University of Waterloo

Co-operative Work Terms

Colin Macmillan
21076623
2A Mechatronics Engineering, Honours, Co-operative Program

Work Term	Employer	Evaluation
Jan - Apr 2024	Student Design Teams - University of Waterloo UW Baja Waterloo Ontario Canada Mechanical Engineering Co-Op, Baja SAE	OUTSTANDING
Sep - Dec 2024	Skygauge Robotics Vectored Propulsion Technologies Inc. Hamilton Ontario Canada Product Team Intern	GOOD

Planned Future Work Term(s)

May - Aug 2025
Jan - Apr 2026
Sep - Dec 2026
May - Aug 2027

Colin MacMillan

csjmacmi@uwaterloo.ca
(416) 949 1376

Dear BH Frontier Solutions,

I'm Colin MacMillan, a Mechatronics Engineering undergrad at the University of Waterloo. I have a passion for off-roading vehicles design team, previously as a co-op and now a team lead. I also compose for piano, and I love learning about electrical systems. I am passionate and curious about robotics, especially how agriculture and robotics combine together, and I'd love to be part of your team.

In my previous roles, I have demonstrated leadership skills and the ability to grasp technical concepts quickly. In high school, I became the President of my Robotics Club after a year because I was able to manage my team and lead effectively. After a year of being on the UWaterloo Baja Off-Roading team, I took over the Chassis, Steering, and Safety teams as a lead, supporting my team members every step of the way. Baja is a very close-knit team, and I'm confident I would be as reliable, accountable, and supportive at your company as I am to Baja.

At my previous co-op at Skygauge Robotics, I was a product intern. I made parts in CAD that were critical for the movement of the propeller assembly. I also created a button tester by soldering a PCB and Teensy for the joysticks and generated renders for the full drone, which were necessary for sales. As a product intern, I also handled quality control methodologies, troubleshot drone PCBs with a multimeter and flight tests, and documented every step on our Notion pages.

I have industrial experience and love hands-on work and collaborating in a big team. I have designed wheel hubs, gears, uprights, steering systems, and drone components using SolidWorks and AutoCAD. I have experience using Bild, a PDM that I used to collaborate with my team members. In addition, I have manufactured parts on the Mill and Lathe, such as an Upright, and steering subsystem. I have also learned ROS in my spare time.

I am eager to bring my technical knowledge, leadership experience, and relentless curiosity to your organization. I look forward to discussing the opportunity to contribute to your team's success and tackle exciting new challenges together. Thank you for considering my application.

Warm regards,

Colin

Colin MacMillan

csjmacmi@uwaterloo.ca

github | linkedin

Skills

Programming Languages Python | Java | C++ | Premiere Pro | | JavaScript | MATLAB | Excel | Arduino IDE

Mechanical Design SolidWorks/OnShape | DFM | DFMEA | Lathe | Mill | CNC | Laser Cutter | Waterjet | GD&T

Experience

Skygauge Robotics
Sep 2024 - Dec 2024

Production Team Intern — *Hamilton, ON*

- Designed and fabricated drone components, such as propeller sub-assembly and GCS components
- Developed and designed a Teensy program using Python and Arduino IDE to optimize the joystick QI process.
- Conducted cycle time and Fish-Bone diagrams to improve repair time by 22 percent.

UW Baja Offroading
Jan 2024 – Apr 2024

Engineering Intern — *Waterloo, ON*

- Designed, and manufactured the Front Upright, using Waterjett, Lathe, Mill and Welding.
- Created engineering part drawing for Wheel hub using SolidWorks based on GD&T and DFM methodology.
- Optimized Chassis Design in PDM, using parametric equations allowing members to change parameters, and leveraging Ansys Workbench for FEA.
- Designed Steering System, achieving an Ackermann of 70 percent, and minimal Bump Steer

Extracurriculars

FRC Harbord Robotics
Jan 2020 – June 2023

Robotics President — *Toronto, ON*

- Responsible for the Drivetrain system, wiring the motors and CAN bus to RoboRIO and testing using DMM.
- Exercised leadership, orchestrating and coordinating various sub-teams during the pandemic.
- Actively cultivating relationships with potential sponsors, achieved 2000 dollars in sponsorship funds.

Academic Representative
May 2024 – Aug 2024

University of Waterloo — *Waterloo, ON*

- Attended meetings with professors to provide constructive feedback collected from current cohort members.
- Actively engaged with other cohort members to improve the course curriculum and how the course is taught.
- Worked with other Academic Representatives to organize feedback.

