2021
Project Day

April 10, 2021
8:30 am - 4:15 pm

FACULTY OF
ENGINEERING &
APPLIED SCIENCE

Welcome To PROJECT DAY 2021!

The Faculty of Engineering and Applied Science is proud to present PROJECT DAY 2021!

This conference-style event includes concurrent sessions where 4th year Engineering students present their final year design projects, and a Virtual Trade Show & Virtual 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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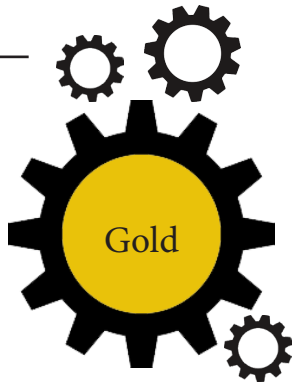
"Somewhere, something incredible is waiting to be known."

- Sharon Begley

Sponsorships



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- Student Volunteers

Thank You from the Dean of Engineering & Applied Science!

Electronic Systems Engineering

ESE 1: Semi-Autonomous UVC Disinfection Robot

Ufuoma Aya Hasin Abrar Matthew Blinkhorn
Yatrik Pamnani

To help combat the spread of the COVID-19 and minimize the risk of infection, we have designed an autonomous UV-C disinfection robot. This robot provides a safe and cost-effective method to disinfect tables/seating areas situated in the Riddell Center at the University of Regina. The robot is powered by a 26800mAh bank which provides an operating time of at least 6 hours. The robot is equipped with UV-C lights that can irradiate SARS-CoV-2. Ultraviolet germicidal radiation causes the inactivation of pathogens by breaking down RNA and DNA biomolecules. The robot is activated using Wi-Fi communication with a microcontroller, which is the robot's primary processor. The microcontroller is responsible for processing signals between input and output devices. For safety, motion sensors are installed to detect when a person is 5 feet away. This causes the UV-C lights to shut down. The robot features a navigation system equipped with ultrasonic sensors and a motor driver that allows it to navigate an area by identifying and avoiding edges. The robot is equipped with an alert system (sound buzzer) that provides operational warnings, as well as feedback upon task completion which is activated by an infrared sensor at the completion point.

ESE 2: Room Occupancy Management System (R.O.M.S)

Dwijen Kapadia Daniel Takyi Arpan Dhamane
Chiamaka Aligwekwe

The University of Regina Facilities Management department is in the process of updating its dashboard for a new energy consumption management system. One feature that must be incorporated is relating energy consumption to occupancy in specific areas. Our project provides temperature, noise, and CO2 measurements in a particular location to determine the location's occupancy. The Room Occupancy Management System (ROMS) is a portable and easily relocated enclosure with three sensor modules that transmit data to a microcontroller. The microcontroller sends the data to a proprietary hub. The proprietary hub saves and transmits the data to the university dashboard. The ROMS device has a user-friendly interface that allows the individual to set the system according to the room size.

Electronic Systems Engineering

ESE 3: Covid Screening Checkpoint (C.S.C)

Ammar Alvi Neel Khatri Shannon D'souza

With the current ongoing pandemic, many companies have hired new employees to manually screen individuals for COVID-19 at entrances. Conducting in-person screening carries the chance of furthering the virus spread, increases labour costs, and introduces subjectivity in the results. Our device mitigates such risks by automating the COVID screening process at entrances which reduces the risk of person-to-person exposure and introduces cost savings. The device implements a computer vision solution to ensure the user is properly wearing a face mask before entrance access is given. It also provides a fast and accurate method to ensure users are tested for both their body temperature and blood oxygen level which adds a layer of objectivity to the results. Additionally, the users will be guided through a series of general COVID survey questions conducted through a contactless user interface. The device also supports an automatic hand sanitizing dispenser to promote hygiene and a multi-user key card authentication system to prevent unauthorized entry. To provide the greatest flexibility for our clients, the device is configurable through admin privileges to enable or disable specific screening procedures.

ESE 4: Semi-Autonomous UV-C Disinfectant Robot

Precious Wangwe Gunjeet Dhaliwal Gurinder Brar
Vitalii Andriievskyi

With the current pandemic of COVID-19, public safety is of utmost importance. Even with the guidelines issued by Health Canada, social distancing is not sufficient. Reliable equipment to disinfect frequently touched surfaces (such as doorknobs, seating areas, and surrounding walls) is required. Our design is a semi-autonomous robot that would use Ultraviolet-C light to kill the virus. As this robot emits harmful radiation, it is equipped with motion sensors to detect the presence of people in the surrounding area. If someone is detected, it stops. The robot travels down a hallway, it detects and maneuvers safely around the obstacles with the help of ultrasonic and infrared sensors. The robot is powered by an extension cord connected to a wall outlet. The extension cord is controlled by a cord management sub-system which winds and unwinds the cord using a NEMA-23 stepper motor. As the extension cord is of finite length, the robot must be manually plugged into a different outlet after reaching the extension cord limit. The robot flashes LEDs in a specific pattern to indicate the current operation (maneuvering, motion, and obstacle detection).

Electronic Systems Engineering

ESE 5: Water Monitoring System

Ethann Clarke Von Feng Huzaifa Sultan

Water usage holds a distinct position among the utilities for the University of Regina for two reasons. Firstly, it is the highest utility expense for the university. Secondly, Facilities Management does not currently track the water usage of buildings. This means there is a gap of information regarding water usage for the individual buildings at the university, leaving open the potential of cost-saving measures that could be put in place. This project details the process and methodology to implement a solution for this gap in information through three components. The first component is a device that takes and processes readings from pre-existing water flow meters and communicates the data to Facilities Management. The second component is a device that notifies Facilities Management when a sink is running unattended and wasting water. The final component is a prototype of a water flow sensor that can be implemented where a meter is not already in place.

