WEEF PROPOSALS

SUMMARY

F2021

Academic Equipment and Resources		
Proposal Title		**Requested**
Additional Drone Batteries		$ 7,376.64
Homer Pro Software for hydroelectric power plant simulation in our Capstone Project		-
Multimeters and cables for the semiconductor and circuits lab		$ 130.00
Ideas Clinic - Materials testing		$ 6,250.00
New WATiMake Equipment		$ 19,000.00
ME 340 - Foundry Lab Activity		$ 3,000.00
Titrator for Residual Water Content		$ 20,869.00
EXO NitraLED Sensor		$ 8,910.00
MA-8005 Manipulators (DC Probes) for Nano Undergrad labs		$ 30,000.00
Tools for engineering student shops		$ 6,649.48
ChE CAPSTONE LAB- STUDENT REQUESTED EQUIPMENT		$ 8,228.00
Keychain Activity		$ 1,200.00
Ideas Clinic - Electric Vehicles		$ 10,500.00
Computer Teaching Classroom and 4th Year Study Room Workstation Replacements		$ 22,500.00
Chemical Engineering 4th Year Projects and Course Work Computational Server Cheterm2 Replacement		$ 7,500.00
FYDP Lab Benchtop DMM Replacement		$ 36,000.00
Capstone Lab 3D Printer		$ 3,250.00
Router Table		$ 1,848.99
Automated Linear Induction Coil Manufacturing Machine		$ 1,040.00
New Microscopes for ChE UG Labs		$ 9,000.00
	Total	$ 203,252.11
Miscellaneous		
Battery Powered / Bluetooth PA		$ 810.00
Smart phone gimbal and or gimbal / camera combination for video content creation		$ 1,899.97
Indigenous spaces		$ 11,500.00
Modular Composites Curing Oven for Student Teams		$ 5,500.00
Furniture for CPH nooks (first, second & third floors)		$ 11,500.00
	Total	$ 31,209.97
Student Design Teams		
Pickup Truck for Student Team Use		$ 15,000.00
W21 WEEF Funding Proposal		$ 2,220.00
UWFM Fall 2021 for 2022 Season		$ 13,500.00
SSDC High-Voltage Test Room Proposal		$ 31,881.24
Waterloo Formula Electric Fall 2021 Funding Proposal		$ 12,191.00
WEEF F21 Proposal		$ 18,650.00
Funding Request from the University of Waterloo's Steel Bridge Team		$ 3,500.00
WATCHEM Equipment Funding Proposal		$ 1,820.00

UWaterloo Robotics Team F2021 WEEF Proposal		$ 17,900.00
UWARG Fall 2021		$ 10,800.00
Desalination Unit capstone project		$ 706.00
Economic Vaccine Refrigerator Prototyping		$ 700.00
DARE - Breaking into Entrepreneurship		$ 1,519.00
WEEF Proposal - UW Orbital Funding for Canadian Satellite Design Challenge (CSDC)		$ 8,975.05
Waterloop WEEF Proposal F21		$ 13,000.00
F21 WATonomous WEEF Proposal		$ 15,769.04
WATOLINK Fall 2021 Funding Proposal		$ 9,706.20
VEX U Robotics 2021 Fall		$ 4,050.00
(murmur), DesignTO 2022		$ 429.71
	Total	$ 182,317.19

Academic Equipment and Resources
Proposal F-237

Additional Drone Batteries

Civil and Environmental Engineering
CIVE 100, ENVE330, ENVE383, Capstone
Dan Jessel, Technologist, Architectural Engineering
djessel@uwaterloo.ca

Description of Proposal
With the generous support of prior WEEF proposals we have been able to purchase a DJI Matrice 300RTK and Zenmuse LiDAR system. In order to make the system more useful to all users we require additional battery packs to extend the operational flight time of the drone.

Proposal Benefits
Additional batteries are most critical in the use of the LiDAR system. A complete scan requires 5 separate flight paths over the target area and means that the drone needs to be airborne for a long period of time. We are currently unable to scan even a small area using the included battery packs as the LiDAR itself drains the batteries about twice as quickly as using a normal camera payload. This means we have to leave the area and recharge the batteries multiple times to complete a single small scan. More battery packs also enable longer flight times with standard equipment as well as more flexibility for remote field work.

Estimated Equipment Lifetime
This is heavily dependent on the amount of use, estimated at 10+ years of moderate activity.

Implementation Schedule
Immediate upon funding.

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
TB60 Intelligent Flight Batteries (in pairs, tax included)	7376.64 (three pairs)	4917.76 (two pairs)	2458.88 (single pair)	2458.88 (single pair)

Academic Equipment and Resources
Proposal F-193

Homer Pro Software for hydroelectric power plant simulation in our Capstone Project

Chemical Engineering
CHE 482
Chemical Engineering Design Workshop
afespiti@uwaterloo.ca

Description of Proposal

Our capstone project focuses on improving the cost efficiency of the Sir Adam Beck Hydroelectric Complex in Niagara Falls through improved energy storage and increased capacity factor. This will be done through powerplant simulation using Homer Pro software.

Proposal Benefits

The main benefit is that it would help our group's progress on our Capstone project. Our supervisor, Prof. Ali Elkamel also mentions that it would be useful for his future co-op students and would also be useful to learn in an energy elective course in the Chemical Engineering department. Furthermore, he mentions that there are some graduate students in his research group who would be interested in using Homer Pro Software and/or the findings of our Capstone project.

Estimated Equipment Lifetime

The estimated equipment lifetime is 5 years, or whenever the newest and most substantial change to the software is released.

Implementation Schedule

This software will be used very frequently/daily, as it will be used graduate students, co-op students, and professors who teach Energy related courses in the Chemical Engineering department like Prof. Ali Elkamel and Prof. Lena Ahmadi

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
HOMER Pro® microgrid software by HOMER Energy	1	2	3	4

Total	1	2	3	4

Academic Equipment and Resources
Proposal F-194

Multimeters and cables for the semiconductor and circuits lab

ECE
ECE231, ECE240, ECE340
Manisha Shah , Lab Instructor
manisha@uwaterloo.ca

Description of Proposal

We need to replace some old multimeters in the lab room E2-3347, E2-3444 and E2-3346 to support various labs. Some of the multimeters are old now and some buttons don't function well on those meters. Additionally we need more multimeters to support some experiments for better measurements to provide good resolution of the numbers. We also need better cables for stable measurements. I have observed the cable issues in the lab and students loose good time in the lab in troubleshooting and hence I am planning to buy new cables.

Proposal Benefits

It will benefit to the students of ECE231, ECE240 and ECE340 courses. It will benefit around 200 to 300 students most of the terms.

They will have better instruments to do the measurements and can get more accurate numbers.

Estimated Equipment Lifetime

7 Years.

Implementation Schedule

By April 2022

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Keysight 34450A and Keithley 2110 Series DMMs (Multimeters)	30	30	14	14
BNC to banana cables, Digikey 501-1117-ND, product number #3073	100	100	50	50

Total	130	130	64	64

Academic Equipment and Resources
Proposal F-196

Ideas Clinic - Materials testing

Engineering Ideas Clinic
ME 219, ME 220, MTE 219
Chris Rennick, Engineering Educational Developer
crennick@uwaterloo.ca

Description of Proposal

The Engineering Ideas Clinic is working to bring real-world problems and equipment to undergraduate students. We firmly believe that "bringing the real-world into the classroom" will reinforce the theory you are learning in lecture, show you the context of that material, and will provide an opportunity for you to integrate all the knowledge you are learning.

To continue bringing meaningful, hands-on activities to students, the Ideas Clinic needs to continue purchasing equipment. As we move forwards, the Ideas Clinic is pushing into domains that until very recently only existed in research labs, and in work terms.

This proposal is seeking WEEF's support for a set of custom, low-cost materials testing devices. We are seeking $6,250 from WEEF for 25 of these devices. The Ideas Clinic is currently employing three co-op students who are continuing the development of the prototypes of these platforms. These platforms can then be used across the Faculty of Engineering.

Proposal Benefits

This unique equipment will allow students to experiment with material properties like yield strength, and fatigue in the classroom so that you can "feel" what this means with your own hands. This will not replace existing labs in these courses, but will supplement instruction in the classroom.

An estimated 600 students per year will directly benefit from the activities that this equipment will allow.

Estimated Equipment Lifetime

We expect a life of 5+ years from this equipment.

Implementation Schedule

The equipment will be purchased as soon as funding is granted.

Additional Information

The Ideas Clinic will provide the salaries for any and all co-op students, and/or grad students required to develop the platform.

Academic Equipment and Resources
Proposal F-196

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Mechanical components for machine $250 each x 25 devices	6250	0	0	0
Total	6250	0	0	0

Academic Equipment and Resources
Proposal F-197

New WATiMake Equipment

MME
ME 100, ME 101, MTE 100. ME 380, MTE 380, ME 482, MTE 482
Eugene Li, Mechatronics Engineering
eugene.li@uwaterloo.ca

Description of Proposal

WATiMake is a maker space located on campus for engineering students to use for their course and personal projects. WATiMake currently has a wide variety of equipment such as a laser cutter, FDM filament 3D printers, SLA resin 3D printers, a desktop CNC milling machine and much more.

To continue to offer valuable equipment to students, WATiMake is proposing either the purchase of a new Form 3 printer to supplement the existing suite of resin printers, or purchase a larger Form 3L printer to facilitate large resin prints. In addition, we are proposing the purchasing of a Roland ZCL-40A add-on to the desktop CNC milling machine. This add-on would allow for an additional axis to be added to the milling machine. This would allow for more complex parts and double-sided parts to be made.

Proposal Benefits

By purchasing this equipment we will allow for more complex parts to be fabricated with greater ease. The Form 3 has improvements in print quality over the Form 2, as well as a larger print area. The additional CNC axis would also make milling parts easier for students.

Estimated Equipment Lifetime

The Form 2 3D printers and Roland CNC have been in use for the past five years. We expect that the new equipment will have similar lifetimes

Implementation Schedule

The equipment can be ordered and installed immediately.

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Formlabs Form 3L	15000	0	15000	0
Formlabs Form 3	0	5000	0	0
Roland ZCL-40A	4000	4000	0	4000

Total	19000	9000	15000	4000

Academic Equipment and Resources
Proposal F-198

ME 340 - Foundry Lab Activity

MME
ME 340
Brian Shillingford - Mechanical Engineer
brian.shillingford@uwaterloo.ca

Description of Proposal

Mechanical Engineering students take a 3A manufacturing processes course where they learn about various manufacturing techniques. There are currently three lab activities associated with the course: cold rolling aluminum, bending and springback, and effect of anisotropy on deep drawing of steel discs. The purpose of this proposal to request the necessary funding to add an additional lab activity for the casting manufacturing process.

Proposal Benefits

Adds casting activity to ME 340 course. Provides the students with a hands on activity to demonstrate the lecture material.

The lab activity helps to highlight differences between theoretical calculations and empirical data collection.

Estimated Equipment Lifetime

The ME 340 course is offered twice every year, Winter/Spring. None of the requested equipment is significantly loaded. Lifetime expected to be 5+ years.

Implementation Schedule

Winter/Spring 2022 (depending on when funding is received)

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Equipment and PPE	3000	3000	3000	3000

Total	3000	3000	3000	3000

Academic Equipment and Resources
Proposal F-200

Titrator for Residual Water Content

Chemical Engineering
CHE 490 CHE 491
Cheryl Newton Undergraduate Laboratory Instructor
c2pearce@uwaterloo.ca

Description of Proposal

In the Chemical Engineering Undergraduate (CHE UG) labs, we have a lab scale freeze dryer that represents a unit used in industry for making direct dose freeze dried pharmaceuticals. Currently, we can run one sample at a time to get an estimate of water loss by intermittent weighing. We currently do not have a reliable tool to accurately measure residual water content in the CHE UG labs. Since run time for freeze drying is 12 hours or more it is impractical to use this equipment for its intended use for an undergraduate laboratory project. This proposal is for an automatic titrator called a Karl Fisher (KF) titrator that can measure residual water content from 1 -100 %. The KF titrator would allow all samples for a project laboratory to be prepared and run overnight and be tested for residual water the next day. This means that the equipment would then be available for the next project group within 2 days.

Specifically, the proposed accessory will add:

1. Method to measure residual water content in CHE UG Project Labs

Proposal Benefits

Proposal Benefits:

1. Use of the new equipment will increase laboratory efficiency and reliable data collection.

2. Exposure to industrially used equipment (Freeze Dryer) and tools (Karl Fisher titrator).

3. The operation capability of the proposed new equipment will offer potential for new and innovative laboratory experiments and projects that will enhance student learning and comprehension.

4. Analytical tool available for capstone design projects.

Estimated Equipment Lifetime

The equipment will be purchased from reputable retailers and the equipment should have a useful life of 10 or more years, with appropriate maintenance and care.

Implementation Schedule

The equipment can be assembled and tested in one to two terms and will be ready for the laboratory courses in Fall 2022 or Winter 2023.