Projects

Planetary Gearbox
Apr 2024 – Apr 2024

SolidWorks, 3D Printing, DFMEA

- Designed a 6-part system, achieving a reduction of 20:1, from Ring to Planet gear.
- Used a parametric modelled gear based on ANSI Gear Standards, allowing diametral pitch, number of teeth and pressure angle to be changed easily.
- Designed to accommodate Rapid Prototyping Techniques.

AI EARTHHACK
Jan 2024 – Jan 2024

Software Architecture, Adobe, UI/UX — *Harvard University*

- Participated in an AI-focused hackathon hosted by Harvard University, focusing on innovative problem-solving and AI application development.
- Collaborated with teammates to rank renewable business models based off several factors, using cutting-edge AI technologies.
- Contributed to the project in the coding and video-editing components.
- Placed top 15 in over 1000 teams.

Education

Bachelor of Engineering - Mechatronics
Sep 2023 - Apr 2028

University of Waterloo — *Waterloo, ON*

Harbord Collegiate Institute
French Proficiency

COLIN

MACMILLAN

Internship at UW Baja SAE

CURRENT TITLE
Steering Lead & Safety Officer

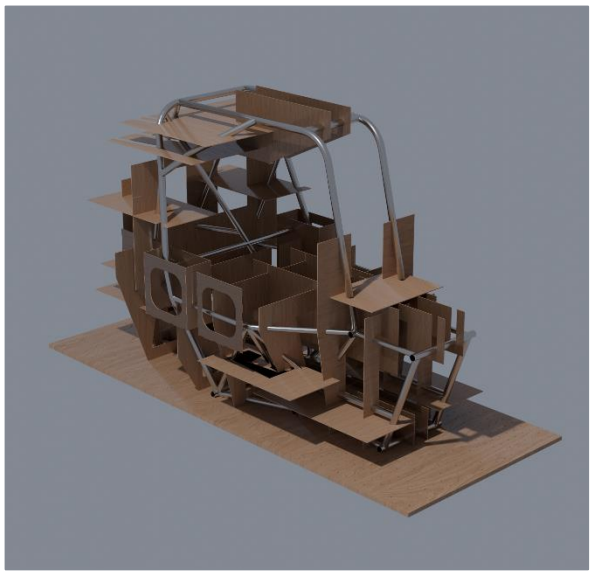
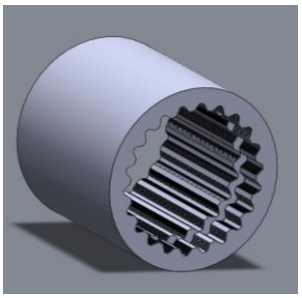
DATE
January - April 2024

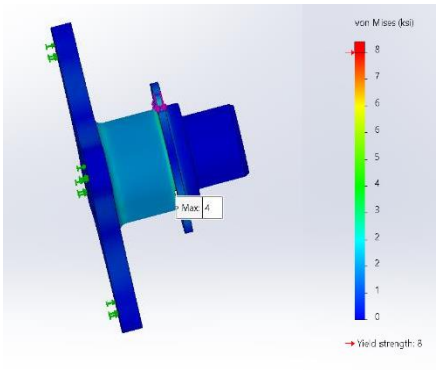
ABOUT

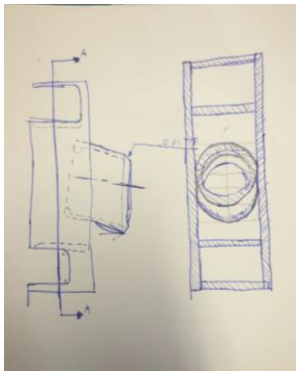
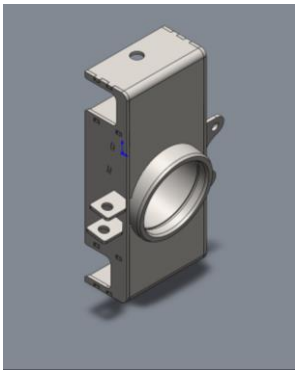
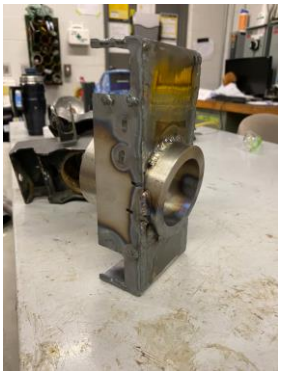
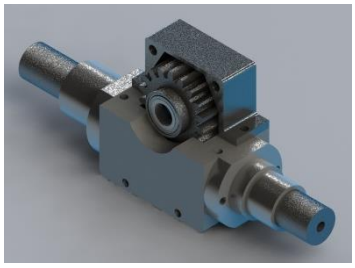
During this internship, the team's main focus was developing an off-road vehicle designed to compete against others in challenging terrains with the ultimate goal of securing first place. We placed 15th out of ~30 teams in the Laval Winter Competition.