ESE 6: Automated Golf Course Irrigation Management System

Olivia DeRosier Austin Waldron Colton Moore

Golf courses require large amounts of land and water to keep fairways in good condition. To reduce the amount of water needed, for environmental and economic reasons, some clubs have begun collecting data on their courses to determine how much water is needed and where. After reaching out to local courses, we found that current systems can provide course employees with data required to manage their system. Unlike other systems, our project processes data at the golf course without needing to be sent back to the system producer for processing. To make decisions, we collect soil data including moisture, salinity, temperature, and weather data to predict rainfall. This data is visible to the user via a web application. Our system is also able to automatically control the water output and only requires a user to override the system in specific cases. The system can be manipulated by the user with a local physical interface.

Electronic Systems Engineering

ESE 7: Health Measurement Station

Thomas Martineau Vincent Grabowski Joseph Zhang

Since the onset of the unprecedented COVID-19 pandemic, both policymakers and service providers have put much thought and consideration into how people can safely and effectively return to normal situations. Many businesses have looked into installing temperature scanners at the entry points of their locations as a method of detecting fevers, which is a common symptom of COVID-19. Our system is able to measure the temperature of a user through a non-contact method and check the SP02 levels of the user through a finger scanner to indicate whether the user presents any COVID-related symptoms. This is done using colored LEDs and an LCD screen. Once the user completes the test, the system will self-sanitize the SP02 finger scanner using a UVC light. The system is primarily powered by a wall outlet but has the ability to operate on battery backup. The system also integrates a WiFi connection to communicate usage statistics over a network.

ESE 8: Smart Greenhouse Management System

Tianrun Guo Fuyang Yan Hanchen Wang
Zhelin Wang

In Saskatchewan's winter seasons, extremely cold weather and limited daylight make it difficult for cultivation. Because of this, the demand for fresh fruits and vegetables exceeds the supply. Many Saskatchewan residents choose to buy a small-scale greenhouse to grow their plants. Most small greenhouses currently available are designed to control a single function (such as temperature control or illumination) and cannot meet the requirements of all plants. Unlike other small greenhouses, our project will serve as a general management system and provides functions including temperature and illumination control, watering, height adjustment, and data access. Our system can be controlled locally and remotely, allowing users to change settings and meet the needs of specific crops. Data is stored in an online database that is visible to authorized users on a web application.

Electronic Systems Engineering

ESE 9: Bot Follower

Justin Igmen Danny Hoang Zain Khokhar

The need for robotic systems is becoming more important in warehouses to assist or replace labor work. Our group designed a semi-autonomous human-following robot that can improve the efficiency of the workplace and lessen the physical labor for the employees. The robot is implemented with optical recognition that can detect a user wearing a unique neon-colored vest. Upon detection, it is capable of following the user through the warehouse while carrying items up to 50lb. The robot is also equipped with a secondary remote control system, audio and visual interaction via buzzer and display screen, as well as safety features such as object and collision detection.

ESE 10: Remote Lab Test Bench

Babishan Suthesh Amar Peringara Koshy
Tinotenda Madzvamuse

Due to the pandemic keeping many students from attending labs, The Electronic Lab of the University of Regina asked us to design and build a remote system that can allow students to remotely test circuits using equipment in the lab. With this system, students can access lab computers via remote desktop since the lab equipment (such as oscilloscopes, power-supplies, and digital multimeters) from the safety of their homes. The equipment can be connected and controlled by existing manufacturers driver software. Our design consists of a switching matrix connected to lab equipment, which is controlled by a Graphic User Interface. This switching matrix system is used to configure equipment connections on the nodes of a circuit via instruction from the student. The matrix allows test equipment to be connected to up to 4 circuit nodes. The student uses a graphical user interface at home to configure the switching matrix as well as monitor and control the lab equipment.

Environmental Systems Engineering

EVSE 1: Design and Optimization of a Dynamic Membrane Bioreactor System for the Treatment of Wastewater from Small Meat Processing Facilities in Regina

Yue Huang Shuyang Cheng Pengyu Chen
Yukun Liu

Meat processing is an important industry in Saskatchewan. However, meat processing facilities can produce wastewater with a complex composition such as heavy loads of solids and natural organic matters. An emerging technique is the dynamic membrane bioreactor (DMBR). DMBR has been developed and examined for wastewater treatment recently as an alternative to conventional membrane bioreactors (MBRs), owing to its merits such as lower membrane cost and higher fluxes production. The previous studies have demonstrated that DMBRs technology can effectively remove COD, nitrogen, and turbidity from various wastewater types. These wastewater types include textile, brewery, and municipal wastewater. Presently, no studies have been reported on the application of DMBRs for meat processing wastewater treatment. This Capstone project proposes to design a model of DMBR for meat processing wastewater treatment, including the hypothesis of factors affecting the performance, cost analysis, environmental impact assessment, and risk assessment. The results of this project are expected to be fundamental information about DMBR, which may be applied to help with the improvement of other wastewater treatment in providing better strategies.

EVSE 2: Impact of Climate Change on Irrigation of Saskatchewan

Jingru Liu Tong Dai Ke Wu
Shang Wang

Agriculture plays an important role in Saskatchewan's economy. To improve agricultural productivity, the Saskatchewan Government recently launched the Lake Diefenbaker irrigation project and invested more than four billion dollars. One of the major water sources for irrigation is surface water, which can be vulnerable to changing climate conditions. Therefore, the impacts of future climate change on irrigation water availability must be assessed. The objective of this project is to explore the feasibility of future irrigation projects in Saskatchewan affected by climate-change-induced water availability variations. Specifically, stepwise regression is used to construct the statistical relationship between climate variables and the streamflow. The developed statistical model is applied to data from global climate models to generate future streamflow projections under various emission scenarios. The trend and the statistical significance of future streamflow will then be estimated using Sen's slope and the Mann-Kendall test. The results of this project include the future change and trend of surface water availability in Saskatchewan, which can help the evaluation of irrigation projects for the province.