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Titrator	12543	15345	15345	19990
Solvent Manager	1429	1429	1429	0
LabX Software	0	0	4095	0
Total	13972	16774	20869	19990

Academic Equipment and Resources
Proposal F-201

EXO NitraLED Sensor

CEE
ENVE 330
Mark Merlau, Lab Technologist
mmerlau@uwaterloo.ca

Description of Proposal

The EXO NitraLED Sensor is a UV nitrate sensor that is used to measure nitrate levels in water. The sensor attaches to a device called a Sonde, which is used to monitor and log in-situ water quality parameters. The EXO NitraLED Sensor will be deployed in Laurel Creek year-round and the data collected will be used for the ENVE 330 course.

The EXO NitraLED Sensor features two LED's which measure the absorption characteristics of nitrate at different wavelengths. These measurements, along with the data produced by a separate Turbidity sensor, are used to generate the nitrate value. This proposal is for one EXO NitraLED Sensor.

Proposal Benefits

The EXO NitraLED Sensor will benefit approximately 80 students per year and will be used primarily for the ENVE 330 course. However, the data collected could also be used for other courses and projects such as Capstone.

Estimated Equipment Lifetime

Approximately 5 to 7 years.

2-year warranty.

Implementation Schedule

Immediately upon receipt.

Additional Information

The CEE department purchased a monitoring Sonde earlier this year at a cost of $20,000. The addition of the EXO NitraLED Sensor would expand the Sonde's testing capabilities.

The CEE department will provide partial funding up to 50%.

Cost Breakdown

Academic Equipment and Resources
Proposal F-201

Item	Option 1	Option 2	Option 3	Option 4
EXO NitraLED Sensor	8910	7425	5940	4455
Total	8910	7425	5940	4455

Academic Equipment and Resources
Proposal F-202

MA-8005 Manipulators (DC Probes) for Nano Undergrad labs

Nanotechnology Engineering Dept (NANO)
NE 242 (Electronic devices)
John Saad Laboratory Instructor, Nanotechnology Engineering
john.saad@uwaterloo.ca

Description of Proposal

This proposal is for purchasing MA-8005 Manipulators (DC Probes) for Nano undergraduate laboratories

Proposal Benefits

We are planning to purchase new MA-8005 Manipulators that will upgrade the lab from very old worn out probes to new

professorial look and very precisely controlled manipulator. It will allow students to measure the sheet resistance for

different semiconductor devices. Currently, all NE students are borrowing 5 of these setups from the ECE labs, and as the

NE program already doubled the throughput of the circuit's laboratory since spring 2016, there is a need to purchase another

20 new sets. Those setups will be used to expand our equipment to fit in devices testing lab for NE 242 course (Electronic

devices).

The expected benefits of the proposal are:

1. To provide new units needed for doubling our labs.

2. To provide spare units to enable quick replacement of faulty units during the lab thus reducing inconvenience to the

student group at the problem station.

3. These manipulators will be used in engineering undergraduate course : NE 242 (Electronic devices)

4. It will serve about 120 undergrad students.

5. Could be used for capstone design projects

Estimated Equipment Lifetime

10+ years

Academic Equipment and Resources
Proposal F-202

Implementation Schedule

Spring 2022

Additional Information

It is our expectation that NE will match WEEF Funding.

Option#1 for 20 units while option#2 for 10 units

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
MA-8005 Manipulator from Semiprobe	30000	15000	0	0
Total	30000	15000	0	0

Academic Equipment and Resources
Proposal F-203

Tools for engineering student shops

Sedra student design centre
Graeme Adair, Manager Sedra student design centre
gadair@uwaterloo.ca

Description of Proposal

To purchase new equipment to expand our tool inventory and to broaden student project support.

Proposal Benefits

Reduce manufacturing times.

Improve quality and professionalism of parts.

Estimated Equipment Lifetime

30 years plus.

Implementation Schedule

Immediately.

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Power feeder for milling machines. Options are different quantities, 4-1	2933.48	2200.11	1466.74	733.37
6" Rotary table with 4" chuck	1205	1010		
Bench-top mitering band saw	1582			
Depth micrometer and coolant proof caliper	929	528	401	
Total	6649.48	3738.11	1867.74	733.37

Academic Equipment and Resources
Proposal F-204

ChE CAPSTONE LAB- STUDENT REQUESTED EQUIPMENT

Chem Eng
ChE 482 / 483
Tom Dean - Director of Technical Operations, ChE
tjdean@uwaterloo.ca

Description of Proposal

Request for battery-research based equipment for the CAPSTONE lab, including voltmeters, ammeter, batter load tester and switch gear.

Proposal Benefits

This request will help support the research interests for CAPSTONE projects involving alternate battery materials and their performance testing for energy storage and dissipation.

Estimated Equipment Lifetime

It is estimated that this equipment will last for at least 10 years.

Implementation Schedule

Once funded, this equipment will be purchased right away and located in the secure CAPSTONE Lab - E6 1113, added to the lab Inventory spreadsheet and communicated to the 4th year teams for their use.

Additional Information

This equipment will greatly enhance the research equipment in the ChE CAPSTONE Lab for current and future highly-desired research projects.

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
FLUKE 117 Multimeter - $284 ea x 4	1136	179	159	135
FLUKE 323 AMMETER - $175	175	118	118	118
R&S NGM201 BATTERY TESTER $7464	7464	7464	7464	7464
Temperature Acquisition Module - RS485 Modbus - $265	265	265	265	265

UXCEL AC Contactor (AC24V) and Momentary Switch UX0206 - 660V - $120	120	120	120	120
Total	9160	8146	8126	8102

Academic Equipment and Resources
Proposal F-205

Keychain Activity

MME
ME/MTE 100
Brian Shillingford - Mechanical Engineer
brian.shillingford@uwaterloo.ca

Description of Proposal

Mechanical, Mechatronics, System Design, and BioMedical Engineering students all participate in the keychain activity in their 1A term. The keychain is a hands-on activity that introduces students to basic machining principles. The purpose of this proposal to request the necessary funding to add additional equipment to the activity.

Proposal Benefits

Adding an additional drill press and two additional hand tappers will let the activity run with 2 completed "assembly lines". By having these pieces of equipment the activity can run in a more streamlined fashion.

Estimated Equipment Lifetime

The keychain activity runs every year in the fall term. Occasionally Engineering Outreach runs the activity as well for the various programmes they run (Catalyst, WiE). Due to the frequency of use the lifetime is expected to be 10+ years.

Implementation Schedule

Fall 2022

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Drill press and hand tapper	850	850	850	850
Total	850	850	850	850

Academic Equipment and Resources
Proposal F-207

Ideas Clinic - Electric Vehicles

Engineering Ideas Clinic
ME 101
Chris Rennick, Engineering Educational Developer
crennick@uwaterloo.ca

Description of Proposal

The Engineering Ideas Clinic is working to bring real-world problems and equipment to undergraduate students. We firmly believe that "bringing the real-world into the classroom" will reinforce the theory you are learning in lecture, show you the context of that material, and will provide an opportunity for you to integrate all the knowledge you are learning.

To continue bringing meaningful, hands-on activities to students, the Ideas Clinic needs to continue purchasing equipment. As we move forwards, the Ideas Clinic is pushing into domains that until very recently only existed in research labs, and in work terms.

This proposal is seeking WEEF's support for the components to build 3, 1/3-scale electric vehicles. We are seeking $10,500 from WEEF for these 3 cars. The Ideas Clinic has employed 5 co-op students over the past 3 terms designing this platform, and we are now ready to scale the activity. These platforms can then be used across the Faculty of Engineering.

The car we have designed is constructed using reconfigurable and re-usable parts and operates at low voltages and powers (24Vdc drive system). The car is also small and light enough that it can be moved around by a single person; total vehicle weight without batteries is in the neighbourhood of 200 lbs.

Proposal Benefits

This unique equipment will give students a platform to learn concepts related to electric and autonomous vehicles. This platform has been designed to be simple to put together, take apart, and reconfigure, and has been designed with student safety foremost in mind. This platform will be available for any courses from first to fourth year, with the first deployment in ME 101 in the winter 2022 term (during their Design Day activity).

An estimated 600 students per year will directly benefit from the activities that this equipment will allow.

Estimated Equipment Lifetime

We expect a life of 5+ years from this equipment.

Implementation Schedule

The equipment will be purchased in the winter 2022 term. The first offering will use our prototype car in the same term.

Additional Information

Through a partnership with Magna International, the Ideas Clinic will provide the salaries for any and all co-op students, and/or grad students required to develop the platform as well as any additional costs that may arise as the project progresses.

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Total cost per car = $3,500. 3 * $3500 = $10,500	10500	0	0	0
Total	10500	0	0	0

Academic Equipment and Resources
Proposal F-208

Computer Teaching Classroom and 4th Year Study Room Workstation Replacements

Chemical Engineering
All courses
Dennis Herman Manager of Information Services
dherman@uwaterloo.ca

Description of Proposal

Replace 24 student computer workstations in Chemical Engineering Computer aided teaching classroom (CHEMCAT) DWE 2529 and 4th year study room E6 5022. These workstations are currently 12+ years old and failing regularly and unreliable.

Chemcat currently contains 60 workstations and the 4th year study room contains 10 workstations. 46 of these have been replaced recently by the department and WEEF therefore we are requesting the replacement of the remaining 24 .

Proposal Benefits

Improved computer workstation availability, capability, responsiveness and student productivity.

Estimated Equipment Lifetime

5-10 Years

Implementation Schedule

As soon as delivered.

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
24- Intel NUC11TNKV5 workstations @$810 = $22,500	22500	11250	5625	3313

Total	22500	11250	5625	3313

Academic Equipment and Resources
Proposal F-209

Chemical Engineering 4th Year Projects and Course Work Computational Server Cheterm2 Replacement

Chemical Engineering
400 and 500 level courses
Dennis Herman Manager of Information Services
dherman@uwaterloo.ca

Description of Proposal

Propose replacement of old Cheterm2 computational server for $7.5K Total cost of $7.5K. SuperMicro server

32 core, 128 GB RAM , 2TB SSD.

Cheterm2 used for all 4th year project work and course work and is now 10+ years old .

Proposal Benefits

Improved availability, capability, responsiveness and student productivity.

Estimated Equipment Lifetime

5-10 years

Implementation Schedule

As soon as delivered.

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Supermicro Server 32 Core, 128 GB RAM, 2 TB NVME SSD	7500	5625	3750	1875
Total	7500	5625	3750	1875

Academic Equipment and Resources
Proposal F-216

FYDP Lab Benchtop DMM Replacement

ECE
ECE-298, ECE-498
Charles K. Pope ECE Lab Instructor, Hardware Specialist
kim.pope@uwaterloo.ca

Description of Proposal

FYDP Lab Benchtop DMM Replacement (qty 24)

Proposal Benefits

to replace slow, intermittent DMM equipment in the FYDP Lab. Students from ECE-298, ECE498A and ECE-498B are using the current DMM's that don't work reliably anymore.

Estimated Equipment Lifetime

5 years estimated

Implementation Schedule

For January 2022

Additional Information

500+ students per year use the lab equipment in the FYDP Lab.

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Bench top DMM purchase for 24 wkstations in ECE FYDP Lab	36000	25680	25824	17424
Total	36000	25680	25824	17424

Academic Equipment and Resources
Proposal F-217

Capstone Lab 3D Printer

Chemical Engineering
CHE482/483
Jason Grove, Assoc Chair Chem Eng
jagrove@uwaterloo.ca

Description of Proposal

The chemical engineering department provides a research lab for the use of capstone project

teams. We would like to provide a 3D printer for use in this lab. A new CHE design team will also be using this lab (or other CHE space in the same building)

Proposal Benefits

Capstone teams and the ChemE car design team will have easy access to a 3D printer for prototyping.

Estimated Equipment Lifetime

Long, say 10 years

Implementation Schedule

We plan to order the equipment on notification of the award

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
3D Printer	3250	1000	0	0
Total	3250	1000	0	0

Academic Equipment and Resources
Proposal F-218

Router Table

School of Architecture - Fabrication Lab
ARCH 193/292/293/393/493
Abeer Ali - 2A WEEF Representative
a353ali@uwaterloo.ca

Description of Proposal

The Fabrication Labs has outgrown its small and underpowered benchtop router table and would like to pursue a larger and more robust option. Working on the router table provides much better control and accuracy making it a popular tool. Adding a new router table will allow for a properly dedicated work station resulting in better operation and higher efficiency for users, while the smaller table could be allocated for back-up and light duty work. The current router is failing and must be replaced as soon as possible.

Proposal Benefits

This equipment will be used in both core and elective classes requiring fabricated deliverables for both graduate and undergraduate student work. These courses are expected to continue for the foreseeable future. Graduate students are also doing individual research for their thesis work that requires this equipment. The entire student body at the School of Architecture (about 500 students) would benefit from this purchase of a new and improved router table.

Estimated Equipment Lifetime

7+ years

Implementation Schedule

As soon as possible

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Router Table with Router Kit	1469	0	0	0
Router Only	379.99			
Total	1848.99	0	0	0

Academic Equipment and Resources
Proposal F-229

Automated Linear Induction Coil Manufacturing Machine

Mechanical Engineering/Waterloop
ME 481
Quinlin Wu, Sponsorship Lead
sponsorship@waterloop.ca

Description of Proposal

The Hyperloop is a revolutionary new form of transportation that stands to dominate continental travel as an intermediary step between railways and airplanes.Through utilizing magnetic levitation alongside a depressurized tube, the slowing forces of contact friction are removed and air friction is greatly reduced. At the heart of the hyperloop developed by the University of Waterloo's hyperloop team, Waterloop, is a linear induction motor (LIM). The LIM is made up of a combination of a metal core with many copper coils manually wound by hand. However, manual winding introduces a lot of human error and is extremely time consuming, resulting in reduced efficiency of the LIM. Upon researching automated winding machines, the costs were deemed too high.

