell heat exchanger will also be present to ensure some fresh airflow into the system while also recovering any heat loss back into the cube. The cube will have easy-to-follow instructions, be environmentally friendly, cost-efficient, and overall be a product not previously attempted by anyone else. The prototype will be manufactured and the second prototype will be theoretically discussed. The prototype will be tested in a lab at -45 degrees Celsius and yield the results of the endurance of the cube. Overall the cube farm ensures to be an interesting project that will find its way to many consumers that are interested in growing their organic vegetables anytime during the seasons of Regina.

# Industrial Systems Engineering

## **ISE 7: Hydraulic Component Test Stand**

Cyril Kuruvilla

Etienne Paquin-Foisy

Karlos Lopez

The hydraulic testing rig design for this capstone project is designed to test various sizes of hydraulic cylinders. The final goal for the project is to be able to measure pressure and flow across multiple hydraulic circuits and log data readings over time with a variable logging frequency. The system design in the report includes the specification of the motor and pump selected appropriately for the system, calculations for pump and motor sizing, pipe sizing, pressure drops, net positive suction head, heat transfer of fluid in the pipe, strict safety specifications, estimated cost of the system, pump efficiency, shaft dimensions and type of fittings. The proposed design has two testing tables, one for single-acting cylinders and the other for double-acting cylinders. Furthermore, the goal of the project is to have a testing rig that is to be as modular as possible, allowing for different types of input settings for specified uses.

## **ISE 8: Process simulation, literature review and sensitivity comparison**

### **analysis of CO<sub>2</sub> capture using ProMax**

Naser Alabdali

Cuong Nguyen

Ahmed Albuhluli

Sikandar Shah

Global warming and environmental change are serious issues nowadays. As a result of global warming and the related variety in the climate framework, outrageous climate occasions, such as tornadoes, earthquakes, reduction of ice caps, and others, appear at a phenomenal rate. Carbon dioxide is the primary molding boundary of a dangerous atmospheric deviation. Therefore, to combat global warming and environmental change ought to be acted to diminish the outflow of carbon dioxide into the climate. Amine fluids are flowing as strong fluid sponges for catching carbon dioxide because of utilizing numerous blends of anions and cations to deliver the fluids. The project is cover rate-based process simulation on ProMax 5.0 and analysis the amount of CO<sub>2</sub> captured from the wet gas feed with the percentage of CO<sub>2</sub> 11.5% mole fraction at 115 degrees Celsius and 1 atm. The CO<sub>2</sub> is captured by single solvent mono-ethanolamine (MEA) at 15-40% wt. The target is achieving the CO<sub>2</sub> capture higher 90% and the purity in the final CO<sub>2</sub> higher 95%. Generating many different conditions such as temperature, pressure, and mass flow rate to figure out the most efficient solvent MEA, energy used, and cost of operation.

# Petroleum Systems Engineering

## **PSE 1: Optimization of a Partially Depleted Low Transmissibility Oil Reservoir Via Cyclic/Continuous Miscible CO<sub>2</sub> Flood**

Andres Hernandez

Yubo Wang

In the oil and gas industry, cyclic and continuous flooding are widely used. Both of the technologies apply to different grades of oil and reservoirs. For continuous flooding, fluid will be injected from the injector and oil will be produced from the producer. Cyclic is used for heavy oil field, in which steam can be injected into a production well with a cycled certain time, therefore, the oil will be produced from the same well. Both technologies have been proven to improve oil production in heavy oil reservoirs. However, these two technologies have barely been used in tight shale formations. This project aims to compare two technologies and testify which would be the best method to optimize a tight shale multi-fractured reservoir with low flow capacity. The team conducted CMG model with CMOST Optimization simulation to compare oil production amount between cyclic, continuous flooding model (experimental groups) and a model without using any techniques (control group). Based on the result, the best method with less cost will be determined to apply.