Environmental Systems Engineering

EVSE 3: Utilizing Engineered Wetlands for Flood Mitigation and Nutrient Management in the Quill Lakes Basin

Eric Atkins Matthew Schroeder

In 2017, the Quill Lakes experienced record high water levels due in part to being in a wet cycle caused by above-normal precipitation. Elevated water levels have resulted in significant flooding of private and crown land, as well as damage to infrastructure. If the water level were to rise above the spill point of Big Quill Lake, water would be discharged into Saline Creek and Last Mountain Lake. The Quill Lakes contain high amounts of salinity and total dissolved solids, making discharge a concern for water quality and the ecosystem health of receiving waters. The objective of this project is to design an engineered wetland to reduce the quantity and improve the quality of surface runoff entering the Quill Lakes. By using an engineered wetland, upstream storage can be created and surface area maximized to increase evaporation, which reduces the volume of water entering the Quills from spring runoff. The conceptual design of the wetland incorporates inflow and outflow controls, a compacted soil liner, and embankments. Design feasibility is evaluated based on environmental, social, and economic impacts. Through evaluation of the design, it is noted that significant reductions in nutrient concentration can be achieved with small reductions in runoff volume.

EVSE 4: Improved Ventilation System for Reduction of Airborne Disease Transmission in the Library of University of Regina

Changyan Chen Gangwei Dong Songsong Wang
Zhenlin Zhou

Infectious diseases such as the SARS virus which spreads through air and aerosols threaten the safety and health of human beings. From 2019 to 2020, the outbreak of COVID-19 and its transmission rates are very high in indoor facilities. At the University of Regina, the high personnel flow rate further aggravates this kind of risk. Poor ventilation and inefficient disinfection are two main reasons that the COVID-19 virus transmits so rapidly indoors. Nowadays, all existing buildings (with the exception of hospitals) are not designed with infectious diseases in mind. This project focuses on improving the performance of a ventilation system to decrease the possibility of airborne disease transmission. First, the current ventilation system will be investigated based on a field tour and CFD simulation. After that, the detailed improved design will be provided based on the previous evaluation and ASHRAE standard. The final design should trade-off between technical feasibility and economic efficiency.

Environmental Systems Engineering

EVSE 5: Improving Safety at Saskatchewan's Least Safe Highway to Highway Intersections

Mario Selvamohan Jesinraj Rajaratnam Terry Yu

The goal of this project is to select the most cost-effective intersection safety improvements that will increase the level of safety at 3 of Saskatchewan's top 10 least safe intersections. To achieve this goal, previously developed intersection Safety Performance Functions (SPFs) are used to determine the top 10 least safe intersections, of which 3 were chosen in the vicinity of Tuxford, Fort Qu'Appelle, and Wakaw. These intersections are reviewed to establish a baseline of existing conditions. This is followed by an analysis of the 5-year (2014-2018) detailed collision history to locate root causes. Extensive research is then conducted to locate Collision Modification Factors (CMFs) for applicable low-cost safety improvements (with planning level estimates), as well as eligible treatments using the Ministry's warrant analyses. A Cost-Benefit Analysis (CBA) for each location was then developed to determine which combination of solutions for each of the 3 intersections is the most economical while improving safety. A high-level design is completed, and the findings are presented to the Ministry of Highways for potential consideration.

EVSE 6: Expanding Saskatchewan's Wind Energy: Analysis of Site Selection and Design

Samuel Ferguson Lenay Sylvestre Nicole Rodgers
Sabrina Gilmore

The global community is currently pushing for a transition from fossil fuels to zero-carbon energy sources to reduce the effects of climate change and promote a cleaner energy future. Following this goal, SaskPower plans to obtain up to 50% of the province's electricity generation from non-emitting sources by 2030. To meet this target, the Saskatchewan wind energy sector must be expanded. The objective of this project is to select the most suitable locations for wind power plants within Saskatchewan and complete a proposal of the findings. To determine the ideal site locations, ArcGIS is used to create a geospatial analysis based on design criteria and modeling. These results were subjected to a multiple-criteria decision analysis to determine the ten most suitable locations. An environmental impact assessment is conducted for these locations, as well as a comprehensive stakeholder evaluation. A preliminary design of each site is also incorporated to demonstrate the expected energy generation and configuration of the wind turbines. The project findings indicate that Saskatchewan has several optimal sites for wind power plants, which can be utilized to support efforts to reduce fossil fuel emissions.

EVSE 7: Designing A Compost System Using Styrofoam

Ayesha Zahid Tinsae Alemu Aimen Ejaz
Anukaranjit Bharthi

The objective of this project is to design a small-scale indoor composting system using Styrofoam containers to reuse and reduce the amount of Styrofoam in the waste stream. The hypothesis of Styrofoam as an exceptional compost is made due to its characteristics such as thermoplasticity, sunlight sensitivity, insulation abilities, and low weight. A 15-week experiment is conducted where five versions of styrofoam containers designed for composting are compared to a regular compost bin. Parameters such as temperature, pH, moisture content, carbon dioxide, and compost weight are monitored and analyzed. Graphical analysis and decision matrix are used to determine the impact of designed Styrofoam containers on the rate of composting as well as to recommend which compost method is most efficient. Based on the results obtained, no significant difference is observed in the two composting methods. However, reusing Styrofoam containers and the organic waste at home can reduce the amount of Styrofoam entering the waste stream, thus reduce the amount of methane produced.

EVSE 8: Designing a Wastewater Treatment Plant for Pasqua First Nation

Akabom Ekpenyon Tomika Pinay Nathan Avery

With the water system becoming stressed and access to safe freshwater becoming more scarce, the treatment of water and wastewater is a necessity that helps reduce contamination to water bodies and alleviate other problems associated with water pollution. This project aims to recommend a design for the construction of a wastewater treatment plant for the Pasqua First Nation community located 65 km northeast of Regina and is home to approximately 2500 residents. Pasqua First Nation is currently lacking a wastewater treatment plant and sewage from homes not connected to the main sewage line is being disposed of by truck. This project helps accelerate the First Nations infrastructure development goals. This project evaluates three treatment alternatives: clustered septic tank, membrane bioreactor system and a rotating biological contactor. The clustered septic tank is the most economically viable option for construction. A proposal is to be included and acceptance of this design will be sought after from the Pasqua First Nation. The recently established Canada Infrastructure Bank will be a potential source of funding for this wastewater treatment plant.