This is where the, "Project Proposal - Automated Linear Induction Motor Coil Manufacturing Machine" aims to solve these issues. By creating a proprietary coil winder, Waterloop can ensure the functional specifications of the winded coils match the LIM, and that the quality is sufficient to be continually functional for the foreseeable future. The automated coil winder is aimed to be constructed in-house using both off-the-shelf and custom components. The mechanical frame will be largely 3D printed while off the shelf power supply, motors, and motor controllers will be purchased. A human-machine interface will be created allowing a user to easily control the device by relaying instructions to an Arduino controlling the system.

This device will enable TeamWaterloop to rapidly prototype development of our linear induction motors. Coil winding has been a significant pain point in our ability to manufacture motors, as it is extremely difficult and time consuming to produce high quality, consistently performing coils. For reference, 500 windings can be completed in 1 hour and a complete LIM requires 12000 windings costing 24 hours, far slower than automated solutions. Coil winding is also very cost intensive, as any mistake often requires rewinding coils from the start. It should be noted that linear induction motors are a very niche motor, especially for high-speed applications such as Hyperloops. Manufacturing processes are not well-developed and therefore much trial and error is needed to advance the technology. By developing this automatic coil winding device, Waterloop will be able to rapidly develop and manufacture motors which will greatly advance the technology.

Proposal Benefits

Benefits to WEEF

- WEEF will be subject to inclusion to Waterloop's sponsorship benefits, which include:

Waterloop provides perks for all of our financial sponsors. The funding requested would qualify WEEF for the Transonic Tier, in which the agreed terms would include:

- Exclusive tickets to our pod unveil event
- WEEF logo displayed on the Waterloop website
- Dedicated social media exposure acknowledging WEEF's support of Waterloop
- Logo on presentation materials
- Logo on pod shell

Benefits to Engineering

As for the faculty of engineering itself, having an automated coil winder available for use with the SDC teams will greatly increase the productivity, quality and efficiency of whoever requires wound coils. For example, the University of Waterloo Satellite Team, UW Orbital, is interested in potentially using Waterloop's coil winding mechanism to wind a magnetorquer. By pushing the limits of research, Waterloo as a university and the engineering faculty itself are uplifted, resulting in increased opportunities for funding, talent sourcing, and reputation.

This project is being designed and built in collaboration with 4 mechanical engineering students in ME 481/482 as part of their degree requirements to complete a final year design project. This funding will allow them to successfully showcase their project to the engineering faculty.

Estimated Equipment Lifetime

The Automated Coil Winder is planned to be used by Waterloop indefinitely. Individual parts may fail, but can be replaced due to a modular design.

Implementation Schedule

September 2021

Deliverable: Ideation and design scoping

Validation: Initial design review and safety review meeting

October 2021

Deliverable: Specification lock and concept generation

Validation: Midterm design review

November 2021
Deliverable: Concept selection
Validation: Detailed design completion

December 2022
Deliverable: Final design lock and initial prototyping
Validation: Final design review

January 2022
Deliverable: Product development
Validation: Functional prototype

February 2022
Deliverable: Peer review and prototype full assembly completion
Validation: Final verification tests

March 2022
Deliverable: Client verification review
Validation: Symposium (March 25th)

April 2022
Deliverable: Product completion
Validation: Final report

Additional Information

Waterloop is grateful for the support that WEEF has shown over the years. The team will be happy to accept any partial funding over no funding. More information about our team, along with past and future initiatives, can be found on our website: https://teamwaterloop.ca.

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Motors	270	260	250	240
Electric actuators	220	210	200	190
Power Supply	150	140	130	110
Controller and sensor boards	280	270	260	250
Copper wire for testing purposes	120	110	100	90
Total	1040	990	940	880

Academic Equipment and Resources
Proposal F-236

New Microscopes for ChE UG Labs

Chemical Engineering
ChE290 mainly. Could also be used for some ChE490 experiments
Jennifer Moll, Lab Instructor
jkmoll@uwaterloo.ca

Description of Proposal

Replace old microscopes nearing end of useful life with modern versions (preferably with digital camera option).

Proposal Benefits

Benefits of Replacing Microscopes: current microscopes are showing age (>30 yrs old/stages drift or knobs are difficult to turn/optics need re-alignment). New microscopes have attractive features (image capture, output to screen, measurement options):

- easier, faster means of collecting lab data (i.e. can collect more data during lab time by snapping image of cell count slides that can be assessed after lab session).

- provides easy means for TA or labmates to share/discuss observations during lab as image is projected to a video screen (as opposed to having to give verbal directions on where one should look inside the microscope view).

- students can capture microscope images with digital camera = enhances lab reports

- could complete counts from images using software (available free online)

Estimated Equipment Lifetime

20 years

Implementation Schedule

Will purchase after funding decision and incorporate into W22 ChE290, if delivered in time.

Additional Information

ChE dept willing to match funding from WEEF. Aiming to eventually purchase 4-6 digital microscopes or 10-12 traditional microscopes for lab. Purchase could be done piecemeal over a few semesters ---> i.e. could request additional WEEF funding in later ter

Cost Breakdown

Academic Equipment and Resources
Proposal F-236

Item	Option 1	Option 2	Option 3	Option 4
Microscopes (with digital cameras/viewscreens $3K- 6K ea or traditional style $800-$2K ea, price depends on quality of optics)	9000	6000	3000	2000
Total	9000	6000	3000	2000

Miscellaneous
Proposal F-206

Battery Powered / Bluetooth PA

Architecture Computing & Media
Fred Hunsberger, Multi Media Specialist
fhunsber@uwaterloo.ca

Description of Proposal

To make a portable available to staff, students and faculty PA that has bluetooth input.

Option 4, Yorkville EXM-MOBILE-12 Battery Powered Portable Bluetooth PA System, is missing from the proposal attached,

Proposal Benefits

For outdoor events and special presentations that take place on our terrace, along the Grand River or at festivals we often rely on powered loud speakers. This past fall we had a land acknowledgment by the Grand River but no safe way get power to the site. Guests were not able to hear what was being said.

I realize now that having a battery powered PA would have helped greatly in the past at outdoor events and want to add a this to our AV loans inventory so in the future we can amplify audio without the need for running electrical cables.

Estimated Equipment Lifetime

The weak link is the battery but expect 5-7 years with one or 2 battery replacements,

Implementation Schedule

These would be added to our equipment loans inventory immediately.

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Battery powered loud speaker (PA) with Bluetooth	810	649	626.41	-
Total	810	649	626.41	-

Miscellaneous
Proposal F-210

Smart phone gimbal and or gimbal / camera combination for video content creation

Architecture Computing & Media
Fred Hunsberger, Multi Media Specialist
fhunsber@uwaterloo.ca

Description of Proposal

Gimbal and Camera for Architecture Computing & Media equipment loans

Proposal Benefits

Architecture students often use video content in their presentations and currently we have no way to assist in creating effective walk through experiences.

By acquiring a smartphone gimbal & small APS mirrorless camera students would have easy access to this technology.

Estimated Equipment Lifetime

The gimbals I estimate to last 5 years

The camera 7 years

Implementation Schedule

This equipment would be put into equipment loans immediately.

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Phone Gimbal, APS mirrorless camera and gimbal	1899.97	1718.98	1548.98	1369.98
Total	1899.97	1718.98	1548.98	1369.98

Miscellaneous
Proposal F-212

Indigenous spaces

Engineering Outreach, Equity & Diversity
Mary Robinson, Associate Dean Outreach Equity & Diversity
mary.robinson@uwaterloo.ca

Description of Proposal

(Re)building relationships with the Indigenous Peoples of Canada is a long-term goal for the faculty of Engineering and as such, spaces in both the Waterloo and Cambridge campuses need to be adapted to be more welcoming to Indigenous ways of knowing and being.

Proposal Benefits

The Indigenous spaces are available to all students. These spaces can be used for meeting with the Elder-in-residence or to learn more about the history of the settler relationship with Indigenous Peoples in Canada. This space is especially important for Indigenous students, staff and faculty to meet with the Elder and/or perform ceremony such as smudging.

The majority of the cost associated with renovating the space is being covered by the Engineering Dean's Office, but furniture, signage and/or art could be provided by WEEF.

Estimated Equipment Lifetime

20 years+

Implementation Schedule

Space has been identified at Cambridge (Architecture) and is in the process of being identified at the Waterloo campus (main Engineering). As sufficient funds are secured, items will be purchased and installed.

Additional Information

This is a first step in responding to the TRC's Calls to Action, to educate settlers on the history of Canada and make space, in a good way, for Indigenous Peoples.

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
KI armchairs (approx $1500 each)	6000	4500	3000	1500
KI tables (approx $500 each)	1500	1000	500	

Art/signage in Engineering (Waterloo campus)	4000	3000	2000	1000
Total	11500	8500	5500	2500

Miscellaneous
Proposal F-223

Modular Composites Curing Oven for Student Teams

FYDP MME Group 41
Calvin DeKoter
crdekote@uwaterloo.ca

Description of Proposal

MME Capstone Group 41 intends to build a composites curing oven capable of curing pre-impregnated composites and resin infusions for teams in the student design centre. We are a team of mechanical engineering students and student team members from Waterloo Formula Electric and Waterloo Rocketry with extensive composites experience.

We see a strong need for student teams to be able to work with pre-preg composites and resin systems requiring high temperature post-curing to improve the strength of their parts. In the past, student teams have shipped their parts to sponsors in Toronto, assembled temporary ovens, or accepted lower performance from their designs. This curing oven will allow student teams such as Waterloo Rocketry, Midnight Sun, Waterloop and Waterloo Formula Electric to use high performance composites also used in industry, improving the performance of their designs and providing valuable experience to the engineering students on their teams.

Proposal Benefits

By funding the Modular Curing Oven, WEEF will allow engineering students from all disciplines to gain valuable experience with industry-standard composite processes and help student teams make stronger, faster, and more competitive vehicles. WEEF's logo will be proudly displayed on all panels of the curing oven and in all software written for the curing oven.

Estimated Equipment Lifetime

This curing oven will be designed to have a long lifetime, up to 10 years. There are no wear components on the oven if it is properly maintained and the oven will be made of steel and industry-standard insulation materials such as mineral wool. Detailed operating instructions and safety procedures will be provided along with the curing oven so that students can continue to use it after the team members of Group 41 graduate.

Implementation Schedule

The Modular Curing Oven will be built in an 8' x 4' x 4' size and demonstrated at the March 2022 capstone symposium. This size is large enough for Waterloo Formula Electric, Waterloo Rocketry, and Waterloop to use. Since the oven is designed to be modular, it could be expanded to be larger by constructing more panels in the following years.

Miscellaneous
Proposal F-223

Additional Information

Our capstone group has diverse experiences with composites, insulation, heater design, and high voltage electronics. This experience will allow us to construct a safe and functional curing oven that fully conforms to all applicable standards, such as the CSA requirement to use appropriate gauge wiring and approved components. We are confident that our oven design will pass inspection and will be a valuable asset to teams in the student design centre for years to come.

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Oven Heating Elements: Heaters and blowers to deliver heat to the composite parts in the oven.	2000	1000	750	500
Oven Insulation and Sealing: Insulation material and gaskets to keep heat in the oven.	1000	500	400	250
Oven Structure: Steel paneling and tube frames to support the oven insulation.	1250	750	500	250
Oven Control Elements: Safety systems, heater and blower controls, and data logging.	750	500	250	200
Oven Testing: Composites supplies to validate oven performance.	500	250	250	150
Total	5500	3000	2150	1350

Miscellaneous
Proposal F-235

Furniture for CPH nooks (first, second & third floors)

Engineering Undergrad Office
Mary Robinson - Assoc Dean Outreach, Equity & Diversity
mary.robinson@uwaterloo.ca

Description of Proposal

The nooks outside of CPH-1325, CPH-2367, and CPH-3360 were regularly used by students to relax, chat, charge phones and study. The furniture that was there has largely been removed. In partnership with the Dean's Office and Plant Ops, we are looking to update the furniture to make it more inviting for students.

Proposal Benefits

Upgraded study and relaxing space for all Engineering students to use at any time of day. Reconfigurable furniture means that it can be adapted to the needs at that time. Additional power plugs to charge your phone or laptop in a convenient, safe location.

Estimated Equipment Lifetime

20+ years

Implementation Schedule

I'm working with Plant Ops and the Dean's Office to get the floor plan finalized and purchase orders issued for the furniture, once we have sufficient funding. Based on the E2 foyer project, total process can be < 6 months once we have sufficient funds ga

Additional Information

With input from WEEF and EngSoc, the furniture will be the favourites from E5/6/7 as identified by students. Exact cost is dependent on fabric and furniture style. Furniture configuration is also dependent on Plant Ops (e.g. emergency exit routes).