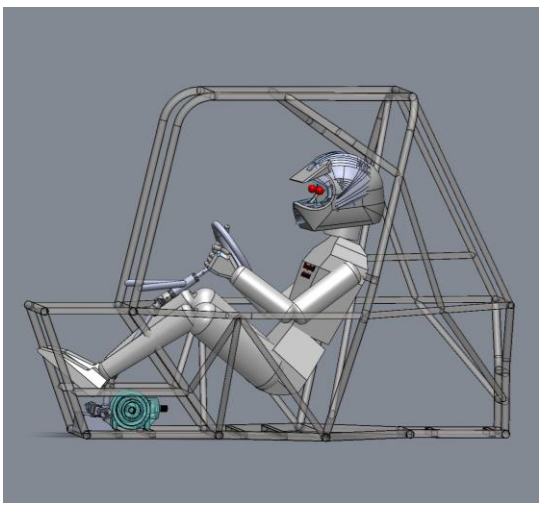
I contributed to many subsystems including Chassis & Dynamics, Front Suspension, and Steering. I designed a Chassis jig and fixture table, and rendered it in Blender. With front suspension, I helped design and FEA the wheel hub (with a F. O. S. of 3), and prototyped, designed, and manufactured the Front Upright.

As the teams' progress in Steering was stagnant, I took initiative and took over as Steering Lead. I created geometries and assemblies where people could put in their respective parts.