Environmental Systems Engineering

EVSE 9: Sustainable Dairy Cattle Manure Treatment System

Yi He Shaheen Humanyun Yuhao Li

Abrar Saeed

Livestock manure poses environmental threats to water, soil, and air quality. It is also a nuisance to farmworkers and presents health concerns to animals and humans. Therefore, adequate manure management for livestock farming is warranted, especially in Saskatchewan where farmers must get permission from the government. In this project, a manure management system for a dairy cattle farm in Regina's rural area is designed. To protect water resources and sensitive areas, the location is selected according to provincial documents to minimize risks and avoid costly modifications. Soil quality has been tested to ensure that the geological condition is suitable for earthen manure storage (EMS) constructions. The management system consists of five steps: collection, transfer, storage, treatment, and reuse. Tractors are used to collect manure into a pump station, then manure is directed into EMS through a transfer pipe. Next, manure is treated in an anaerobic digester to produce biogas and digestate. The goals are to protect soil, water sources, and reduce greenhouse gas (GHG) emissions. Additionally, regular manure collection minimizes odor and pest attraction in the barn. The team also simulated 3-D models for the structural visualization, investigated cost-benefit analysis, and established a matrix for environmental impact assessment (EIA). Our preliminary analyses show the project will reduce the risk of soil and groundwater pollution, eutrophication, GHG emission, and pathogen transmission. This will help producers achieve sustainable production and enhance their environmental stewardship within the circular economy framework.

EVSE 10: Analysis of Biofuel Sources for Canada's Future Development

Dallas Barber Qian Kang

This project provides a detailed assessment of the future of biofuels in Canada. Since the federal Renewable Fuels Regulations enacted in 2010, biofuel mixing has played an increasing role in the transportation sector as part of a wider strategy of reducing greenhouse gases. With new federal legislation such as the Low Carbon Fuel Standard coming out later in 2021 and innovations in the biofuel industry, biofuels are expected to continue this important role. Due to the novelty of some biofuel production methods as well as improvements in vehicle engines for consuming biofuel mixtures, predicting the future of the industry can be challenging. To understand what the future of biofuel will look like, four possible scenarios are identified and subject to economic analysis, lifecycle greenhouse gas assessment as well as discussed in a broader societal context.

Industrial Systems Engineering

ISE 1: Variable Air Volume Control Apparatus: HVAC Undergraduate Laboratory

Christina McCusker Avah Strueby Emily Albano

Building airflow control is a complex system with many equipment interactions; variable air volume (VAV) terminals are commonly used in the heating, ventilating, air conditioning, and refrigeration industry (HVAC&R). The purpose of this project is to design and construct a portable, interactive teaching tool that demonstrates the fundamental principles of air movement, heat transfer, and building control for use in the University of Regina HVAC&R laboratory. The apparatus consists of a scaled version of a building control system using VAV units. Students gain an appreciation for building control in dynamic systems by observing both manual and automated control. The Portable VAV system is developed using project management principles to design the system layout, source and order components, fabricate the apparatus, and test the equipment.

ISE 2: 4WD Drivetrain of a Mini Baja Vehicle

Ryan Rhodes Keegan Parsons Coleman Peterson
Joe Keller

The Baja SAE student engineering competition has been dominated year after year with two-wheel drive off-road vehicles. The off-road consumer market primarily consists of four-wheel-drive vehicles, and Baja SAE is changing to meet these demands. The U of R Cougar Racing team is taking on this challenge by developing a four-wheel-drive system to fit in an existing 2WD Baja frame that was built in 2019. The proposed solution is to implement a hydraulically driven front differential to power the front wheels while retaining the previous mechanical rear-wheel drive system. The engineering design of this system includes the evaluation of tractive effort, specification of hydraulic components, suspension and steering design, integration of components into the vehicle chassis, calculations, as well as component costing and sourcing. Hand calculations, SolidWorks modeling, and kinematic suspension software analysis software tools are used throughout the engineering design process. Dimensional drawings shall be created for fabrication and procurement to create a physical prototype for testing and validation.

Industrial Systems Engineering

ISE 3: ASHRAE Level 3 Energy Audit of the Education Building

Cole Bailey Robert Avram Erik EInarson
Zachary Kotylak

This project aims to optimize the efficiency of the Education Building at the University of Regina. This building uses a mechanical system designed in 1967 for the first four floors and has not undergone substantial HVAC retrofits in over fifty years. The subsequent floors were added in 2001 and have a separate mechanical system. Since the construction of the Education Building, there have been numerous innovations in HVAC system technology. The primary directive of this project is to use modern HVAC knowledge to pinpoint energy optimization opportunities in the Education Building's daily operations. This is achieved using energy modeling software called Trace700. It involves performing an ASHRAE energy audit while taking an engineering approach to test conceptual energy efficiency measures (EEMs). EEMs are changes that optimize system efficiency. Some proposed efficiency measures include variable frequency drives on glycol pumps, heat recovery solutions to transfer energy between exhaust and intake ducts, window retrofits, and alternative lighting solutions. A validated baseline model is used to compare mechanical and non-mechanical solutions. The quantifiable results obtained are used to provide the University with an economic analysis report, highlighting the recommended measures to be implemented and their associated payback period. Assumptions made must be documented in preparation of the model and associated consequences explained to the client.

ISE 4: Automated Ventilation System for CNH

Andrew Hajewich Fairooz Zaima Khan Iveren Tersoo-Gwaza
Rubi Oviedo Meneses

This project proposes an automated ventilation system for Saskatoon's CNH Industrial facility. A ventilation system (also known as an air circulation system), which is a mechanical system that enables fresh air from the environment to get into the workplace to remove air contaminated by CO and CO_2 from inside of the workplace. The objective is to design a system that fulfills industry requirements and ensures a safe environment for its workers. A properly designed system improves the cost savings associated with heating and cooling the facility. Workplace requirement standards such as ASHRAE are followed when designing this system. As stated in tentative methodologies, various aspects are taken into consideration. These aspects include the use of sensors are implored and factors such as the number of sensors needed, sensor placement for maximum efficiency, evaluation of sensor accuracy when the system is operational, as well as maintenance procedure and lifespan for each sensor. A detailed drawing of the components (devices and locations in the plant) and connections as well as their location in the plant would be made as the project progresses.