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Chairs (up to 4 at $1500 each)	6000	4500	3000	1500
Tables (up to 3 at $500 each)	1500	1000	500	
Grey Hauser table with plugs	4000			

Total	11500	5500	3500	1500

Student Team
Proposal F-199

Pickup Truck for Student Team Use

Sedra Student Design Centre
Peter Teertstra, Director, SDC
peter.teertstra@uwaterloo.ca

Description of Proposal

The Sedra Student Design Centre includes a number of shared-use resources, including physical spaces for fabrication and testing, and equipment used by student teams. The student teams have access to 3 vehicles and a number of trailers as part of a fleet of vehicles administered by the SDC. For teams that have large projects, two pickup trucks and two large, enclosed trailers are available to haul the team's equipment to their competitions.

One of the pickup trucks in a 2007 GMC Silverado 3500 which has been in service at UW since it was purchased new from a dealer in 2008. The truck has 220,000 km so reliability for long distance trips is becoming a concern. Also it has a large displacement gasoline-powered engine which is very expensive to operate, particularly when towing a trailer.

The Student Design Centre is proposing to purchase a new pickup truck to be used by the student teams for transporting their projects. The specifications are as follows: new (current model year) 1500 series pickup truck, crew cab (4 doors) to accommodate five, diesel engine for improved fuel economy and reduced maintenance costs.

The anticipated cost for a vehicle (after dealer and manufacturer sponsorship) is approximately $60,000. The anticipated trade-in or resale value for the 2007 GMC is $15,000. The funds to be provided by WEEF is $45,000 distributed over a 2 or 3-year period.

Proposal Benefits

Having vehicles and trailers owned and maintained by the University and administered by the Student Design Centre is of great benefit to all student team users. As these are considered commercial vehicles, there is a requirement for annual inspections and certifications which is paid for by the SDC. Regular preventative maintenance, including replacement of tires and small repairs, are also paid for by the SDC and performed by the UW Vehicle Shop. Insurance is administered and paid for by the SDC. Scheduling is performed by the SDC to ensure equal, fair access to all vehicles and trailers for all teams. Truck and trailer training is provided to all student team drivers to ensure they know how to tow and back up a trailer prior to their trip.

Another benefit to student teams is that having vehicles and trailers available to transport projects greatly reduces the cost associated with attending competitions. Regular, annual competition destinations for the SDC trucks/trailers include New Mexico, Utah, California, New Hampshire and Michigan.

Estimated Equipment Lifetime

The truck would be undercoated to reduce corrosion damage. The expected service life of the truck is 15 – 20 years.

Implementation Schedule

The goal is to purchase the truck when sufficient funds ($45,000) have been raised. It is anticipated that 2 - 3 years will be required for this.

Additional Information

The plan is to make this proposal each term, starting in the Fall 2021 term, until sufficient funding is allocated. We will also approach General Motors and local dealers for sponsorship.

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
45,000, divided into equal allocations over 1, 2 or 3 years	15000	7500	5000	5000
Total	15000	7500	5000	5000

Student Team
Proposal F-211

W21 WEEF Funding Proposal

Concrete Toboggan and Canoe Team
Devon Hendrie - Canoe Co-Captain
dhendrie@uwaterloo.ca

Description of Proposal

The UW Concrete Design Team requests up to $2,220 in W21 funding from WEEF for the purchase of safety equipment, tools, and measuring devices. Items and their uses are listed below:

Proposal Benefits

Improved neck braces (5x) - Neck braces reduce the frequency of critical spinal injuries by 10x compared to not wearing a neck brace.

Mouthguards (x40) - Boil and bite style mouthguard required by safety regulations.

Handheld electric cement mixer - Used for batch mixing small volumes

0.1g Precision scale - Offers improved precision compared to current scale (+/- 1 g)

15pk misc volume graduated cylinders - Additional graduated cylinders to measure admixtures and other liquids.

HEPA Shopvac - For removal of respiratory hazards when cleaning/mixing/cutting/pouring/etc

6pk 82 L rubbermaid storage and mixing bins - For storage of team materials and batch mixes.

Estimated Equipment Lifetime

Improved neck braces (5x) - 10 yr

Mouthguards (x40) - 3 yr

Handheld electric cement mixer - 8 yr

0.1g Precision scale - 5 yr

15pk misc volume graduated cylinders - 5 yr

HEPA Shopvac - 8 yr

6pk 82 L rubbermaid storage and mixing bins - 8 yr

Implementation Schedule

Improved neck braces (5x) - Preferred for Feb 2nd competition.

Mouthguards (x40) - Required for Feb 2nd competition.

Handheld electric cement mixer - Project schedule is not dependent on this item.

0.1g Precision scale - Project schedule is not depende

Additional Information

Depending on the value of funding provided, WEEF will be eligible for the sponsorship benefits outlined in the attached presentation.

Thank you for your consideration - please do not hesitate to contact the team with any questions.

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Safety Equipment - Improved Neck Braces & Mouthguards	1280	1280	1280	0
Handheld Grout Mixer	250	0	0	0
Measuring Equipment (0.1g Scale and Graduated Cylinders	90	90	90	0
HEPA Shopvac	400	400	0	0
6pk Large Storage Bins	200	200	0	0
Total	2220	1970	1370	0

Student Team
Proposal F-213

UWFM Fall 2021 for 2022 Season

University of Waterloo Formula Motorsports
Sam Swift, Technical Lead
seswift@uwaterloo.ca

Description of Proposal

The University of Waterloo Formula Motorsports Team designs, builds, and competes with a small open-wheel formula style race car in the Formula Society of Automotive Engineers design series. This proposal is intended to secure funding to better perform in all our future seasons and secure more points at competition.

Proposal Benefits

The first item of interest our team is requesting funding for is a Motec M150 ECU & Development License for $5000. This item would provide our team a large increase on our engine control that will benefit our team in competition immensely. Combustion engines required optimal performance and monitoring, and a large upgrade through this M150 ECU can make the performance of our new Yamaha WR450 Engine exceptional. The next item we would like to request for funding is McMaster Carr Raw Materials and Unique Fasteners for $1000. This includes niche material such as bronze for the throttle butterfly valve, an assortment of fasteners not available from Spaneur such as the dzeus fasteners to hold on our nosecone. Another noticeable funding option we are requesting is Keizer Wheel Shells for $2500. Wheel shells provide a base for our tires and vehicle to sit on which greatly affect the speed and stability of our vehicle during competition. It is incredibly important that these wheels shell are durable and high quality, and our team believes Keizer with their 35 years of FSAE experience dealing with teams like us can provide that solution. The next funding category we are requesting is for Pneumatics, Powertrain, and Electronical Components for $3500. This would include a battery, battery charger, Pneumatics Paintball Tank, Pneumatics Regulator, Wheel Speed Sensors, Brake Pressure Sensors, Pneumatic Valves, LTC, Gyro, Pneumatic Components, Throttle Potentiometer, GPS and coil driver. These components are necessary for our electronics system which is responsible for collecting data, a large portion of shifter functions as well as electronic fuel injection. A number of these components are focused on data collection which would allow the opportunity to collect more data on the car and ensure we are maximizing the car's absolute performance as well as driver training. The last item we are requesting is brake calipers & pads for $1500. These provide a secure way and sustainable way to protect your breaks and ensure the longevity of our braking system.

Estimated Equipment Lifetime

The Motec M150 ECU would last a minimum of 10 years and can carry with us from vehicle to vehicle. McMaster material and fasteners will be used to build the 2022 competition car, and then will be used for testing after that. The Kaiser wheel shells will l

Implementation Schedule

All of these items will be utilized on the 2022 car that is currently being manufactured. They are needed for various stages of the build and assembly process, so they will be between now and our competition date in May of 2022.

Additional Information

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Motec M150 & Development License	5000	0	0	0
McMaster Carr Raw Materials and Unique Fasteners	1000	1000	0	0
Keizer Wheel Shells	2500	2500	2500	2500
Pneumatics, Powertrain & Electronical Components	3500	3500	3500	2500
Brake Calipers and Pads	1500	1500	1500	1500
Total	13500	8500	7500	6500

Student Team
Proposal F-214

SSDC High-Voltage Test Room Proposal

UWAFT: University of Waterloo Alternative Fuels Team
ME559
David Gillespie
uwaftcommunications@gmail.com

Description of Proposal

Many of the Teams in the Sedra Student Design Centre (SSDC) work with various high-voltage systems and equipment. UWAFT, for example, uses a high-voltage battery in their eco-car Chevrolet Blazer, and many of the car's systems require high-voltage for testing. However the SSDC lacks the HV infrastructure to allow them to test the car's high-voltage systems. The only way for UWAFT to perform HV tests on the vehicle is to take it to a test track and drive the vehicle in circles. These time-consuming tests are of limited value, since they are not repeatable, and necessarily lack the rigour of a more controlled testing environment.

UWAFT, on behalf of the teams in the SSDC, proposes WEEF fund the purchase and installation of a high-voltage power pack. The power pack would be installed inside a room already provided by Dr. Peter Teertstra (Director of the SSDC), to become the new SSDC high-voltage testing room. We have researched options and with input from Waterloop, Midnight Sun, and Formula Electric, we are requesting the following be purchased from Keysight Technologies Canada Inc:

1) A regenerative power supply, model RP7963A, with 3-year extended warranty, $28,378.95

2) BenchVue Advanced Power Control and Analysis - single instrument connection. Perpetual transportable software license, $3,202.29

Beyond the above amounts, we believe we will require a further $300 for installation costs such as plugs/wires etc. for a total of $31,881.24

Last year, WEEF funded a proposal by Dr. Teertstra for high voltage equipment: Proposal F20-142

1 square meter HV insulating blanket

HV insulated PPE (4 pairs of gloves, 2 face shield)

Rescue hook (1 required)

HV tools (sockets, wrenches, pliers, tweezers, etc. 2 sets)

Spot welder (for assembling battery packs)

Total $5310

Our current proposal builds upon the capabilities provided by the above items and will benefit many SSDC teams aside from UWAFT. Midnight sun, Waterloop, and Formula Electric have have all given their support for this proposal, as all three will greatly benefit from HV testing space inside the SSDC.

Proposal Benefits

Many teams within the SSDC would benefit from this proposal. The following are just some of the key benefits sited by the teams supporting this proposal:

- Midnight Sun would be able to use the power-pack and software for testing batteries and motors, as well as running solar-panel and battery simulations. All of these currently entail significant time and effort and data gathered using the proposed power pack and software would be much more useful and efficient.

- Formula Electric would use the power-pack and software for charging and load-testing on their batteries, simulating their endurance event to better understand the characteristics of their batteries and get more reliable performance. This is key to their team's success. This represents significant improvements in their analysis capability, allowing them to get key information before on-track testing and letting them iron-out software issues much earlier in the build-process. Efficiencies would be felt at every step.

- UWAFT would use the power pack and software to perform repeatable tests on our battery pack and HV powertrain, enabling accurate data collection and model development. With a better understanding of how our HV components perform, we can create better torque control strategies for our vehicles. Last year we experienced a battery failure; without a source of power we couldn't test on our HV system at all and had to borrow from other research groups. If we had access to a HV bench we could have continued testing on our HV powertrain while the battery was being repaired.

Currently the only way for us to perform tests on our HV system is to drive around at a test track. This requires a lot of time investment to coordinate for limited testing.

- Waterloop would use the power supply for testing of their linear induction motor and battery packs. The information they gather using the software would be important as the team continues scaling up their prototype to larger, higher voltage designs.

Beyond the above mentioned teams, the high-voltage power pack and software will continue to be useful for years to come. UWAFT's new competition vehicle will be entirely electric and the team will require the HV testing equipment in this proposal to credibly compete. In the future, as elctric vehicles become more and more the norm in our economy, This HV equipment will continue to pay dividends to the teams of the SSDC.

Estimated Equipment Lifetime

We estimate the proposed equipment will have a useful life of at least 10 years, based upon our research.

Implementation Schedule

Dr. Teertstra will handle the installation of the proposed equipment and the implementation of the new high-voltage testing room in the SSDC. He estimated the equipment would be installed and working by the end of February 2022.

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Regenerative Power Supply, Model RP7963A, computer controlled variable output high voltage power supply	28378.95	28378.95	28378.95	28378.95
Software license: BenchVue Advanced Power Control and Analysis - single instrument connection. Perpetual transportable	3202.29			
Incidental installation costs	300			
Total	31881.24	28378.95	28378.95	28378.95

Student Team
Proposal F-215

Waterloo Formula Electric Fall 2021 Funding Proposal

Waterloo Formula Electric
Bao Anh Nguyen
ba2nguye@uwaterloo.ca

Description of Proposal

Waterloo Formula Electric is a team of highly motivated and passionate undergraduate students based out of the Sedra Student Design Centre. We compete in the international Formula SAE Electric competition, organized by the Society of Automotive Engineers.

Each season, the team is tasked with developing a new vehicle from the ground up. This multidisciplinary project is no small task, but we love what we do and are committed to learning and developing as future professionals.

Our goal is to improve upon our last competition result by placing 1st. We plan to do this by producing excellent technical documentation, manufacturing our designs, and thoroughly testing the car before running at competition.

