

The following Motions and Documents were considered by the GFC Academic Planning Committee at its Wednesday, September 06, 2023 meeting:

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Agenda Title: **Forward with Purpose: A Strategic Plan for Research and Innovation**

CARRIED MOTION:

That General Faculties Council Academic Planning Committee recommend "Forward with Purpose: A Strategic Plan for Research and Innovation" to the General Faculties Council for approval.

FINAL Item 5.

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Agenda Title: **Bachelor of Science in Mechatronics and Robotics Engineering Cooperative Program**

CARRIED MOTION:

THAT the GFC Academic Planning Committee recommend that the Board of Governors approve the proposed Bachelor of Science in Mechatronics and Robotics Engineering Cooperative Program for implementation upon final approval.

FINAL Item 6.

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**FINAL ITEM NO. 4****Decision X Discussion Information**

**ITEM OBJECTIVE:** This item is before the General Faculties Council (GFC) Academic Planning Committee (APC) to recommend “Forward with Purpose: A Strategic Plan for Research and Innovation” to the General Faculties Council for approval.

<b>DATE</b>	6 September 2023
<b>TO</b>	GFC Academic Planning Committee
<b>RESPONSIBLE PORTFOLIO</b>	Vice-President (Research and Innovation)

**MOTION:**

That General Faculties Council Academic Planning Committee recommend “Forward with Purpose: A Strategic Plan for Research and Innovation” to the General Faculties Council for approval.

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**EXECUTIVE SUMMARY:**Background

The development of an institutional strategic plan for research and innovation has been completed. Its working title has been Strategic Plan for Research and Innovation (SPRI), and its final title is “Forward with Purpose: A Strategic Plan for Research and Innovation”. Over the same period of time, colleagues in the President’s Office and the Provost and Vice-President (Academic)’s Office led the consultations that informed the University Strategic Plan (USP), and the two initiatives kept in close touch with each other as they evolved.

A Working Group focused on the research and innovation plan was convened in July 2021 by Vice-President (Research and Innovation) Aminah Robinson Fayek, comprised of two individuals from each of the three Colleges, representatives from the President’s Office and External Relations, and all the Associate Vice-Presidents in the VPRI portfolio. The Working Group met regularly and produced an initial draft document for discussion by the group. The VPRI Office reviewed and addressed the feedback received from a small number of focus groups in late 2022 who commented on the initial draft Strategic Plan for Research and Innovation. The Working Group then prepared a revised draft of the plan based on this preliminary feedback, which underwent widespread consultation in April and May 2023.

Analysis / Discussion

While the Vice-President (Research and Innovation) portfolio has developed strategic plans in the past for its internal use, no comprehensive institutional strategic plan for research and innovation has been produced at the U of A. Guided by the University’s [Equity, Diversity and Inclusion](#) Strategic Plan and the Indigenous Strategic Plan [Braiding Past, Present and Future](#), as well as the development of the University Strategic Plan, there was an excellent opportunity to

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**FINAL ITEM NO. 4**

highlight the central importance of research and innovation in the University's mission and mandate through the creation of a strategic plan for these areas.

The plan identifies research and innovation priorities for the University and highlights its proposed strategic vision and goals to:

- Focus on people and build talent;
- Support researchers with tools and infrastructure;
- Strengthen our research and innovation culture and broaden our impact; and
- Enhance our reputation as a global research and innovation leader.

These goals and priorities were identified and developed through consultation with the University community and refined by the multi-disciplinary Working Group. The plan recognizes the need to focus on targeted areas of research and innovation that will highlight existing strengths and expand capacity over the next five years, help implement the *One University* vision and enable support of the growth of the people and the diverse communities with whom the University engages.

The draft institutional Strategic Plan for Research and Innovation was posted on the VPRI website and it underwent consultation during April and May 2023, with 18 sessions being held that were hosted by the Office of the Vice-President (Research and Innovation) with the assistance of professional facilitators. As part of the consultation process, two meetings with external groups were held – one with Federal and Municipal government representatives, and the other with Industry and Community Partners and Supporters, including Alumni and Senate members. A total of 269 participants engaged in the formal consultation meetings; others provided input through informal meetings, and comments were also received via an online form. APC discussed the draft Strategic Plan for Research and Innovation at its meeting on 17 May. The collective frank and valuable feedback on the draft plan that emerged from these productive conversations and submissions was synthesized in the final version of the plan. Its accompanying document, [What We Heard](#), summarizes the feedback received in the various consultation sessions and how such feedback was incorporated in the final plan.

During the development of the research and innovation plan, the VPRI Office worked closely with colleagues leading the development of the University Strategic Plan (USP), and “Forward with Purpose: A Strategic Plan for Research and Innovation” will support the main objectives of the USP related to research and innovation.

#### Next Steps

“Forward with Purpose: A Strategic Plan for Research and Innovation” is on the APC agenda for a decision, and the VPRI is requesting that it be transmitted to GFC for its consideration on 18 September. If GFC recommends its approval to the Board, the plan will be on the BLRSEC agenda on 29 September and the Board of Governors agenda on 13 October.