Industrial Systems Engineering

ISE 5: Manual Wheelchair Seat Elevation Mechanism

Chengjun Zhang Denghui Wang Jianqing Ma
Zhaoxuan Yang

The goal of this project is to design a manual-operated wheelchair seat elevation mechanism. Current wheelchairs have fixed seat heights and it limits the reaching range of the users. The elevation mechanism will conduct a scissor lifting structure and is powered by the hydraulic solution. An energy storage mechanism is introduced to reduce the power required to operate the mechanism. The design is to increase the accessibility of manual wheelchairs so users can reach a higher with easy operation and less time. An economic analysis is performed. There is also a detailed calculation to prove the structure's rigidity and strength are capable of withstanding the desired weight limitations.

ISE 6: Brandt Heavy Haul Trailer-Wheeler Suspension Design

Alexander Strelic Evan Desrosiers Justin Jones
Kaden Bowerman-Moggey

A new dual axle suspension system is designed for Brandt's heavy haul trailers. The current heavy haul trailers operate with a single axle suspension system, which is incompatible with the dual axle system. A custom dual axle suspension system is designed and analyzed for Brandt to use on their new trailer as none are commercially available. This design doubles the sets of dual tires across the trailer from two to four, increasing load capacity and ground contact. To design the suspension system, it is crucial to be familiar with trailer suspension types, components, and supporting calculations. An air spring suspension system is determined to be the most reliable, compact, safest, and easiest to maintain. The key components of the suspension system include the hanger, trailing beam, and air spring. These three components are the main result of the design and analysis that is completed. The suspension is designed by performing supporting calculations, constructing CAD models, and completing finite element analysis, showing that the provided design can withstand loads placed on the trailer.

Industrial Systems Engineering

ISE 7: Motorcycle Drivetrain Conversion of a Formula Racing Car

Jayden Raabel Jeff Strueby Alex St.Amand
Nick Volsky

Cost is one of the highest barriers to entry into Formula Car Racing. This project lowers the initial and running costs of a formula racing car while maintaining a high safety and performance standard. The car utilizes a Formula 1600 style chassis and proposes the use of a motorcycle engine in replacement of a more costly typical class-specified engine package. The motorcycle powered drivetrain is significantly cheaper, has a high power to weight ratio, is reliable, and is compact enough to fit in the open-wheel chassis. This design is unique as it integrates original equipment manufactured (OEM) components with custom-designed parts to increase reliability and reduce costs. The three main deliverables within the scope of the project are the Power Transmission System, Rear Suspension Design, and Rear Subframe. A prototype is currently at its final stages of construction and will be tested on track this summer.

ISE 8: The Study of Heat transfer in Windows Using a Radiant Heating System

Ahmed Ahmed Jose Loyola Papa Anim
Vineeth Suresh

A radiant energy system is currently applied to in-floor heating to improve cooling and heating efficiency in homes. This system takes five goals from the United Nations and seventeen goals of Sustainable Development into consideration. This is done to improve thermal comfort in the home and make the system affordable and available to anyone. The study of heat transfer in windows using a Radiant Heating system is to compare two different windows, one with the radiant link heating system using PEX piping and the other as a control group. The prototype of the system is built by McPherson Engineering. Both windows have temperature sensors that record the window's temperature every three minutes for November, December, January, and February. Next, the heat loss of the two systems must be found. The radiant system cycles a heated 35% glycol-water solution through a Radiant Energy Heat Exchanger designed and made by MacPherson Engineering. The heat exchanger is located under a downflow furnace where hot air is blown into the heat exchanger and uses the same heat energy to transfer it to the glycol solution. The mixture then cycles through PEX piping through the floors and around the windows resulting in less heat loss.

Industrial Systems Engineering

ISE 9: CNH Saw Door

Jason Jacobs Brett Seguin Marone Meyer
Breanna Townsend

This project is to design a saw door for the CNH Industrial's New Holland Agricultural Plant, which is seeking a solution to reduce the amount of energy consumption due to their saw door openings. The current door at the plant is an inadequate insulator against the cold air that enters the building. Our project is going to improve the working conditions for the saw operator by reducing the wind and snow that enters through the opening, the design will also reduce the amount of CO_2 emissions via reducing the use of the heating system in the winter months. Several design options were presented, and as the designs became narrowed down, thorough investigations were performed to determine the best possible solution. An economic analysis is completed for each of the prospective design options, as well as detailed calculations to determine if the designs would withstand the forces of the system. The final design is chosen with the recommendation of CNH based on the benefits it may provide, the ease of use, and the reduction of maintenance required.

ISE 10: Fine Cooler System Upgrade

Jace Woods Cullen Murray Mebin Babu
Khadijah Mirza

Mosaic Potash Belle Plaine is one of the largest solution mines in the world and produces Fine, Standard, Course, Ag Granular, HQ Granular, and special granular MOP (Muriate of Potash). The major engineering problem that is involved with the current Fines Cooler system for Mosaic Potash Belle Plaine is that if the product leaves the cooler too hot and reaches the warehouse at too high temperature, the treatment will be burned off on the product, causing the potash to clump together. The project focusses on achieving the desired product temperature during summertime, which is the worst-case scenario for the product while ensuring the quality of the product and increasing the throughput of the cooling system. As the winter condition is the desired condition, the new upgraded system focuses on increasing the heat transfer by incorporating cooling coils in the system to mimic winter conditions and including internal and/or external modifications to the Fine Cooler System.