This proposal intends to secure funding to improve the team's competition results and long-term knowledge and processes.

Waterloo Formula Electric is requesting $12191 to purchase materials required to build and test our car safely, including components for our mechanical, electrical, tractive and firmware subteams.

The components for the mechanical sub-team include EMS frame welding, manufacturing supplies and tyre sets. The frame welding and tyre sets are safety-critical items that we were unable to find in-kind sponsorships for.

Electrical components comprise of PCBs and parts needed to assemble our various boards. These boards are necessary to complete our new accumulator safely, but also to teach new members PCB bring up skills, as UW returns to in-person studies.

The tractive components are competition required insulation materials necessary to complete and test the new accumulator. In addition, a "High-voltage power supply" is requested, which will improve the team's long-term safety and testing procedures with HV components.

The firmware equipment is the Saelae Logic Analyzer and a Siglent Oscilloscope, which are essential to debugging and teaching new members about electrical systems.

Proposal Benefits

Electric cars are a sustainable alternative in a rapidly growing auto industry. WEEF Funding represents the University's long-term interests in environmentally friendly solutions in the automotive world.

Our team members come primarily from the Faculty of Engineering, with a focus on the MME and ECE departments. We also rely on students from Management, Systems, Chemical, Nano Engineering and the Faculty of Business, and Mathematics.

Through hands-on design, manufacturing, and leadership, our team members are able to gain invaluable, industry relevant experience by applying their knowledge to a real project. Students are able to develop technical skills in mechanical design, embedded systems, HV power electronics and software development. In addition, this provides a rare opportunity to gain skills in team leadership, project management and operations.

These skills are highly sought after by automotive companies, such as Tesla Motors, Lucid Motors, GM and TMMC, as indicated by various recruitment events and outreach.

We also provide opportunities for students to build connections with upper years, alumni, and industry sponsors.

Our team switched over from a hybrid vehicle to a fully electric vehicle in Fall of 2016. As a hybrid team, we had many accomplishments during this competition season such as:

- Placed 1st in 2021 Formula Hybrid Design Events - Electric Class
- Placed 2nd in the 2021 Formula Hybrid Competition Electric Class
- Placed 4th in 2021 PM Events - Electric Class

The requested funding will allow team members to perform tasks more efficiently and drive growth in team results and subsequently membership.

WEEF Funding enables our team to have stronger collaboration and sharing of materials and tools between other student design teams. Firmware equipment, including the logic analyzer, will greatly benefit many design teams.

Waterloo Formula Electric greatly appreciates the funding that WEEF helps the team with, as demonstrated by the WEEF logo proudly displayed on the race car, the website, and on team wear. Based on the value of this sponsorship, the team will continue to display the WEEF logo in these places, as well as on team merchandise, our banner, and our social media pages.

Estimated Equipment Lifetime

The mechanical parts that are used to develop the frame will last 1-2 competition seasons. The new tyre sets will last us up to 4 competition seasons, depending on the degradation from testing and dynamic events.

Electrical PCBs will last us 1-2 competition seasons, but can be stretched for educational and training purposes for an additional season.

Tractive components will last us 2 competition seasons, as the accumulator segments and cells can be reused for the next year. The HV power supply will last us 5-8 years depending on the use.

The firmware equipment: Saelae logic analyzer and Siglent oscilloscope will last the team 5-8 years.

Implementation Schedule

All of the items above are critical to the safety and development of our vehicle and will be ordered immediately as soon as the funding is released. We are aiming to purchase these by the end of December 2021.

Additional Information

Our team understands the benefit of sharing and collaboration between UWaterloo design teams, as well as the practical redundancies of having multiple similar products throughout the SDC. As such, our team would be willing to share these tools with similar design teams who may have use for a logic analyzer, oscilloscope and HV power supply, i.e. UW Midnight Sun, Waterloop and UWAFT. Sharing these items would of course be conditional on scheduling availability as well as assurance that all parties will use the equipment responsibly and safely, and with the proper training.

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4

Mechanical Components	4882	4807	3357	2780
Electrical Components	2539	2266	2266	2026
Tractice Components	3150	500	500	500
Firmware Equipment	1620	1620	1240	1240
Total	12191	9193	7363	6546

Student Team
Proposal F-219

WEEF F21 Proposal

Waterloo Rocketry
ABM Hussien - Propulsion Co-Lead
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Description of Proposal

Waterloo Rocketry is a student design team that develops rockets. We compete annually at the Spaceport America Cup with >100 global teams, and this year we are competing in the inaugural Launch Canada competition. This term, our team grew by over 20 members, allowing work on more projects and maintaining knowledge transfer in the team. Our work comprises designing, manufacturing, and testing all flight and ground systems required to launch the rocket.

Achievements in our most recent competition cycle:

(2021) Kraken of the Sky (Virtual Spaceport America Cup): 2nd place 30,000ft SRAD Hybrid/Liquid, Dr. Gil Moore Award for Innovation, Top 10 Finalist in SDL Payload Challenge

Our current projects include finalizing our hybrid-powered rocket for launch, developing a deployable payload, 360° on-board launch footage, and a new liquid-propellant engine. Moving forward, we hope to represent the Faculty of Engineering with pride through success at the 2022 Spaceport America Cup.

We are requesting funding for the following categories:

1. Electrical($1,900)

Most Avionics project costs are electrical components. Our Avionics and control system, RocketCAN, allows us to safely control and monitor our rocket, as well as remotely fill and launch it.

2. Media($1,050)

It is critical for us to gather and record high quality footage of tests and events to ensure the nominal operation of the rocket - too dangerous to do while in close proximity, so reliable, good quality remote cameras are necessary.

3. Safety($3,800)

During operations, effective communication is critical, and walkie-talkies help improve test safety. Due to the inherent danger of testing rocket engines, safety is our #1 priority. Funding will mostly be used on

PPE(Personal Protective Equipment) to accommodate team growth, and replacing expired PPE(lused respirator cartridges, etc.).

4. Recovery($500)

Recovery has been conducting multiple tests to verify parachute performance. Funds will be used for parachute material, lines, rope, and recovery material stock.

5. Plumbing & Sanitation($2,800)

Funding here will be used on plumbing upgrades, as well as improving the sanitation setup&protocol of components in contact with oxidizer for added safety.

6. Payload($2,000)

We are approaching the prototyping and fabrication phase of our newest rocket's deployable payload, the scientific experiment that our rocket carries.

7. Data Acquisition($1,100)

Our data acquisition (DAQ) system allows us to gather test data to tune engine design. Funding here is used for sensors/load cells to measure mass/thrust.

8. Infrastructure($2,700)

The infrastructure subteam builds/maintains the test set-up, ensuring quick, reliable testing. Our test site needs maintenance and upgrades, including a tank stand and flame diverter to protect nearby grass and soil.

9. Software($800)

Software needs to purchase a laptop for remote testing and mission control, which allows for cheaper software license expenditure. Funding will also be used to purchase a monitor for use inside our bay to aid with coding/design.

10. Tooling and Fabrication($2,000)

Rocket fabrication and component prototyping requires tools, some of which are not available in the machine shop. Fabrication funding allows us to use professional help for complex/high-precision parts, as well as obtaining stock material.

Proposal Benefits

1. Electrical

Besides being a valuable learning experience for team members, the electrical system on our rocket controls its flight path and allows us to communicate with its subsystems like recovery deployment. Most costs of this system (RocketCAN) are individual component costs, which allows us to remotely prepare/operate the rocket, and gather data about its position/velocity throughout its flight.

2. Media

Rocketry is very fast-paced, and for safety reasons, is usually observed from afar. Cameras and visual equipment allow us to see the rocket up close safely, and the footage can be used for analysis or as outreach footage. Cameras, stands, mounts and protective lenses are where the funding would go towards.

3. Safety

Our current walkie-talkies have unreliable performance, which caused us to lose communications between personnel before and was not safe. Part of this funding will be used to purchase 8 longer-range, more reliable walkie-talkies. The rest will be used for purchasing PPE to replace damaged/expired and consumed equipment, as well as accommodate the increasing member count. Examples of PPE include respirators, filters/cartridges, gloves, welding helmets, face shields, and shop coats.

4. Recovery

Successful recovery allows us to preserve our rocket's equipment for use in future competition cycles, and grants us a significant amount of points in the competition's grading criteria.

5. Plumbing & Sanitation

Sanitation is critical to prevent premature decomposition of our oxidizer inside plumbing, and we can finish the sanitation campaign in less time and have quicker test turnover if we obtain a bigger ultrasonic cleaner. We are also in the process of switching our plumbing to Swagelok, which allows for safer, more reliable plumbing that lasts longer.

6. Payload

Funding will be used for sensors, electrical integration, shock cord and deployment mechanism equipment, which will be experimentally validated and repurposed for other subteams and projects after use in the payload.

7. DAQ (Data Acquisition)

Data collection and analysis of a test fire is crucial for design validation. DAQ funding will be used on sensors (pressure transducers, thermocouples) and load cells to measure thrust and propellant tank/rocket masses.

8. Infrastructure

Most infrastructure funding will be used to maintain and upgrade our test site. We are looking to secure and weatherproof it, which allows us to store difficult-to-move equipment for faster testing. The flame diverter project would help us keep our testing process safe and clean (a requirement by Plant Operations). Part of the funding will be used to purchase a mission control generator, allowing operation of lighting/heating equipment (critical during cold winter tests).

9. Software

Using a single laptop with all software licenses stored on it saves us license costs, where it would be kept in our bay and remotely access it, only using one software license.

10. Tooling and Fabrication

Tooling funding will be used to purchase ratchets, drill bits, prototyping plastic, and various tools. Fabrication funding will be used for material stock, and professionally-machined parts if required. Having good tools allows us to efficiently prototype and save long-term fabrication costs.

Estimated Equipment Lifetime

1. Electrical: two terms
2. Media: >5 years
3. Safety: >3 years for devices and most equipment
4. Recovery: 2-3 years
5. Plumbing and Sanitation: >5 years
6. Payload: >2-3 years
7. DAQ (Data Acquisition): >5 years
8. Infrastructure: >5 years
9. Software: 3-5 years for laptop, rest >5 years
10. Tooling and Fabrication: >2-3 years

Implementation Schedule

All purchases will begin after funding is secured and designs are finalized, likely W22.

Additional Information

Due to limited space for categories in the next section, option details are listed below:

1. Electrical
Option 1: 1,900
Option 2: 1,700
Option 3: 1,500
Option 4: 1,000

2. Media
Option 1: 1,050
Option 2: 750
Option 3: 550
Option 4: 300

3. Safety
Option 1: 3,800
Option 2: 3,000
Option 3: 2,300
Option 4: 2,000

4. Recovery
Option 1: 500
Option 2: 500
Option 3: 450
Option 4: 450

5. Plumbing & Sanitation
Option 1: 2,800
Option 2: 2,000
Option 3: 1,500
Option 4: 1,200

6. Payload
Option 1: 2,000
Option 2: 1,800
Option 3: 1,600
Option 4: 1,500

7. Data Acquisition
Option 1: 1,100
Option 2: 1,000
Option 3: 800

Option 4: 700

8. Infrastructure
Option 1: 2,700
Option 2: 2,500
Option 3: 2,200
Option 4: 1,900

9. Software
Option 1: 800
Option 2: 750
Option 3: 700
Option 4: 640

10. Tooling and Fabrication
Option 1: 2,000
Option 2: 1,800
Option 3: 1,600
Option 4: 1,000

Total
Option 1 Total: 18,650
Option 2 Total: 15,800
Option 3 Total: 13,200
Option 4 Total: 10,690

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Total (Please refer to "Additional Information" section for details by category)	18650	15800	13200	10690
Total	18650	15800	13200	10690

Student Team
Proposal F-220

Funding Request from the University of Waterloo's Steel Bridge Team

University of Waterloo's Steel Bridge Team
Nicole Balles, Finance Lead
uwsteelbridgedesign@gmail.com

Description of Proposal

The University of Waterloo's Steel Bridge Team is participating in the American Student Steel Bridge Competition in April 2022 and the Canadian National Steel Bridge Competition in May 2022. The team prides itself in the hard work of its team members as they perform all the processes: bridge design, structural analysis, fabrication, construction, marketing, and management. The fabrication of the bridge is vital to the success of the team and provides academic enrichment for students beyond classrooms.

To begin fabrication of the bridge in January 2022, the team is seeking support to fund a $3,500 cold saw. With the support from WEEF, the team will be able to produce better quality custom steel members, and consequently, a better bridge.

Proposal Benefits

Students will be able to develop new hands-on experience, a vital component that they have been deprived of due to the pandemic. Learning how to safely operate this machine will enrich their professional career. In addition, the cold saw will be stored in the concrete laboratory (E3 2104). Thus, it will be available for use to any undergraduate student with permission from Richard Morrison, lab technologist.