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Once “Forward with Purpose: A Strategic Plan for Research and Innovation” has been approved, its implementation will be guided by a comprehensive plan being developed in conjunction with the VPRI Senior Communications Partner. As it is an institutional plan, the VPRI Office will be working closely with the Colleges and Faculties to ensure alignment of planning for research and innovation in all areas of the University. Working collectively, the University community will harness its resources to achieve the goals and objectives outlined in “Forward with Purpose: A Strategic Plan for Research and Innovation”, thereby supporting the overall institutional vision outlined in the University Strategic Plan.

**Supporting Materials:**

1. [Forward with Purpose: A Strategic Plan for Research and Innovation](#)
2. [What We Heard](#)

**SCHEDULE A:**

**Engagement and Routing**

Consultation and Stakeholder Participation / Approval Route (parties who have seen the proposal and in what capacity) <[Governance Resources Section Student Participation Protocol](#)>

*Those who are actively **participating**:*

- Members of the University of Alberta community
- GFC Academic Planning Committee
- General Faculties Council
- Government Partners
- External Industry and Community Groups

*Those who were invited to participate in **consultation**:*

- University Research and Innovation Advisory Committee (URIAC, formerly URPC)
- Campus Saint-Jean
- Augustana Faculty
- Faculty of Native Studies
- Undergraduate and Graduate Students
- Postdoctoral Fellows
- College of Natural and Applied Sciences
- College of Social Sciences and Humanities
- College of Health Sciences
- Deans, Vice Provosts and Associate Vice-Presidents
- Indigenous Scholars
- U of A Centres and Institutes Directors
- Academic Planning Committee
- General Faculties Council
- Board Learning, Research and Student Experience Committee



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| <ul style="list-style-type: none"><li>• Board of Governors</li><li>• Government Partners</li><li>• External Industry and Community Partners</li></ul> |
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<p><i>Those who have been <b>informed</b>:</i></p>
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- |   |
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| <ul style="list-style-type: none"><li>• The Quad article on 8 April 2023 invited everyone in the University community to offer input into the consultation process through both in person and online means.</li></ul> |
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<p><b><u>Approval Route:</u></b></p>
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<p>The final version of “Forward with Purpose: A Strategic Plan for Research and Innovation” will be presented to the Board for its approval on 13 October 2023</p>
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**Supplementary Notes / Context:**

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## **Forward with Purpose: A Strategic Plan for Research and Innovation**

**2023-2028**

The University of Alberta respectfully acknowledges that we are located on Treaty 6 territory, a traditional gathering place for diverse Indigenous peoples including the Cree, Blackfoot, Métis, Nakota Sioux, Iroquois, Dene, Ojibway/Saulteaux/Anishinaabe, Inuit and many others whose histories, languages and cultures continue to influence our vibrant community.

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The University of Alberta also acknowledges our enduring roots in the City of Edmonton, traditionally known as amiskwaciywâskahikan, which means Beaver Hills House in Cree. We view our location as an integral aspect of our identity, intertwined with our history, present engagements and future aspirations. Embracing our relationship with this vibrant community, the university strives to work together for the enhancement and betterment of the Edmonton region and beyond.

# A Message from the Vice President of Research and Innovation

I am extremely pleased to present the University of Alberta's *Strategic Plan for Research and Innovation (SPRI)* – a five-year roadmap toward a future in which our University's leadership and contributions have an even greater impact on the world.

This institutional *SPRI* is the first of its kind at the University of Alberta and reflects the future of our research and innovation enterprise, presenting a bold new step in defining areas for maximum impact to address the grand challenges of our time. It sets out strategies for creating a renewed focus on knowledge mobilization and translation, innovation, commercialization, and for increased mobilization of creative and artistic work.

In an increasingly competitive landscape, this plan establishes clear directions for transforming key strengths into sustainable funding opportunities led by University of Alberta researchers. The *SPRI* will advance our public, private and community partnerships, empowering us all to move forward together. By focusing on tackling grand challenges through our areas of global excellence—broad, long-term and deep institutional strengths—and areas of leadership primed for further growth, we are fostering a research and innovation ecosystem that supports our researchers and positions the University of Alberta as a top global research institution.

At the same time, the *SPRI* demonstrates a deep commitment to fundamental, curiosity-driven research. Our institution has significant and extensive research capacity to bring to bear on grand challenges that are vital to the well-being of our societies, economy and environment. Addressing these challenges locally, provincially, nationally and globally requires strong multidisciplinary and intersectoral connections among academia, industry, the public sector and community members. The *SPRI* is intended for the diverse internal and external communities that make up our research and innovation ecosystem, groups to whom we offer our commitment to being a partner of choice.

The development of *the SPRI* has been a collective effort of co-creation. We consulted with our expert teams of researchers, innovators, staff and students as well as government, industry and community members, taking into account their strategic priorities. The *SPRI* serves as a testament to the collective effort and collaborative dialogue that underpins the University of Alberta's commitment to research and innovation.