Industrial Systems Engineering

ISE 11: Design of Heat Reclaim System from CNH Industrial's Cure Oven

Karl Tristan Ayran Zachary Ewanchuk Ric Sablada
Imtiyaz Ahmed

The environmental impact of carbon emissions from industrial plants in Canada is a growing concern. CNH Industrial aims to address this issue by limiting the operating hours of the unit and radiant heaters in their receiving bay. This project uses a fan and ductwork system that recovers the exhaust heat from a nearby cure oven and recycles this energy to heat the receiving bay. This reduces the runtime demand of the current heating system. The primary objective of this project is to reduce the carbon footprint of the plant and potentially void needs for unit and radiant heaters. The final design includes a comprehensive layout of the heat recovery system and an automated controller that turns on the system when certain parameters are met. The project delivers a highly detailed design (dimensions and part lists), AutoCAD drawings, and economical analysis of the reclaimed heating system. The budget for the project follows CNH's approval and is obtained from annual savings that the system will incur after three years of operations. Safety concerns such as exhaust air particulates, tension forces on duct hangers, and duct velocities are considered. By implementing this reclaimed heating system, CNH Industrial can reduce the need for natural gas to heat their receiving bay.

ISE 12: SaskPower Smart Streetlight Project

Shaji Faruqi Aryia Alaghband Angelo Palemara

This capstone project focuses on the design and optimizing of a newly developed streetlight management system to be used for streets in the City of Regina. It is the pilot project initiated by SaskPower with aims to replace the current streetlight system that has no management capability and intensively consumes electricity due to the use of High Pressure Sodium (HPS) light bulbs. The new technology relies on the use of energy-efficient LED lights that can be constantly monitored and controlled from the remote operation centre. In this study, the system design is based on the installation of fifty wireless mesh controllers, five radars, and five air-quality sensors along with access to their Livable Cities software. The technology is being piloted in Harbour Landing with expansion plans for the rest of the City of Regina. With the advanced capability to incorporate surveillance cameras and acoustic sensors, the new technology will be beneficial to other organizations such as Police Department and SaskTel.

ISE 13: Inventory Management of Cornerstone Building Brands for Supply Chain Improvement

Rishabh Sharma Vaibhav Shienh Hamza Javed

The scope of this project is to standardize and develop a data model for the windows manufacturing division of Cornerstone Building Brands. With data becoming more prevalent in today's business world, it is crucial to utilize its usefulness to stay competitive. Lack of standardization leads to inconsistent data reporting which ultimately causes a loss in time and money for the business and can lead to missed opportunities as analytics will not be as effective. This project standardizes the data model to improve inventory management at the windows division. This is done using Excel power features (Power Query and Power Pivot) where the data across the division is aggregated then cleaned using various data analytic techniques while implementing several design iterations to account for the requirements set by the client. Ultimately, the standard model is used to provide the back-end structure for the analysis of inventory management through either MRP or BI visuals for the company. This helps save time and costs in the long run as the new model is used.

ISE 14: HVAC - In-floor Heating and Cooling System

An Vo

The analysis and optimization of electricity consumption are important matters of modern society. This project focuses on analyzing the electricity consumption of two buildings: the Paskwaw/Wakpa Tower and the Kisik Tower. The Paskwaw/Wakpa Tower uses an outdated generation heating system, while Kisik Tower uses a new heating system. Based on the historical power usage, the energy consumption per square foot of each building is calculated. Furthermore, to improve the heating efficiency of the old heating system, a mathematical model is built and simulated to estimate the new energy consumption. The economic analysis method can be applied to calculate whether the Paskwaw/Wakpa Tower could save money based on the Return on Investment (ROI) with lifetime-sensitive. Depending on the final economic result, the decision on financial investment to improve the old heating system is made.

Petroleum Systems Engineering

PSE 1: Catalytic Heaters as an Alternative to Methane Venting in CHOPS

James Ashworth Saad Ali Khokhar Michael Clarke

This project evaluates the feasibility of catalytic heaters to convert vented casing gas to CO_2 at CHOPS sites. The greenhouse gas methane can be reduced by converting vented volumes into CO_2. Flaring practices as an alternative to venting are often not suitable for CHOPS due to low and intermittent gas volumes. With the government targeting up to 45% methane emission reduction by 2025, technical solutions to reduce such emissions are critical. Catalytic heaters may provide a means of reducing methane venting on low-volume wells while providing other benefits including reduced infrastructure requirements, eliminating unsightly flares, and reducting combustion byproducts and particulate matter. The project goals are to develop a technically feasible unit and conduct an environmental and economic analysis on the units for use with CHOPS. Production data and gas rates are collected for Dee Valley and Gully Lake Fields in Western Saskatchewan using AccuMap to generate baseline vent volumes. Preliminary catalytic unit sizing is done using empirical data and mass-energy balance at varying combustion efficiencies to determine the size and number of heaters required for varying methane volumes. A model is generated using ASPEN Plus to support the empirical unit sizing and determine the maximum amount of gas the units can handle. Taken into consideration are safety and wellsite regulations, physical unit design, and potential quantification methods for gas volumes. The environmental and economic analysis considers CO_2eq reduction to proportional carbon off-set credits and taxes. The environmental assessment determined our design off-sets up to 89% of CO_2eq emitted annually.

PSE 2: A Comparative Evaluation of Miscible and Immiscible CO2 Flooding Performance in a Light Oil Reservoir in Saskatchewan

Oluwakorede Dosu Raisssa Kalamai Wiysahnyuy
Chiamaka Okorie

Carbon dioxide (CO_2) flooding is an enhanced oil recovery method that can be achieved in two ways: miscible and immiscible flooding. Due to the reduced cost of using carbon dioxide, this gas is highly recommended for enhanced oil recovery when compared to utilizing hydrocarbon gases. CO_2 flooding presents potential environmental benefits by reducing the emission of greenhouse gases. The purpose of this project is to determine the most feasible CO_2 flooding process for a light oil reservoir in Saskatchewan. After a screening process, the Elmore Frobisher Beds Pool is selected for this study. The minimum miscibility pressure (MMP) required for CO_2 injection is calculated using empirical correlations. CMG GEM software was used to create the reservoir model and perform simulations for both methods of CO_2 flooding. Also, the most viable operational conditions for both flooding types are determined. From the simulation results, recovery rate, economic and environmental effects the most beneficial flooding type for the selected pool is determined.