Estimated Equipment Lifetime

According to the manufacturer, CraftEx Industries Inc., the cold saw has a warranty of 3 years. Since the machine will be placed in the concrete laboratory and operated in a safe manner, then the cold saw is expected to remain in operation for at least fo

Implementation Schedule

The cold saw will be purchased in the Fall 2021 term and will be utilized in the Winter 2022 term for fabrication. Afterwards, the machine will be used for the following years for competitions and for other student activities, as aforementioned in the "Pr

Additional Information

The machine cost was obtained from Busy Bee Tools: https://www.busybeetools.com/products/12in-slow-speed-cold-saw-with-stand-cx110.html

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
A 12 inch slow speed cold saw (CX110) with a stand.	3500	3150	2625	1750
Total	3500	3150	2625	1750

Student Team
Proposal F-221

WATCHEM Equipment Funding Proposal

WATCHEM
Abin Varghese (Business Team Lead)
aavarghe@uwaterloo.ca

Description of Proposal

WatChem is the first Chemical Engineering Design Team at the University of Waterloo. As the new competitors for AIChE's annual Chem-E-Car Competition®, we are focused on the design and assembling of lab scaled cars powered by chemical reactions. In the pilot year of our launch, we have set the objective to work with University of Waterloo's finest chemical and nano-engineering undergraduates to design a car from scratch that works purely on chemical reactions.

Proposal Benefits

-In one month alone, our team has grown from 3 individuals to a team of 25 promising Chemical and Nano-Engineering students, and we are still receiving applications!

-Students develop technical, research and interpersonal skills in our various divisions

-Research on power source, stopping mechanisms and controls tools and implementations.

-Development of chemical reactions and conducting reaction kinetic analysis to evaluate the energy generated.

-Development of an entire control system using Arduino and circuit design to build a test lab-scaled vehicle.

-Interpersonal, communication and documentation skills as part of Business Team

-Increased co-op prospects & industry connections with AIChE

Estimated Equipment Lifetime

The estimated lifetime of all our equipments we seek to purchase range from a lifetime of 2-3 years from initiation of use.

Implementation Schedule

Our team has completed all research stages and are currently in the design and development stages, but are at halt due to the lack of equipments. Therefore, once the equipments are attained, they are implemented right away this term.

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Process Chemicals, such as NaOH, pure Vit.C, Tincture of Iodine, Ascorbic Acid. These are for the chemical reaction for our car	900	0	0	0
Chemistry Lab Equipments, specifically speaking, Beakers, Test Tubes, Weighing Scales. These are needed for testing purposes	500	0	0	0
Arduino, specifically the arduino kit, which is used to build the controls system, currently relying on Prof. Gostick for now.	90	0	0	0
Filament (PLA), required for testing and building the controls system	240	0	0	0
Motor and wheels, which are crucial components for our test vehicle	90	0	0	0
Total	1820	0	0	0

Student Team
Proposal F-222

UWaterloo Robotics Team F2021 WEEF Proposal

UWaterloo Robotics Team
Anna Fyfe, Finance/Business Lead
uwaterloorobotics.finance@gmail.com

Description of Proposal

The University of Waterloo Robotics Team (UWRT) consists of over 40 students who aspire to design, build, and program the robots of tomorrow. The team competes at the University Rover Challenge held by the Mars Society with the challenge to design and build the next generation of Mars rovers that will one day work alongside human explorers in the field. The team has been accepted to the competition for the past three years out of an application pool of over 90 universities, placing 33rd globally in 2019, 22nd in 2018, and 15th in 2017. Due to the COVID-19 pandemic, UWRT was unable to compete in both the 2021, and 2020 competitions. However, in 2020 the team placed 21 in the final System Acceptance Review with a score of 85 out of 100.

Electrical Components

Batteries + Charger

Soldering Station

PCB Components

The battery and associated components are the heart of the rover. This year the team plans to use 48V batteries. Currently, we do not have the necessary infrastructure for this and will need chargers to allow the rover to operate. Backup batteries are needed in the event that our battery runs out prematurely or fails. Meanwhile, a soldering station is essential in order to properly assemble and build custom electrical components, currently our soldering iron works poorly and risks damaging components. Finally, every year the team designs updated versions of our PCBs. These PCBs require components as all of the electrical designs need to be fabricated in order to be used.

Mechanical Components

Various Tools

Stock Material

Bearings

Gears/Gearboxes

Motors

UWRT plans to completely build up the robotic arm and drivetrain from scratch. Tools are needed in order to manufacture and assemble the custom parts which our team creates. Stock material will be used to build the rover's frame and ensure that we will not have to use previous year scrap material, which could compromise the integrity of our designs. Bearings will be used to ensure a long lifespan of rotating parts. Gears/gearboxes will be utilized for power transmission. We plan on using 6 directly driven motors to drive the rover's wheels. Each of these wheels will require a high gearing ratio, which must be achieved with a gearbox. Lastly, in order to actuate each mechanical component motors will be needed. Historically we have used brushed DC motors. However, this year we plan on upgrading to Brushless DC motors to improve efficiency and power density.

Software Components

Cameras

Cables/Tools

We will need to purchase cameras for image processing, and object detection of items that the rover may encounter. Various cables and connecting tools will be used for testing and system integration.

Firmware Components

Encoders

ODrive Controllers

Encoders will be used to ensure that the rover's various joints and wheels are in a proper position. ODrive controllers are used for BLDC motors in order to drive them, as they cannot be driven with only two leads, like a traditional brushed DC motor.

Proposal Benefits

The UWRT has proven to be a great educational ground for undergraduate students interested in robotics for 18 years as one of the most iconic student teams in Waterloo. With WEEF's funding, UWRT can continue to participate in university events put on by organizations such as the SDC, WiSTEM, and Engineering Outreach. A truly multidisciplinary group, UWRT builds robots that could not be imagined by a single type of engineering, emphasizing teamwork, collaboration, and system integration.

In preparation for the University Rover Challenge, there are many upgrades that we need to make to our existing rover to improve performance.

Student Team
Proposal F-222

Estimated Equipment Lifetime

Electrical Components

- Batteries + Charger: 3 years
- Electrical Components: 1 year
- Soldering Station: 3 years
- PCB Components: 1 year

Mechanical Components

- Various Tools: 5+ years
- Stock Material: 1 year
- Bearings: 3 years
- Gears/Gear

Implementation Schedule

Will all be purchased ASAP

All to be used before the University Rover Competition (held June 1-4).

Additional Information

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Electrical Components/Tools	2900	2150	1500	1000
Mechanical Components/Tools	9000	7300	5500	3950
Software Components/Tools	1000	750	600	400
Firmware Components/Tools	5000	3750	3000	1500
Total	17900	13950	10600	6850

Student Team
Proposal F-224

UWARG Fall 2021

University of Waterloo Aerial Robotics Group
Shrinjay Mukherjee, Technical Lead, Computer Vision
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Description of Proposal

The Waterloo Aerial Robotics Group (WARG) is a team of passionate students developing autonomous aerial vehicles capable of performing various tasks. WARG will be competing in the annual Unmanned Systems Canada Student Competition this May.

This term, we are currently working on prototypes and test runs in preparation for the competition. This year has shown that we must be able to adapt to different scenarios and situations. There was a lot to be learned this year. With university opening again, more people are in person, and we are looking to take advantage of this opportunity. During this season we will need money to fund our various activities. We are currently in the process of creating our aircraft for this upcoming 2022 competition.

Currently we have 5 things that we need funding for in order to create this aircraft. We need funding for the following:

Mechanical Components for Airframe

Electrical PCB and PCB Components

Firmware Components & CPU Processors

CV System Components

Training Drone

All of these things require money for the prototyping stage as well as for the manufacturing and designing stages. WEEF's sponsorship will allow us to continue through these processes and in addition supplement student learning. With your support, we can achieve the goals that we set out for this year that are all in lead up to the 2022 Unmanned Systems Canada Student Competition.

Proposal Benefits

In WARG our main priority is student learning. Two of our current projects include Project VANGUARD and ZeroPilot. Project VANGUARD is the current quadcopter that students are currently constructing. They get to be involved in making the prototypes, designing, testing as well as coding aspect for this. ZeroPilot is our own custom-built autopilot system. This is a great experience for students as this helps them learn about how to set up a first-person autopilot system which is very unique. Whether we fail or succeed we make sure our students learn lifelong skills and be able to take something away from this club that can be applicable to the future.

Since the University is opening again there are more opportunities for students to work and learn about things hands-on. With WEEF being a big financial contributor to WARG we are very grateful for the support that they have continued to give us every year.

WEEF has continued to be a big help to WARG and we respect them fully for continuing to help us in times of need. The money that it provides comes from students and they help students by providing this money. This money allows us to pursue opportunities and learn things that would not be possible. Like last year and as we continue to do so, if WEEF decides to sponsor WARG, WEEF will continue to keep their "High Flyer" bracket status. We will continue to promote WEEF through our logos, apparel, social media and more. We believe promoting WEEF is important because of how they continue to help us. By helping us as a "High Flyer" sponsor a large WEEF logo will be added to our aircraft. The same will be done for our apparel and team website.

Estimated Equipment Lifetime

The estimated equipment lifetime for all of the requested equipment is 3-4 years.

Implementation Schedule

Our plan after getting the equipment is to use them to prepare for the 2022 USC student competition.

Additional Information

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Mechanical Components for Airframe	4000	2955	1910	955
Electrical PCB and PCB Components	4000	2745	1490	745

Firmware Components and CPU Processors	1000	650	300	150
CV System Components	1000	750	500	250
Training Drone	800	500	300	0
Total	10800	7600	4500	2100

Student Team
Proposal F-225

Desalination Unit capstone project

Chemical Engineering
CHE 482
Chemical Engineering Capstone (Group 29)
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Description of Proposal

Desalination is one of the most efficient, but costly methods of processing saltwater into drinking water - economically and environmentally. Globally, climate change continues to cause environmental effects that can compromise or deplete access to existing drinking water resources. Especially in disaster situations, access to electricity and clean water can be a challenge and/or costly. Existing large-scale operations may take time to construct and require many material and human resources, while small-scale solutions may not be effective for off-grid situations.

For our 4th year Chemical Engineering capstone project, we plan to design and build a household-sized (50L/person per day), off-grid saltwater desalination unit. This unit will feature 2 filtration steps to purify the water input, solar panel(s) to harvest energy, a battery to store harvested energy, and a controller. The objective of this project is to: a) build a working desalination unit to actualize the design b) optimize energy storage and expenditure for prolonged off-grid use.

Proposal Benefits

The actualization of this optimized off-grid desalination unit design benefits the Faculty of Engineering and Faculty of Chemical Engineering through its potential use for graduate-level (or undergraduate) courses. The unit itself can be used as a teaching tool for process control courses and labs. The unit can also be deconstructed so that the individual parts can be reused for future projects.

Estimated Equipment Lifetime

We expect the equipment to last 5+ years. However, the items/equipment requested are not consumables and life expectancy is dependent on usage frequency and application.

Implementation Schedule

October 2021 – receive funding

November 2021 – acquire materials

December 2021 – begin constructing prototype unit

January 2021 – finalize unit design and operation

February 2021 – present unit in 4th year Chemical Engineering Capstone Sym

Additional Information

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Reverse Osmosis Membrane (1)	76	123	0	0
Sediment Filters (2) and housing (2)	156	0	0	0
RO Booster Pumps (2)	280	394.99	0	0
Pressure Transmitters (3)	127	0	0	0
Automatic Valves (2)	67	0	0	0
Total	706	517.99	0	0

Student Team
Proposal F-226

Economic Vaccine Refrigerator Prototyping

ImmunoCool
Surabhi Bhattarai (Funding Lead)
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Description of Proposal

This proposal is to finance the prototyping of an economic solar vaccine refrigerator that employs a thermoelectric module for refrigeration. More specifically, its to fund the prototyping materials that can be reused by the engineering department.

Proposal Benefits

The physical prototype can be used in educating undergraduates on heat and mass transfer, and thermodynamics as they are fundamental courses in Chemical Engineering. More specifically, it can showcase the Peltier effect (which is not seen in the more common vapor-compression cycles).

This prototype can be divided into two systems: the refrigeration system and the energy system. They can be used in chemical engineering labs or by future students that want to study/complete a project on solar energy or thermoelectric refrigeration.

Estimated Equipment Lifetime

Solar Panel: 25-30 years

Rechargeable Battery: 2-3 years

Inverter: 10 years

Refrigeration System: 5 years

Implementation Schedule

Once the 2021 Capstone project/course is completed, the prototype will be given to the engineering department (May 2021).

Additional Information

The total estimated cost of the prototype is ~$1100 including shipping and tax. We have secured $600 from the engineer of future fund.

The option description for the Prototyping Materials are:
Energy System (Solar Panel + Battery): $700

Energy System (Solar Panel + Inverter): $660
Solar Panel ONLY: $600
Refrigeration System (TE Module + Heat pipes + Sensor & Alarms + Raspberry Pi Control Unit + Insulation): $330

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Prototyping Materials	700	660	600	330
Total	700	660	600	330

Student Team
Proposal F-227

DARE - Breaking into Entrepreneurship

UW Entrepreneurship Society x SoGal Waterloo
DARE - Breaking into Entrepreneurship
j93cao@uwaterloo.ca

Description of Proposal

The region of Waterloo has the second-highest startup density in the world. Even then, only around 77% of US startup founders are white or caucasian, and only 43% of companies have at least one female C-suite executive. The entrepreneurship industry is dominated by white males, and various barriers and lack of support prevent others from breaking into this space. To empower UWaterloo students to enter the space, we must first increase representation and share resources available to them.