## **PSE 2: Engineering design and analysis on heavy oil recovery by geothermal resources**

Qifan Wu

Xinyu Fan

Water flooding as a mature enhanced oil recovery (EOR) technology that is being widely applied all around the world. In contrast with normal water flooding techniques, the implementation of thermal energy from geothermal sources helps to provide an environmentally-friendly way in oil recovery by eliminating burns of natural gas and oil. Besides, this particular methodology is always applicable on oilfields with high pressure and viscosity and there are several oilfields in central Canada that fit this type. More importantly, the development of the geothermal resource is cost-effective due to the observation of rich geothermal resources in central Canada. The purpose of this project is to consider the most feasible way of applying hot water flooding from geothermal resources in Canada's heavy oil reservoir. To finish this project, the ACCUMAP will apply which gives the basic data of the well production, locations and status. The CMG Builder is going to build up the 3D geological model and simulate the hot water injection into the designed reservoir. Applying CMG STARS will obtain simulation experience of the hot water recovery process and determine energy savings in comparison with other recovery methods. Lastly, the final results of all sensitivity analyses and simulations will prove the feasibility of this technique.



# Petroleum Systems Engineering

## **PSE 3: Piping Engineering Design and Optimization Analysis Using CAESAR-II**

Rome Donnelly

Ahmed Besbas

Gio Franz Magracia

Piping engineering and optimization analysis can be used to model a piping system and define the loading conditions imposed on the system. CAESAR-II will be used to generate a mechanical design and use stress analysis to optimize a piping system. CAESAR-II is able to analyze both static and dynamic stresses that are imposed on the system and can determine if the design is up to standards. The requirements for a quality design are to ensure operating pressures and temperatures can be sustained, and that the design is capable of handling the loads on the system. CAESAR-II can simulate the design using various materials and choosing the best material for the design is part of the optimization process. Possible candidates for material include; ASTM A106 steel, grade 310 stainless steel, and copper-nickel pipe. CAESAR-II will generate results required to make a decisive assessment and the results will be given in the form of displacements, expansions, bends, etc. An analysis of the results will determine if the design is up to ASME B31.3 standards for process piping. The final design will be chosen based on safety, functionality as well as the economic costs of the design. Finally, to ensure significant corrosion resistance, a corrosion resistance plan will be implemented on the final design. The plan will consist of using an implemented rectifier (50V/50A) to peruse a large area of influence. The anodes will be MMO (Mixed Metal Oxides) which will cathodically protect any piping system underground.

## **PSE 4: Design and optimization of a greenhouse gas mitigation**

### **approach: From Capture to Utilization in Northminster field**

Abdulqadir Abdi

Adam Prpick

Currently, there is an ongoing initiative in Canada and many other countries to reduce carbon emissions by capturing carbon dioxides that would otherwise enter the atmosphere, such as emissions from power or chemical plants. These carbon dioxides are then condensed, shipped, and utilized for Enhanced Oil Recovery (EOR) purposes, or injected directly into the depleted underground reservoirs for permanent storage. The objective of this project is to perform a feasibility analysis on a CO<sub>2</sub> based EOR process applied to a depleted oil reservoir while designing an effective CO<sub>2</sub> sequestration procedure to mitigate or defer carbon exposure. This project was executed in four stages with stage 1 being gathering/sourcing data from the Northminster Field in Saskatchewan via AccuMap. In Stage 2, we designed a geological model for the reservoir using the data gathered from stage 1. Stage 3 involves the use of CMG-GEM to model fluid properties. Stage 4 consists of using CMOST to perform sensitivity analysis, optimization, and uncertainty assessment to evaluate and determine the optimal injection rate to maximize the oil recovery and amount of carbon dioxides sequestered into the reservoir by the end of the project. A geological model for the reservoir was built using CMG-Builder and the fluid properties modelling is complete. The next step involves running CMG-GEM to establish a base case scenario. Furthermore, sensitivity analysis on various key parameters will be performed and environmental impacts and economic feasibility of the project will be evaluated.