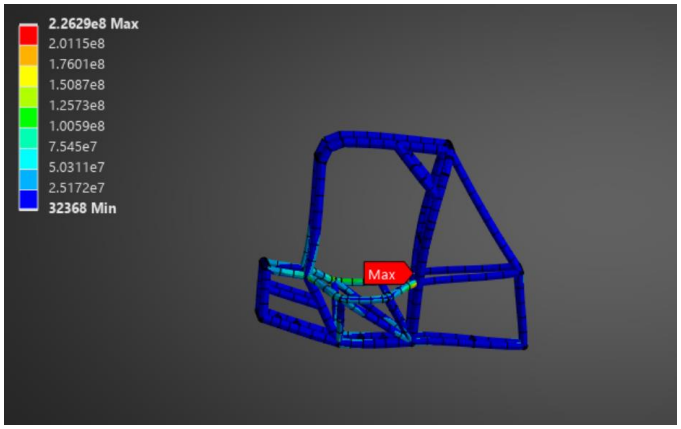





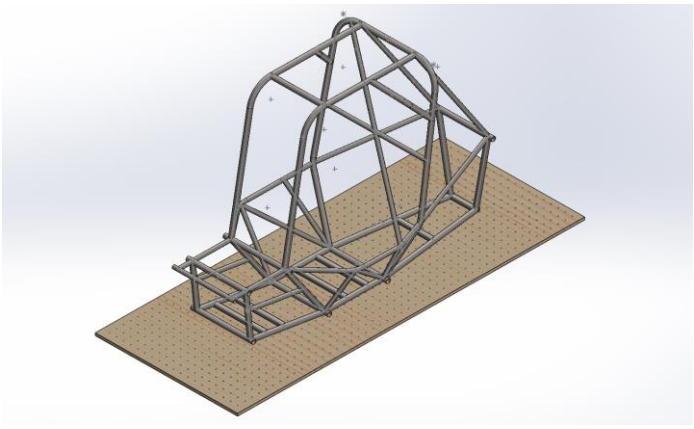


COLIN
MACMILLAN

PORTFOLIO

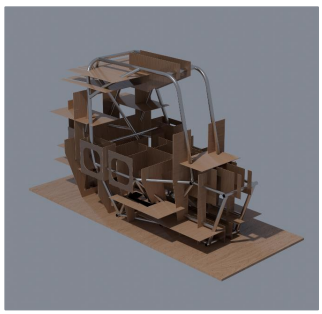
Chassis
UW Baja SAE 2025

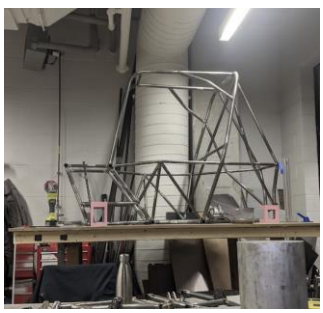




- Developed a robust chassis made from AISI 4130 to withstand the demanding conditions of off-roading
- Improved ergonomics by lowering midplane tubes for ease on ingress/egress and by designing the chassis around 95th percentile of men.
- Compiled to all SAE rules and coordinated with outsource manufacturing the make the design as efficient as possible.
- 5% weight reduction from the 2024 chassis.
- Checked feasibility with suspension and powertrain
- Performed FEA Analysis on various load cases including Frontal and Rear Impact Test, Rear Bump Test, and a Roll-Over Test with a Factor of Safety greater than 1.7.

Chassis jig
UW Baja SAE 2024





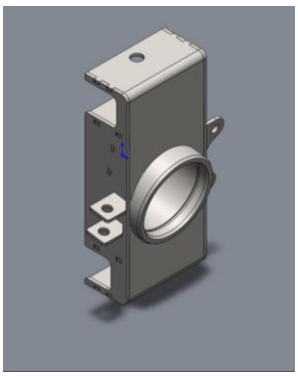
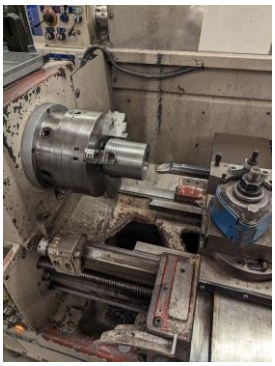
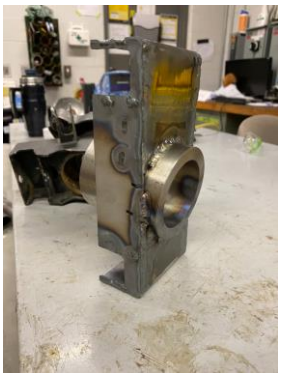
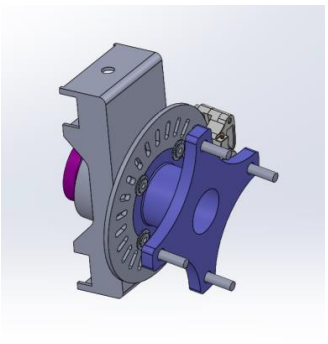
- Created the 2024 chassis jig made from laser-cut MDF boards
- Ensured adequate clearance for welding
- Created tab & slot interlocking pieces so it could support itself as well as the chassis
- Successfully manufactured the jig with minor issues

Front Wheel hub
UW Baja SAE 2024



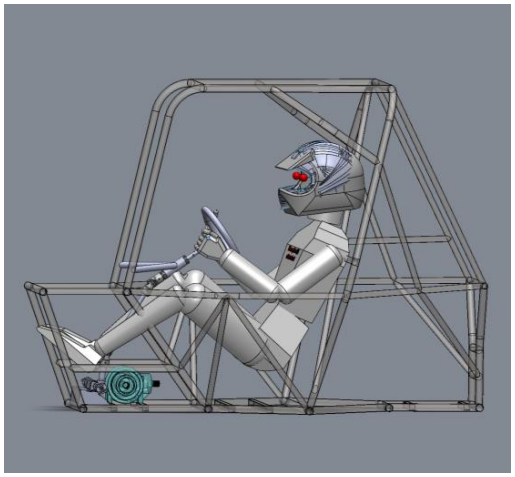
- Designed the Front Wheel hubs that are responsible for rotating the wheel when torque is applied from the half-shaft.
- Ensured system-integration with braking system, front suspension, wheel and upright, with no interference between sub-assemblies.
- Design needed to be robust and withstand torque load case.
- Determined off-the-shelf half-shaft male spline using AGMA spline standard to design matching female splines for wheel hub using measurement over pins
- Created design based off of DFM principles
- Conducted FEA in SolidWorks, Designed with a F.O.S. of 3