The solution we propose is DARE: Breaking into Entrepreneurship, a physical magazine that promotes UW's entrepreneurship in an inclusive and diverse manner. We want to share resources to help students succeed in all stages of their entrepreneurial journey, whether that is students who have just started exploring the space, students who are planning a venture, or students who want to scale their projects. Our magazine shares content based on the different stages of one's journey. The content covered will include hard resources accessible to students, how-to articles, and will feature anecdotes from student founders from different faculties, problem spaces, and industries.

Proposal Benefits

Creativity and being innovative are traits of engineering majors and are important for aspiring entrepreneurs and innovators. With fifteen programs under the faculty of engineering at UW and a wide selection of courses that foster creative thinking, engineering students have the potential to play an important role in the field of entrepreneurship. Engineering is a broad field with many areas of application. Supporting this magazine allows the faculty to show their commitment to innovation in all these different application areas.

The faculty of engineering's vision is to encourage students to "challenge the status quo, collaborate, innovate, and learn to create." Our magazine promotes entrepreneurship as a valuable experiential learning opportunity and provides resources that will fuel students' passions and guide their journey. We believe our initiative will help advance the faculty's vision of increasing student engagement and success.

Our magazine would also be a great resource for students completing their Capstone projects in their fourth year, especially for those who plan to take an entrepreneurial approach and build their own projects to explore emerging challenges or even to explore future business ideas.

Estimated Equipment Lifetime

The lifetime of the magazines will be indefinite. While the magazines are intended to be distributed throughout campus for students to keep, we expect a portion of the magazines to remain as static resources.

Implementation Schedule

We started this project in May 2021 with some resources already available for the magazine content. Over the summer, we spent the bulk of our time drafting the article content. Now we are editing this content and finalizing our illustrations and magazine visuals to accompany the articles. Our target deadline for the finished draft is early December, after which we will print the copies to be distributed in January for the beginning of the school term.

Additional Information

We explored multiple printing companies to evaluate the different options available. Of the options, Book Print Canada provided us with the most economical printing value. Thus, we have eliminated other funding options. We prepared a budget breakdown but there is no space for additional additions, so it will be available through additional request.

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Magazine Funding	1519	0	0	0
Total	1519	0	0	0

Student Team
Proposal F-228

WEEF Proposal - UW Orbital Funding for Canadian Satellite Design Challenge (CSDC)

UW Orbital
Roman Semin, Business Lead, 3A Systems Design Engineering
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Description of Proposal

UW Orbital's mission is to become a launching pad for students' careers in SpaceTech. By incorporating technical and hands-on experience with access to a professional network which would allow any UW graduate to explore their passion for space. To provide students with relevant experience and connections, we will be competing in the Canadian Satellite Design Challenge (CSDC) in 2023, by building a CubeSat satellite. We are requesting funding of which will be used towards materials associated with prototyping, testing, and constructing our CubeSat that will house innovative technologies. Our success in participating in the CSDC will become a key stepping-stone towards jump-starting UW Orbital's vision of ultimately building a permanent space-oriented community for students at the University of Waterloo.

The CubeSat satellite we are building will carry two payloads:

The first being is a "Selfie-Sat" camera that communicates with Amateur Radio Operators to capture an image of a given set of coordinates, all in pursuit of furthering amateur radio education.

The secondary payload will carry our partnership with QEYnet, of their "Infrared Laser Beacon". The first of its kind prototype utilizing their satellite laser transmission technology to provide security for quantum distribution networks. Their "Infrared Laser Beacon" will show the potential of Quantum (encrypted) Key Distribution as a technology of the future.

Proposal Benefits

Benefits for Students:

Orbital is an "open" team - this means there are no applications required and anyone has complete freedom to move between sub-teams and projects. All members can take on challenging projects and tasks they feel passionate about, and mentorship is provided to each other. Each of our six subsystems will work towards the CSDC and provide students with unique technical skills (such as working with specific software) and develop soft skills (such as communicating with sponsors).

1. Attitude Determination and Control Systems (ADCS) - Working with magnetorquers, reaction wheels, and sensors (IMUs, sun sensors, GPS) to control the orientation of the CubeSat within space, as well as determining the location of the CubeSat.

2. Communications team - Using an antenna, transceiver, and ground station equipment to handle the interface between the CubeSat and the ground station.

3. Electrical Power Systems (EPS) - Operating with solar panels and batteries to manage power production and distribution.

4. Command and Data Handling (CDH) - Manage the two payloads and the primary microcontroller and all the interfaces between the various subsystems.

5. Mechanical - Construct the actual frame of the CubeSat and responsible for Finite Element Modelling (FEM) and thermal analysis.

6. Business - Responsible for coordinating team social media accounts, developing marketing materials, running outreach and recruiting events, handling finance/budgeting, and reaching out to sponsors/mentors.

As we build our CubeSat working towards the CSDC, any student participating with us has the opportunity to be surrounded by our inclusive framework of designated subteams that will allow any individual to be engaged and hone their skills in a proactive and challenging professional environment. Ultimately, we provide students with the competence to break into the space industry without prior industry experience or a relevant graduate degree.

Benefit to the Engineering Faculty

The majority of members of UW Orbital are from the Faculty of Engineering. Through the development of our CubeSat payloads, five of our subteams benefit from garnering invaluable technical and hands-on experience unique to the space industry. Aspiring students will also have access to a professional network of mentorship and resources to support their endeavours. For example, this past month, we invited Sohrab Haghighatto, the CEO and Co-founder of SpaceRyde, to a fireside chat to share his experience in the SpaceTech industry and respond to students' questions.

Estimated Equipment Lifetime

1. CubeSat frame - The lifespan of the frame is from the time of purchase to one year after launch. All frames are non-reusable.
2. Tools & Thermal Camera - Estimated to last for an indefinite amount of time, and to be used in future projects.
3. Dev boards, and microcontrollers - An estimated useful life from the time of purchase to the time of launch. They are non-reusable.
4. PCBs - An estimated useful life from the time of purchase to the time of completion of the prototype model, roughly one year. They are non-reusable.

5. Dev payload camera - The lifespan of the camera is from the time of purchase to one year after launch. It is a non-reusable item.

Implementation Schedule

October 2021 - April 2022 - Prototyping

April 2022 - October 2022 - Subsystem construction

October 2022 - March 2023 - Final assembly of CubeSat

March 2023 - April 2023 - Environment and vibration testing

May 2023 - CSDC winner selected

Additional Information

Details of Items Requested:
1. The CubeSat Frame will be outsourced as a pre-manufactured item and will be used as a reference for the Mechanical team to construct the outer frame of the CubeSat.

2. Mechanical testing and work tools include:
    a)A thermal camera that will be used for Non-Destructive Testing (NDT).
    b)Tools, such as screwdrivers, pliers, wrenches, etc. will be used during the construction of the prototype and the CubeSat. The tools will be bought second hand or from the E5 Store.

3.Dev boards and microcontrollers will be used to test and debug the software used in the CubeSat.

4. Printed circuit boards (PCBs) will be used for prototyping and the development of the FlatSat. The requested amount also includes manufacturing and shipping.

5. Dev cameras will be used for prototyping and FlatSat development. It is used to help integrate our primary payload - the “Selfie-Sat” with the rest of our system.

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
CubeSat Frame	5446.67	4567.5	4567.5	3996.56
Mechanical Testing and Work Tools	860	688	516	344
Dev Boards and Microcontrollers	1475.9	1180.72	885.54	590.36
Printed Circuit Boards (PCBs)	1100	880	660	440
Dev Cameras	92.48	73.98	55.49	36.99
Total	8975.05	7390.20	6684.53	5407.91

Student Team
Proposal F-230

Waterloop WEEF Proposal F21

Waterloop
Quinlin Wu, Sponsorship Lead
sponsorship@waterloop.ca

Description of Proposal

Hyperloop is a proposed new mode of transportation for the future, which moves quickly, safely, and it is being designed right here on the University of Waterloo's campus! Waterloop's mission is to design and build a working, full-sized, scalable Hyperloop pod by 2025. A Hyperloop is a levitating pod that carries passengers through an airtight tube at near-vacuum pressure, removing friction and air resistance; this allows the pod to travel at over 1,300 km/h. With Hyperloop technology, passengers will be able to travel from Toronto to Montreal in 30 minutes! We've identified an opportunity for UWaterloo to come into the lead in Hyperloop worldwide by constructing a Hyperloop test track at the Waterloo Airport. We have already received approval for this endeavour from the Region of Waterloo and expect to break ground within the next two weeks.

After four years of hard work, Waterloop has completed five iterations of our pod design and is now working on our sixth pod—Goose VI. We are planning to use this new Goose VI frame as a testbed while the team can develop more advanced technologies. The funds requested within this proposal would be used to purchase general electrical and mechanical supplies, as well as a new Lim Core for the Goose 6 pod. Goose VI will be designed to prove the feasibility of electromagnetic levitation. Some of the key changes are adding a levitation system, a full carbon fibre monocoque frame, a custom battery pack, battery management system, and motor controller, and a regenerative braking system.

Proposal Benefits

1. Benefits to WEEF

Waterloop's business and sponsorship team works on building contacts with various companies that help sponsor us by providing materials we might need at discounted rates, in exchange for marketing their brand on our website and pod (depending on the agreed upon terms). Our sponsors also provide support in the form of technical materials, software, and marketing. We believe that WEEF's funding assistance will help our business team greatly.

Waterloop provides perks for all of our financial sponsors. The funding requested would qualify WEEF for the Transonic Tier, in which the agreed terms would include:

-Exclusive tickets to our pod unveil event

-WEEF logo displayed on the Waterloop website

-Dedicated social media exposure acknowledging WEEF's support of Waterloop

-Logo on presentation materials

-Logo on pod shell

2. Benefits to Engineering

As one of the largest student design teams at University of Waterloo with over 110 members, Waterloop values the culture of mentorship, innovation and constant learning. By nurturing and developing the talent of many members from all faculties, especially in Engineering where the majority of our members are from, we become the first stepping-stone for many generations of students on their path to success. The process of being a part of a proprietary development provides students with insight into manufacturing as well as research and development basics that can be brought into future co-op or other professional endeavors. Having experienced students going out into the workplace will not only reflect well on Waterloop, but the University as well. Through funding from WEEF, the research, design, and construction of the Gosse VI pod will provide a unique and rewarding experience that students will really value.

Moreover, having a stable design team like Waterloop will ensure the University of Waterloo generates a reputation as a leader in hyperloop design and development in Canada, attracting new students and investors to the university itself, and garnering attention through our accomplishments.

Estimated Equipment Lifetime

1. Oscilloscope: This tool will be used across all of our electrical projects to analyze the signals and debug our printed circuit boards for multiple years. This tool has no particular lifespan; it should be usable for the next 10 years if

2. Thermal Components: thermal components can be disassembled and reused. We will initially use the components to build a prototype, and then reuse them to build a full-size version of the pod.

3. Aerostructures: these materials will be used for testing new manufacturing processes for the carbon fiber to build a carbon fiber monocoque. It's our team's first attempt at building structural carbon fiber, so initially, we will be conducting simple tests to evaluate the strength and structural properties of the material. After some basic tests, we will progress towards building a mini-scale prototype, and then eventually the full-size frame. These materials will be used over the course of the next year until we complete the manufacturing cycle for the completed frame.

4. New Core and Copper Coils: the new core will be ordered in February of 2022 and then used for the new Goose 6 pod design. This motor core is developed through COMSOL simulations and will be used for the next 2 years to race our pod at the Canadian Hyperloop Competitions.

Implementation Schedule

The electrical tools that we are requesting funding for would be used this term (Fall 2021),whereas the mechanical components would be used over the next year and a half for prototyping and within the final version of the G6 pod.

Additional Information

Waterloop is grateful for the support that WEEF has shown over the years. The team will be happy to accept any partial funding over no funding. More information about our team, along with past and future initiatives, can be found on our website: https://teamwaterloop.ca.

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Mechanical and Electrical Components	6000	5000	4300	3600
Thermal components	1200	1000	800	600
Aerostructures	1200	1000	800	600
New Core and Coil	4600	4000	3700	3100
Total	13000	11000	9600	7900

Student Team
Proposal F-231

F21 WATonomous WEEF Proposal

WATonomous
Ashwin Sureshchandra, Sponsorship Core Member
sponsorship@watonomous.ca

Description of Proposal

WATonomous was established in April 2017 when our team was elected to represent the University of Waterloo in the SAE AutoDrive Challenge, a competition to transform a stock Chevrolet Bolt EV into a level 4 autonomous vehicle. WATonomous ended the final year of competitions with a phenomenal 2nd place overall finish. This accomplishment was only possible through the hard work and collaborative effort of our team members, who stem from a multitude of programs, of which almost one third are math faculty students! WATonomous is currently working on and has made significant progress in furthering autonomous vehicle research in topics such as environmental modelling, behavioural prediction, and lane detection/classification. In addition, WATonomous' exceptional performance in the AutoDrive Challenge impressed General Motors, and we are currently in talks with their Head of Innovation to discuss the details of a potential research partnership.