# Petroleum Systems Engineering

## **PSE 5: Influence of CO<sub>2</sub> phase behavior on sequestration in a depleted gas reservoir**

Orgesi Kuburi

Asmita Kulkarni

Emissions of greenhouse gases such as carbon dioxide (CO<sub>2</sub>) into the atmosphere from fossil fuel and industrial production have been a great concern worldwide. To sustain the balance between protecting our environment and supporting the need for energy in our economy, carbon capture and storage (CCS) technology has been developed and studied. To further our knowledge of CCS, the study of the influence of CO<sub>2</sub> phase behavior on sequestration for a depleted gas reservoir was performed. This paper discusses the supercritical nature of CO<sub>2</sub>, along with the oil and gas wells present in SE Saskatchewan. The paper also explores the different techniques which can be applied to determine the most efficient way in which to sequester CO<sub>2</sub> in the respective well and/ or formation present in SE Saskatchewan. To complete this study, a combination of theoretical and experimental data was used. The focus area was narrowed down to the furbisher formation. By leveraging CMG simulation and Win prop the team can test the behavior of CO<sub>2</sub> in a gas reservoir. The learnings will be translated onto CMOST to optimize sequestration safely and effectively while exploring the scalability of this technology

*“You are always a student, never a master. You have to keep moving forward.”*

*- Conrad Hall*

# Software Systems Engineering

## **SSE 1: Master Calculator**

Philip Anyuon

Adding more calculation options to the complex calculator made calculators more confusing and more complicated for the user. The calculations keyboard becomes crowded with symbols and letters. This tends to frustrate users. The master calculator on the other hand is designed to resolve the problem of the crowded keyboard by moving away from that tiny and static keyboard to a dynamic and clean keyboard. It will provide a better interface with more clarity. A user may navigate from simple to calculator on the same screen. In addition, the master calculator allows the addition of more calculation options without interference with the previous design. A formula is provided to help the user associate the problem with the process during the calculation. An additional screen will be added to show a definition of the important terminologies.

## **SSE 2: Climate Awareness**

Anupras Burokas

Mohamed Bashir

Timothy Pasion

This application is intended with the hope of reducing carbon footprint to support goal 13 of the UN's Sustainable Development goal. Climate change is one of many important environmental issues that need to be addressed. Climate change is caused by the increase of greenhouse gases in the atmosphere. This increase of GHG in the atmosphere is due to various human activities that emit the major GHG such as carbon dioxide, methane, nitrous oxide, fluorinated gases, and water vapour. We want to help educate the community about the climate issues we face by developing a knowledge-based content application that provides users with a supportive community, informative resources, and tools to help lower their carbon footprint. This application is built to support the United Nations Sustainability Goal 13 Climate Action. Focusing on Target 13.3: Improve education, awareness-raising, and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

# Software Systems Engineering

## **SSE 3: F.L.O.A.T.**

Jonathan Vargas

Carter Brezinski

The health of the world's waters is a priority by most. Recreational waters have many aspects when considering their upkeep. Maintaining safe levels of Water Quality in recreational waters of Saskatchewan not only preserves the environment but also protects public health. F.L.O.A.T (Facilitating Level Objectives Assessment Technology) is a system that proposes an automated solution to report water parameters and any other foreign objects. With the use of artificial intelligence and our systems code, it can detect litter floating in recreational waters while periodically collecting samples to develop quantifiable trends in the water. Data on water waste and water parameters will be displayed on an external client for revision by groundskeepers or environmental scientists. By providing various data about the water qualities we hope that our system and the various readings provided will aid in maintaining the health and safety of waters in Saskatchewan.

## **SSE 4: SolarSize**

Tristan Brown-Hannibal

Karlee Fidek

Kaden Goski

Fossil fuels pose serious threats to the environment and need to be replaced as Canada's primary source of energy. Solar energy is one of the renewable and sustainable green energy alternatives for fossil fuels. SolarSize is a web application that aims to provide Greenwave Innovation's clients with an accurate return on investment estimations and solar installation suggestions. The tool utilizes a client's building energy consumption metrics and location-based solar intensity data to determine the optimal solar energy installation for the client's needs and the associated return on investment. The optimal solar installation and return on investment calculations consider installation costs, full-credit power generation savings, half-credit power generation savings, and maintenance costs. The SolarSize application can be used to persuade more people and businesses to install solar generation solutions by clearly depicting the possible return on their solar installation investment.