Petroleum Systems Engineering

PSE 3: Performance Optimization of Hybrid Steam-Solvent Huff-n-Puff Processes in A Post-CHOPS Reservoir

Di Lu Chiagoziem Imegwu Teresa Gombe

Cold Heavy Oil Production with Sand (CHOPS) usually leaves the reservoir with about 85-90% of its OOIP. To recover more oil from the post-CHOPS reservoir, other EOR methods are used. The huff-n-puff (cyclic process) process is a thermal EOR method that is used because it significantly improves the mobility ratio as well as production. "Huff" is steam injected through a well and allowed to soak. "Puff" is when fluid production occurs by producing well. In CHOPS wells, a pressure drawdown is created inside the reservoir, causing high permeability channels to form called wormholes, where mixtures of oil, water, gas, and sand flow out of the wellbore and enhance the production rate. By delineating the wormhole network and manipulating the steam-solvent ratio, the performance of the improved cyclic steam-solvent stimulation method facilitates higher recovery. This project explores the recovery rates of a CHOPS reservoir using different steam-solvent compositions to determine what combination yields the highest recovery. The solvent used is carbon dioxide, nitrogen gas, and steam. The simulations that perform the evaluation include data collection from Accumap and Acculog around the Lloydminster area. Next, a modified Material Balance Equation (MBE) is used to calculate pressure as a function of time. The fluid properties are prepared using CMG WINPROP. The 3D reservoir geological model is created using CMG Builder simulation for the selected CHOPS well. Next, a history match and performance evaluation are done using CMG CMOS and STARS simulation. Lastly, economical and cost analyses are performed on the selected solvent stated.

PSE 4: Carbon Capture and Storage (CCS) Design Study In A Depleted Heavy Oil Reservoir

Linda Kuruvila Mitchell Bentley Akshita Tyagi

The objective of this project is to run a design study on using Carbon Capture Sequestration (CCS) on a depleted heavy oil reservoir. This is done by designing an efficient CO_2 sequestration process to optimize carbon storage. The dangers of global warming have enhanced interest in reducing greenhouse gas (GHG) emission reduction. In today's world, the CCS process is a major technical method to moderate GHG emissions. Among the various potential storage alternatives, the geological storage option promises the utmost chance of success with relatively low costs, where CO_2 is injected into depleted reservoirs, oil, and gas fields. This project explores both the design study and economic viability of CCS in a depleted heavy oil reservoir near Cherhill area Banff reservoir. For the completion of this project, production data and fluid properties from the Banff reservoir are acquired to develop a fluid model using WinProp. Core and production data are collected to create a geological model using STARS in CMG software. Several simulations are run to determine the optimum injection rate and amount of CO_2 to be injected into the depleted heavy oil reservoir. Finally, the economic and environmental benefits of the CCS process in the Banff reservoir are analyzed.

Petroleum Systems Engineering

PSE 5: Well Testing and Production Decline Analysis for Horizontal Wells in Saskatchewan

AgneshKumar Gohil Mohammed Abdullahi Mohammad Jumah

Horizontal drilling is a way of drilling wells from the surface and then deviating to intersect the reservoir at a near horizontal inclination. Production decline analysis curves are used to understand and predict future well production. The objectives of this project include collecting data using Accumap or Geoscout and simulating collected data to develop plots. Well testing is the execution of a set of acquired data to broaden the knowledge of hydrocarbon properties and the type and characteristics of the reservoir they exist in. The fluid samples are obtained to find an efficient way of exploring it on a large scale. Production decline analysis is a method of obtaining trends from data collected during production. This analysis is to predict future production from the well. Additionally, it is used to determine if the well is profitable and when to start enhanced oil recovery methods to enhance oil production when the reservoir pressure is depleted. The analysis of horizontal well production data and properties can help with estimating reservoir flowing capacity (kh), effective horizontal wellbore length, and original oil in place. This project compares the state for systematic matching of production decline data used to understand reservoir geometry.

PSE 6: Comparative study of naturally fractured reservoir performance using warren and roots model and numerical simulation

Chi Zhang Zhanyu Li

Natural fracture reservoir is the most common reservoir in the world. It represents a large amount of oil and gas reservoirs and neutral resources on Earth. In the petroleum field, approximately 50% of oil and gas was produced from Naturally fractured reservoirs. The Warren-Roots fracture model is used to stimulate this kind of reservoir. It consists of two large scales of homogeneous reservoir sections evenly isolated and hydraulically connected by an evenly structured fracture section over the rock domain. The Warren-Roots model is also referred to as the dual-porosity model. This project performs a comparative study of the Warren-Roots model and numerical simulation to enhance the model's accuracy and the particle application potential.

PSE 7: Comparative Assessment of Cloud-Based Machine Learning Models in Production Engineering

Delmar Koshin Ahsen Ejaz Han Bao

Cloud-based services allow engineers to analyze oil-field data, leveraging best-in-class machine learning models. These models are difficult to design, have high sustaining costs, and require significant time and resources. With recent cloud service updates, there has been unprecedented growth in the number of use cases. These sophisticated models are cost-effective, scalable, flexible, and dynamic. A holistic assessment is conducted to evaluate the accuracy of the models in production engineering. This assessment consists of machine learning models that forecast production performance against various input parameters and constraints. A sensitivity analysis is considered to assess the outcomes using descriptive statistics. The cloud-based services used are not programmed to detect data anomalies. Thus, refining data to make it conducive for analyses becomes imperative. This data is divided into two sections. 70% of the data set is used for supervised learning. The program assigns weights and activation functions to data and deciphers intricate latent relationships. To enhance this process, codes that govern these functions are altered using manual intervention. The supervised learning module includes specific inputs and an output. After the training module, the relationship's veracity is tested using the remaining 30% of the data. The testing data's output is compared to true values.