Currently, the completion of our research projects remains our utmost priority whilst we simultaneously aim to compete in additional competitions in the forthcoming terms. As a result, we are actively looking to upgrade our test track infrastructure to put us in pole position for future competitions, open pathways to showcase our vehicle, and strengthen our corporate partnerships.

Proposal Benefits

All of the items mentioned in the proposal are crucial to our success.

1. Since all of the ports on our cluster switches are occupied, networking equipment will help expand our compute cluster to help handle more concurrent developers and more sophisticated simulation software.

2. The car battery maintenance items will increase the longevity of our vehicle, Bolty. A trickle charger will charge the battery slowly while also preventing overcharging, and a spare battery will allow us to use one while charging the other.

3. Additional server RAM is required to run more resource-heavy tasks simultaneously, which will increase our productivity, and to enable intensive mechanical or aerodynamic simulations.

4. The CarSim HPC License will allow us to use a simulator that has accurate dynamics and is an industry standard, which will aid us in publishing our research projects.

5. The Mini Vehicle Platform allows us to test our path planning algorithms in a real-world, small-scale setting, which is more cost effective and time efficient.

6. The GPUs will be added to our compute cluster which will boost our simulation and research project efforts and allow us to expand our hardware and infrastructure as our team grows.

7. Our current server reached maximum capacity in the recent Indy Autonomous Challenge. A Threadripper server will allow us to expand our compute cluster to train more ML models and accommodate more students.

With the funding, WATonomous can improve the efficiency of our development, the quality of our testing, and ultimately the experience we provide to the many current and future engineering students on our team.

Estimated Equipment Lifetime

1. Networking Equipment: 10+ years
2. Car Battery Maintenance Items: 4-5 years
3. Server Ram: 5 years
4. CarSim HPC Licenses: 2 years
5. Mini Vehicle Platform: 5 years
6. GPUs: 5 years
7. Threadripper Server: 5 years

Implementation Schedule

All items will be purchased immediately upon receiving funding and will be utilized immediately.

Additional Information

If full funding cannot be provided, please prioritize funding in the order that the items are listed.
(i.e. prioritizing in the order of Networking Equipment, Car Battery Maintenance Items, Server Ram, CarSim HPC Licenses, Mini Vehicle Platform, GPUs, and Threadripper Server).

Note that we are requesting the same items from both MEF and WEEF in hopes of acquiring full funding from the sum of both funds.
We are requesting 7 items, but only 5 items can be inputted in this form. Please view our full F21 Budget spreadsheet here:
https://docs.google.com/spreadsheets/d/1mH14pSVR20NeNMpkQc6aYObSKE_b38vj/edit#gid=1052422000

Cost Breakdown

Item	Option 1	Option 2	Option 3	Option 4
Networking Equipment	1510	1132.5	755	377.5
Car Battery Maintenance Items	500	375	250	125
Server Ram	650	487.5	325	162.5
CarSim HPC Licenses	11626	8719.5	5813	2906.5
Mini Vehicle Platform	1483.04	1112.28	741.52	370.76
Total	15769.04	11826.78	7884.52	3942.26

Student Team
Proposal F-232

WATOLINK Fall 2021 Funding Proposal

WATOLINK
Christopher Samra - Team Lead
csamra@uwaterloo.ca

Description of Proposal

WATOLINK offers students an opportunity to develop brain-computer interface applications involving action-classification via EEG signal analysis and inference. Our team is currently developing a mind-controlled speech interface that we will submit to the NeuroTechX Student Competition in 2022.

In order for our mind-speech interface to be fully realized we need some essentials:

- An OpenBCI headset that we can use our applications with.

- A workstation PC that multiple members can write and execute code on at once, and to train our models on without needing to rely on the cloud.

- Team T-Shirts to promote our Team and bring to events.

Proposal Benefits

OpenBCI:

Gives team members new, working BCI hardware to test their applications with.

Team T-Shirts:

Allows us to represent ourselves in a unified way during events and promote the team to potential new members.

Development Workstation:

Allows for centralized development, drastically speeding up dev time and allows us to train models whenever we want without needing to wait on a cloud service.

Estimated Equipment Lifetime

OpenBCI (At least 3 Years)

Student Team
Proposal F-232

Team T-Shirts (1 Year)

Development Workstation (At least 3 Years)

Implementation Schedule

OpenBCI (ASAP)

T-Shirts (Winter 2022)

Development Workstation (ASAP)

Additional Information

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
OpenBCI Hardware (16 channel BCI)	4506.20	2911.5	2911.5	2911.5
Development Workstation Server	4650	3200	3200	3200
Team T-Shirts	550			
Total	9706.2	6111.5	6111.5	6111.5

Student Team
Proposal F-233

VEX U Robotics 2021 Fall

VEX U Robotics
Alex Su, Electrical Lead
uwvexu@gmail.com

Description of Proposal

VEX U is a university-level competition that enables over 300 post-secondary institutions all over the world to compete at an international level. The rules of the competition are similar to VEX EDR, however, VEX U offers more flexibility in the robot design, electronics, and manufacturing process. In particular, students have the opportunity to customize circuitry, boards, and sensors to enhance the functionality of the robot. Additionally, the machining of steel, aluminum and composite materials, and 3D printing of plastics is permitted, allowing for a more versatile robot. Students who are familiar with high school robotics, as well as newcomers will be provided with opportunities to succeed and learn about things outside of the curriculum. Along with greater technical skills, we aim to form students into members of a team, and productive members of our community. VEX U competitions have historically been held mostly in Mexico and the United States. However, in recent years Canadian teams have the opportunity to compete domestically as a competition will be held at the University of Waterloo each year. This event will allow Canadian teams to qualify for the World Championship held in Dallas, Texas which will be broadcasted on ESPN/CBS. We are led by a core of students with a background of success, having won the world championships in both the High School and University level. In recent years we also received 2x Design Award and 2x Robot Skills Champion, 1x Robot Skills 3rd place, and 2021 Skills World Champions.

We are requesting funding to allow us to grow the universities' very own VEX U team. We have made great progress in the past years, however there are still many items that we would like to purchase to make our team well equipped to compete at future competitions. Funding would cover equipment, tools, sensors and robot parts etc. In addition to this, funding in these areas would alleviate team members' pressure on competition fees we encounter. Many resources, such as electronics, parts, tools, and the playing field are reusable past their time of purchase. We believe that a VEX U team would fill the University's void of not having a large-scale competitive robotics team. At the same time, the team is such that it is not intimidating to new students who only have had a high school background since there is only a small learning curve involved. It will be a fun and competitive way for students to get an introduction to the various aspects of robotics, programming and engineering.

Proposal Benefits

The existence of this team would come with many benefits. For instance, it would benefit undergraduate engineering education, as well as the University as a whole. This team would further the educational experience of engineering undergraduate students by providing a competitive, educational, and fun environment to learn about robotics. The current robotics teams can seem daunting to new students, as they demand a large time commitment as well as the requirement to do a lot of additional learning, outside of meeting the already strenuous academic requirements. The teams are also easily scalable unlike others, if more students are interested in joining, we can simply register more teams and

share the parts between robots. This would allow all students to participate in all aspects and will not feel left out. They would have the opportunity to implement their own design since the cost of additional robots is lessened. This team would also act as a good opportunity for students to get their first hands-on experience, a valuable characteristic that co-op employers look for. Not only would this benefit students in their search for co-op placements, but it would increase the University's reputation of producing students that have applied experience. Another way this team would benefit the University's reputation is through the competitions. Good performances at competitions can bring international recognition to the University. At the very least, just having a presence at competitions builds the reputation of the University. Lastly, we are in the process of gathering the resources needed to host a VEX High School Competition on campus, which would attract high school students to the campus and giving professors/lecturers the chance to talk to students with potential interest to the university

Thank you greatly for your support, we were able to kickstart our rookie year from your generous support. You are a Platinum sponsor. We appreciate your consideration in sponsoring the universities' VEX U team.

Platinum ($2000+)

- Recognition in official team name announced at competition
- Company name in social media, press releases, brochures
- Large logo on robots
- Premium logo on website, team banner and jersey

Gold ($1000+)

- Company name in social media, press releases, brochures
- Medium logo on robots
- Large logo on website, team banner and jersey

Silver ($500+)

- Company name in social media, press releases, brochures
- Medium logo on website, team banner and jersey

Bronze ($300+)

- Company name in social media, press releases, brochures
- Small logo on website, team banner and jersey

Blue ($100)

- Small logo on website, team banner and jersey

Estimated Equipment Lifetime

The initial start-up cost for a VEX U team was high mainly because of the long term assets we need to operate the team, such as storage, tools and electronics. However, it soon became clear that the majority of this cost exists in the first few years. Past the first few years, there is minimal recurring cost, with only a few hundred dollars required for replacement parts and game elements. The majority of the components that our team requires to compete can be used for multiple years. For instance, the bearings and wheels we are proposing have long lifespans lasting multiple years assuming normal wear and tear. The pneumatics are easily reusable and expected to last well over 9000 cycles, which equates to many years of normal usage. The field riser is expected to last more than 15 years due to its rigid construction and the fact that it is reusable every year. We will be using it when hosting high school competitions as well. The majority of the components from the initial purchase are all being used for multiple seasons. As a result, the recurring cost of running a VEX U team is substantially less than the upfront investment required to start one.

Implementation Schedule

In order to be ready for competition, our team must have two competition-ready robots (the university competition requires a 15” and 24” robot).We will be designing, programming and tuning our robots so that they are ready for the competition. The requested funding will be used very soon after it is allocated.

Additional Information

More information about the items we are requesting funding for:

We are planning to utilize the SMC pneumatics system for additional functionality. SMC provides an affordable pneumatics system with high performance. The expected life span of the pneumatics system is very long as pneumatics system is not subjected to physical damage. They are also reusable across many years and can be used in different applications.

Bearings + Wheels: We are planning to make new drivetrains with ball bearings to reduce friction. They are not considered consumables because we can reuse them every year and it will last many years under normal and extended wear and tear. We also plan to use new wheels for their performance benefits, which can be reused for the next years.

Sensors: We are planning to use new sensors to add functionality to our robots and innovate new technologies in both hardware and software. Doing so will allow students greater knowledge and exposure to new code and technology, as well as keep the team with a competitive edge. The sensors are reusable across many years and can be reused for different applications, for both competitive and testing purposes.

Competition Perimeter Riser provides us additional storage under the field. The riser will be 24 inch, which creates a space 24inch x 12ft x 12ft under the field for storage.

We would like to thank you for your time and consideration of our proposal for funding. We hope you see the many benefits that a VEX U team would bring not only to engineering undergraduate students but to the University itself. We are excited by the prospect of continuing the VEX U team and hope you share our enthusiasm.

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Pneumatics	350	300	250	200
Bearing, wheels	400	350	300	250
Sensors	800	700	600	500
Tools/Storage/Field Riser	2500	2200	1800	1500
Total	4050	3550	2950	2450

Student Team
Proposal F-234

(murmur), DesignTO 2022

School of Architecture / F_RMlabs
Adrian Chiu, Co-director of F_RMlabs
a23chiu@uwaterloo.ca

Description of Proposal

(murmur) is an interactive window installation that is in a continuous motion of slowly drifting up and fluttering back down. A series of floral fabric entities attached to a stiff wire body are mounted on and suspended from the ceiling. They are dropped down and pulled up by motors connected to arduinos which will require a power source. When the store is open, it uses sensors to detect nearby people, resulting in an increase of energy in movement, lighting color, brightness and frequency as the sensor detects more people. Amongst the floral entities there will hang a series of string lights that will be programmed to change colour with the floral entities.

{murmur} is an interacitve window installation that will be part of the DesignTO festival in Toronto, showcasing the design community and skills that UWSA has.

Proposal Benefits

Benefits of funding this project is the experience and knowledge gained by students involved. The project provides a valuable opportunity for students to realize a design in the real world - from concept to construction in the span of a single term. As school has moved online, F_RMlabs provides a space for students to socialize about design regardless of year and collaborate on a project that they are passionate about while gaining experiential learning that goes beyond the school's curriculum. Through this collaboration, students are able to learn from each other on their own initiative on a variety of skills relating to technology, architecture and many administrative soft skills that are transferrable. The process of producing a built installation involves valuable skills that are essential to professional practice, but are difficult to incorporate into the curriculum such as securing funding and project management. It also provides an opportunity for students to explore interaction design, responsive design methods, and soft-architecture systems in the context of a built-work. Students are also given a unique interdisciplinary opportunity to work with digital interfacing and programming action-script for the micro-controllers, as well as projection mapping techniques and software; equipment that they otherwise would have difficulty incorporating into their own coursework.

Estimated Equipment Lifetime

Initial use of 7 days for the festival, but an afterlife of being retained by the group to be used in future projects.

Implementation Schedule

Student Team
Proposal F-234

Prototyping: Until Mid december

Fabrication: Until January 15th

Installation: Until January 20th

Festival Dates: January 21th - 30th

Takedown: January 31st

Additional Information

Cost Breakdown

Item	**Option 1**	**Option 2**	**Option 3**	**Option 4**
12x Bipolar Stepper Motor	176.28	243.94	257.64	157.16
12x Motor Control Board	52.77	61.56	103.46	149.02
12x Ultrasonic Sensor	67.12	47.42	68.61	67.66
Total	296.17	352.92	429.71	373.84