Front Upright
UW Baja SAE 2024

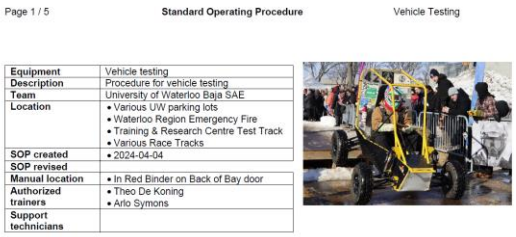
- The Front Uprights in a Baja SAE vehicle are integral structural components that mount the suspension and steering mechanisms, house wheel hubs, and absorb off-road stresses, ensuring robust maneuverability.
- Develop a cost-effective, simple, and durable upright capable of withstanding rigorous environments
- Easy to fabricate with minimal jigs
- Constructed from 10 Ga mild steel sheets to create a boxed structure
- Designed and manufactured bearing carrier from 4140 solid round stock
- Features were tabbed and slotted sheet metal pieces, significantly cutting down on fabrication time
- Successfully endured extensive testing and completed in the 2024 season

Steering Sub-Assembly
UW Baja SAE 2024



- Designed the steering system based on the constraints found by a MATLAB model which incorporated Ackerman geometry
- Designed the steering system with ergonomics, such as a quick release coupler.
- Designed and manufactured a bearing sleeve to achieve a secure press-fit for bearings.
- Created u-joints with split pins to remove dead zone of steering column.
- Resulted in a successfully steering system that improved ergonomics and backlash of 10 degrees

Safety Officer
UW Baja SAE 2024



Page 1 / 5 **Standard Operating Procedure** Vehicle Testing

Equipment	Vehicle testing
Description	Procedure for vehicle testing
Team	University of Waterloo Baja SAE
Location	• Various UW parking lots • Waterloo Region Emergency Fire • Training & Research Centre Test Track • Various Race Tracks
SOP created	• 2024-04-04
SOP revised	
Manual location	• In Red Binder on Back of Bay door
Authorized trainers	• Theo De Koning • Arlo Symons
Support technicians	

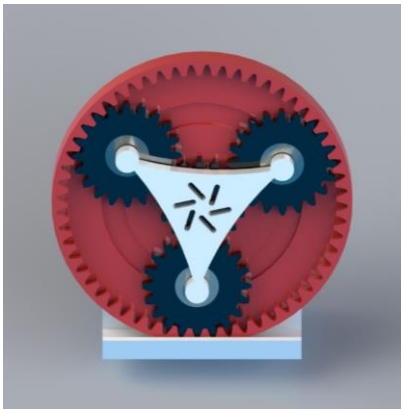
- Created safety binders of MSDS's and SOP's for all equipment that it used
- 5S the area and created instructions on how to keep the bay clean
- Handled the hazardous waste of the team, ensuring that no waste is in the bay longer than 2 weeks
- Maintained a database of people with the eligible amount of training

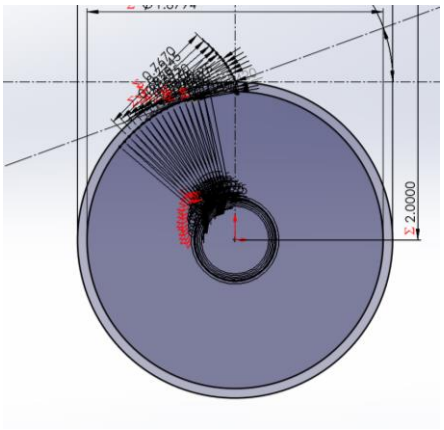
Mechanical Intern
UW Baja SAE 2024

Winter Baja Event. (Feb 5th, 2024)
Placed 15th out of 26th with the 2023 off-roading vehicle

Michigan Baja Event. (Sep 9th, 2024)
Placed top 5 in acceleration with the 2024 off-roading vehicle

Planetary Gearbox Desk Ornament



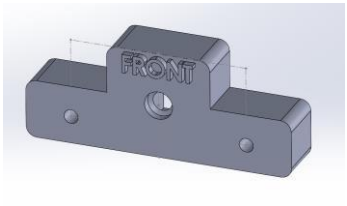


- Designed the planetary gearbox based off the need to make a gear that had a proper involute curve in SolidWorks and could work in a PDM system unlike Toolbox.
- Created a gear template with parametric design that automatically updates based on module for ease of changes.
- Chose a planet to sun 4:1 ratio, did an interference formula to find the minimum number of teeth
- Determined the perfect coprime numbers for each gear to achieve the 4:1 ratio.
- Iterated on the design until the right size to comfortably hold, and precise bearing fit was achieved.
- Successfully made a desk ornament that any mechanical engineer would love.