PSE 8: Design of an Optimized Polymer Injection for a Lloydminster Reservoir

Ruijie Gao Yu Zheng Runzhi Li

Polymer injection is a chemical Enhanced Oil Recovery (EOR) technique to increase oil recovery by injecting a polymer into a reservoir to increase the displacing water's viscosity. Increasing water viscosity results in decreased mobility fluid ratio and increased sweep efficiency, achieving a favorable oil recovery factor. It is used in high permeability regions. Therefore Lloydminster's reservoir is chosen. The first commercial production was Lloydminister in 1943. AccuMap is used to gather extract well trajectory, production data, and fluid data. This data determines oil and gas composition, density, and viscosity. Then WINPROP is used to match these properties and generate PVT data. The porosity of selected wells is read from a sonic log and density log in AccuMap. Porosity is used to build the reservoir's geological model. The CMG defines the Rock-Fluid Properties. History matching is performed using CMOST. The hydrolyzed polyacrylamide (HPAM) F3630 with a molecular weight of $18x10^6$ Daltons and 32% hydrolysis is prepared, and a production well is changed to an injector. HPAM F3630 is injected by the Process Wizard function in CMG. Polymer flooding is optimized by comparing oil recovery, polymer concentration, and weight. These results determine the design of an optimized polymer injection for Lloydminster's reservoir.

Software Systems Engineering

SSE 1: The Complete Recorder App

Azeezat Lawal Mfonisoabasi Idorenyin James
Muhammad Shafiq Zainuddin

The Complete Recorder app is a sound recording app with organizational features for easy access and search. The app includes desired features that do not exist in apps currently in the market. Most sound recorders pile recordings into a list without basic search functionality or organization to help users find a specific recording. As some users have a large number of recordings per week, sifting through the recordings to locate a specific one is not feasible. The Complete Recorder app helps to solve these issues.

SSE 2: Humane Transport

Clark Inocalla Kelly Holtzman Mansi Patel
Sana Khan

Canadian livestock transporters are required to follow rules and regulations specified by the Canadian Food Inspection Agency (CFIA) before, during, and after animal transport. The current transportation process requires paper manifests to be created and maintained by transporters. These documents ensure that all animals and data are collected for business, market, and tracing purposes. However, it is not well-suited to transporters who may not have access to materials while on the road. Humane Transport is a mobile application that provides transporters with a paperless way to collect and provide CFIA required data while meeting the requirements of the Health of Animals Regulations Part XII, Humane transport of animals (sections 136-155). It also provides access to interpretive guidance documentation to assist understanding.

Software Systems Engineering

SSE 3: Photo Organizer

Allan Wambold Jiaan Nie Sopuru Ugwuonah

Ali Rizvi

Organizing and labeling your vacation photos can be a time-consuming and tedious task. This project is focused on automatically labeling images by using a machine learning model. The model is trained to identify landmarks in images. Using the labels provided by the model, the images are sorted into appropriate file folders. Users can upload their images and download a sorted file structure populated with their images. This project also helps users discover similar landmarks to those in the photos.

SSE 4: SoundByte

Mason Lane Brandon Clarke Brian Jiwoun Kim

Disc Jockeys (DJs) and casual hobbyists often keep a list of tracks to sample and create songs. From their tastes and reading the room, they mix songs accordingly. Our goal is to provide a utility that recommends pieces that may streamline a DJ's workflow. This is a real-time utility for performers that assists them in sifting through their extensive song library. This is done through machine learning algorithms and general search criteria. Our algorithm uses features such as the key, tempo, and beats per minute (bpm) to recommend ideal candidates for mixing, thereby aiding the DJ and narrow down options. Ideally, this improves a DJ's workflow.

Software Systems Engineering

SSE 5: StreamSight: Computer Vision & Data Visualization for Identifying Contaminants in Residential Curbside Recycling

Raymond Knorr Noah Rowbotham Avery Cameron

Canadian citizens are confused as to what proper recycling is. This costs millions of dollars in processing fees and lost revenue due to contaminated recycling. This project produces a website that is used by municipalities to review contamination data. Reports and educational campaigns are created based on the information. The contamination is detected as a recycling bin is tipped into the recycling truck. A machine learning model identifies and flags contaminants for review. The project consists of a front end, API, machine learning model, and image pipeline all hosted on AWS. By providing a method of measuring contamination from households, municipalities can begin to target the issue at its source. Additionally, municipalities can begin to provide individuals with contextual feedback to improve their recycling habits.

SSE 6: Visual Schedule Builder Plus (VSB_Plus)

Xinyu Liu Jingkang Yang Xia Hua

Priscilla Chua

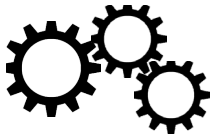
The purpose of this project is to enhance the functionality of the University of Regina's existing Visual Schedule Builder, helping to simplify future students' course selection. While the opinions from the professors and faculty are considered, the opinions of the students are mainly considered. The Visual Schedule Builder Plus is designed for students taking courses in different faculties. Then through the faculty, the Visual Schedule Builder Plus recommends what courses the students should take in the different semesters according to the importance and limitations of classes. After the students have chosen their desired time schedule, the Visual Schedule Builder Plus gives advice on their timetable to help with time management. Also, users can search for individual courses faster using the courseBD filter.

SSE 7: The Link

Joseph Bello Jaskirat Josan Onisokien Ayonoadu
Samuel Iregbu

The Link is a Progressive Web Application designed to bridge the communication gap between the City of Regina and its citizens. The Link allows citizens to take a picture of road hazards in their area and submit a report that can easily be viewed, approved, and monitored by The City of Regina. Once a report is approved, it appears on the homepage and can be viewed by all users. This is to keep users in the loop of what is happening around the city. The Link strives to be an inclusive platform that organizes the communication between the citizens and the City of Regina in the most streamlined and concise way possible.

Feedback



This is the 22nd Annual Project Day.

We would greatly appreciate your feedback on how things went.

Please send an email to engg@uregina.ca with your feedback

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

"Passion is energy. Feel the power that comes from focusing on what excites you. "

- Oprah Winfrey