# Software Systems Engineering

## **SSE 5: Rare Contaminant Detection in Residential Recycling**

Nolan Flegel

William Peers

Rishabh Prasad

Mismanagement of recyclable waste is an environmental disaster and a burden on society. Recycling is an inefficient, costly and risky process. This project's purpose is to increase recycling collection rates while also reducing risks for waste management workers and costs for municipalities. We intend to accomplish this goal through three deliverables:

1. Universal Waste Bin Detector
2. Green Screen: Waste Management Dashboard
3. Detecting Rare and Severe Contaminants through Copy-Paste Data Augmentation

The bin detector aims to improve the efficiency of recycling bin detection and allow for rapid scalability of the recycling collection to additional municipalities. This is achieved by creating an object detection model that can be deployed to any waste collection vehicle.

The dashboard strives to build an interactive platform which provides residential recycling collection data analytics and insights to municipalities and stakeholders. Increasing the availability of this information allows the municipality to strategize and evaluate recycling information to reduce costs and inefficiencies.

Finally, through data augmentation, this project also focuses on detecting rare and severe contaminants which are currently undetectable. Although these contaminants occur rarely in residential recycling, they are critical to detect as they pose serious risks to waste collection workers and surrounding properties. This data augmentation pipeline will be able to generate artificial image datasets of rare contaminants from a few sample images. Our objective is to train machine learning models using the augmented dataset to detect an object which was previously undetectable and mitigate risks.

## **SSE 6: Growing Gamers**

Shane Toma

Bryden Trakalo

The goal of Growing Gamers is to improve the well-being of the video game community by encouraging healthy gaming practices. To achieve this, we will be targeting young gamers and their parents. We are developing a tool to give parents the ability to be informed about their child's game activity while respecting their space. This tool allows parents and children to work together on forming healthy habits regarding video games. Parents are notified of positive and negative habits via SMS (text message) based on limits outlined by the parent on a web portal. The parents can select what information they wish to receive via the web portal for a customized experience as well as view statistics about their child's gaming. Young gamers receive customized messages that support healthy practices based on factors such as parent preferences, in-game events, and their habits. These messages include things such as words of encouragement, reminders, advice, and information to prevent the formation of bad habits. GG-Good Gaming.

# Software Systems Engineering

## **SSE 7: SOS**

Renz Rivero

Abdelrahman Rabaa

Li Pan

Client mobile application and a PSAP (public-safety answering point) dispatcher web application that converses with each other via modern methods such as (SMS, Video, etc) other than just the current audio implementation. The purpose of the project is to improve responder efficiency for distress signals by providing more ways to communicate, send accurate information, and real-time updates.

## **SSE 8: ArachnoTherapy VR**

Jacob Chapman

Jacob Sauer

Roxanne

Harrison

Current exposure therapy techniques, especially for arachnophobia pose danger with the unpredictability of spider behaviour. Virtual reality exposure therapy is one step safer, however, interactions the user has are often only passive. These things, coupled with the increasing demand and shortage of therapists available make exposure therapy less accessible than necessary. ArachnoTherapy VR is an application created to improve the accessibility and efficacy of current exposure therapy techniques by allowing for level-based progression and optional guidance from a virtual therapist.

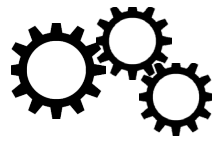
## **SSE 9: Mirror++**

Qurrat Ulain

Annoor Rahman

Our project is a smart mirror aimed toward people with different forms and levels of disabilities. It performs operations based on gestures and voice control, depending on user preference. The mirror extends technologies already available on smart devices, using existing user data and displaying it with simple gestures and commands. It will also be able to automate existing IoT devices like lights, alarms, and outlets.

# Feedback



This is the 23rd Annual Project Day.

We would greatly appreciate your feedback on how things went.

Please send an email to [engg@uregina.ca](mailto:engg@uregina.ca) with your feedback

Thank you for helping us ensure next year is even better!

*“Develop a passion for learning. If you do, you will never cease to grow.”*

*- Anthony J. D'Angelo*

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