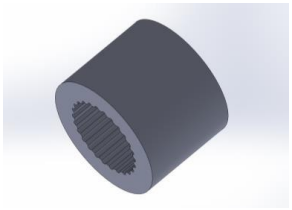
Robotics club Member
FRC 2019

- Created the Drivetrain for the 2019 season
- Chose a 6-wheel drive with 2 motors, powered by a belt chain
- Used depreciated SD540 Motor Controllers, connected through one CAN bus line
- Used WAGO connectors to connect all of the motors
- Chose a 24in by 20in drive to facilitate that year's competition.
- Coded in Java through WPILib extension on VSCode

Internship at UW Baja SAE (2024)

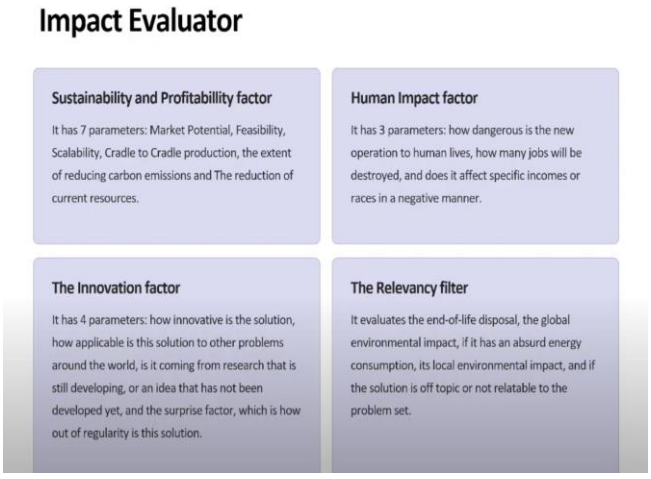


A front suspension switch mount that I designed for the current year's vehicle.



A spline coupler that I designed based off the half-shafts. Needed to find the number of teeth, diametral pitch, and pressure angle.

A table jig that I designed with sheet metal and weldment features.



https://youtu.be/MBCtwsU87E0?si=2O7ZInhb1A4wOxnP Top 15% in the 36-Hours Generative AI Earth Hackathon Competition from the Digital Data Design (D^3) Institute at Harvard and Microsoft, Toronto.

Created the structure and pitch video for the AI tool that would rank a sustainable business model from 1-10 using the Impact Evaluator criteria.

UNIVERSITY OF WATERLOO
UNOFFICIAL GRADE REPORT

Colin Macmillan
21076623

2A Mechatronics Engineering, Honours, Co-operative Program

Winter 2025

WKRPT	100	Work-term Report	*
		*Degree Requirement, Not in Average	
MTE	182	Physics 2: Dynamics	
MTE	219	Mechanics of Deformable Solids	
MTE	200A	Seminar	
MTE	262	Intro to Digital Logic	
MTE	201	Exp Measure & Stat Analysis	
MTE	202	Ordinary Differential Equation	
STV	100	Intro Society, Tech & Values	

Term Average: N/A Decision:

Fall 2024

PD	20	Strategies for Career Success	CR
COOP	2	Co-operative Work Term	CR

Term Average: N/A Decision:

Spring 2024

MTE	100B	Seminar	
MTE	140	Algorithms & Data Structures	88
MTE	111	Material Struct & Props	66
MTE	119	Statics	61
MATH	118	Calculus 2 (Eng)	64
MTE	120	Circuits	64

Term Average: 68.18 Decision: Satisfactory Standing

Winter 2024

PD	19	Tactics for Workplace Success	CR
COOP	1	Co-operative Work Term	CR

Term Average: N/A Decision:

Fall 2023

MATH	116	Calculus 1 (Eng)	72
MATH	115	Linear Algebra (Eng)	68
MTE	121	Digital Computation	90
CHE	102	Chemistry for Engineers	42*
		*Supplementary Exam Completed - S	
MTE	100	Mechatronics Engineering	80
GENE	119	Problems Seminar	

Term Average: 71.27 Decision: Promotion Granted

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New Category	
How many years of experience do you have with robotics development using ROS?	1
Have you participated in any autonomous vehicle/robotics project in the past?	Yes, 1 project
Do you have a driver's license?	No
This job is funded by the Government of Canada as advertised in the job posting. To be eligible you must be a Canadian citizen, permanent resident or a protected person defined by the Immigration and Refugee Protection Act. Do you meet this requirement?	Yes
Are you willing to conduct work on farms?	Yes