I would like to express my great appreciation to my colleagues on the *Strategic Plan for Research and Innovation* Working Group. Their commitment of time, wisdom and vision over the past two years has been inspiring. I also extend my sincere gratitude to the members of the University community and to our external partners who provided their



insights and candid feedback, all of which resulted in the creation of our first pan-institutional research and innovation strategic plan.

The Office of the Vice President (Research and Innovation) advances the University's large and complex research and innovation enterprise through support, outreach, advocacy and community engagement. The *SPRI* charts a pathway for the next five years across University endeavours. This Plan aligns with other institutional strategic plans, including *Shape: A Strategic Plan of Impact*, [\*Braiding Past, Present and Future\*](#), and our [\*Strategic Plan for Equity, Diversity and Inclusion\*](#). The *SPRI* is a living document, providing our community with the freedom and flexibility necessary to pursue their specific research aspirations in the context of the University's strategic vision. Going forward, we will support our colleges, faculties, centres and institutes in the development of their own strategic plans, building on the vision of the University of Tomorrow and our One University approach.

This *SPRI* is important now. The world continues to recover and learn from the COVID-19 pandemic while facing enduring global inequities and environmental crises. Meanwhile, challenges remain for researchers, administrators, students and staff in meeting these issues. These challenges create opportunities to ask new and significant questions—and to change our ways of thinking. The goals, objectives and actions outlined in the *SPRI* will help us empower our researchers and innovators with the tools they need to address grand challenges for maximum impact. Our indicators, which enable us to measure our success over the next five years, are both aspirational and achievable.

There is no denying the magnitude of work ahead, nor the variety of perspectives on how to achieve our goals. Our *SPRI*—both ambitious and focused—challenges us to recognize our strength and potential as an institution and the capacity of our people. It encourages us to ask what we can do at the University of Alberta that cannot be done elsewhere and how we can best serve our communities and partners. Prioritizing and investing in people is the driving force behind this Plan—because our true strength is people: our researchers, administrators, students, staff and partners.

We are here to work with all of you to make what you see on these pages a reality. Our door is open. Our eyes are on the future. We are ready to move Forward with Purpose.

- Aminah Robinson Fayek  
*Vice President (Research and Innovation)*

*Strategic Plan for Research and Innovation Working Group*

- Aminah Robinson Fayek, Vice-President (Research and Innovation) – Chair
- André McDonald, Associate Vice-President (Strategic Research Initiatives and Performance), Office of the Vice-President (Research and Innovation)
- Jason Acker, Associate Vice-President (Research Integrity Support), Office of the Vice-President (Research and Innovation)
- Laura Beard, Former Associate Vice-President (Research Development and Services), Office of the Vice-President (Research and Innovation)
- David Bressler, Associate Dean (Research), College of Natural and Applied Sciences
- Marie Carriere, Former Associate Dean (Research), Faculty of Arts
- Kerry Courneya, Professor, Faculty of Kinesiology, Sport, and Recreation
- Walter Dixon, Special Advisor to the Vice-President (Research and Innovation), Office of the Vice-President (Research and Innovation)
- Florence Glanfield, Vice-Provost (Indigenous Programming & Research)
- Joanna Harrington, Associate Dean (Research), College of Social Sciences and Humanities
- Deborah James, Former Associate Vice-President (Innovation & Commercialization), Office of the Vice-President (Research and Innovation)
- Michael Lounsbury, Professor, Alberta School of Business
- Elan MacDonald, Vice-President (External Relations)
- Matt McCreary, Former Senior Communications & Marketing Partner, Offices of the Provost and VP (Academic) and Vice-President (Research and Innovation)
- Katharine Moore, Chief of Staff, Office of the Vice-President (Research and Innovation)
- Sandra Rein, Associate Dean (Research), Augustana Campus
- Lawrence Richer, Associate Dean (Research), College of Health Sciences and Vice Dean (Clinical Research), Faculty of Medicine & Dentistry
- Carrie Smith, Vice-Provost (Equity, Diversity and Inclusion)
- Kelly Spencer, Associate Vice-President (Development and Alumni Relations), External Relations
- Catherine Swindlehurst, Former Chief Strategy Officer, Office of the President
- Ying Tsui, Professor, Faculty of Engineering

## **Building on a Legacy of Transformational Impact**

Research, innovation and creative activities are a cornerstone of the University of Alberta's mission and identity. The dedicated researchers, scholars and innovators at our institution consistently produce and transfer knowledge that has enhanced our society, the economy and the environment.

Through the work of these individuals, teams and partners, the University of Alberta drives positive change in the face of grand societal challenges: environment and climate change, affordable and clean energy, pandemic preparedness, ethical use of digital technologies and artificial intelligence, decolonization and reduced social inequities.

### **Our Research and Innovation Ambition**

The University of Alberta strives to be a leader in knowledge generation and translation, inspiring solutions to grand challenges of local, provincial, national and global importance through creativity, research, innovation and higher education.

Our university is the site of the first successful open-heart surgery, home to Canada's first organ transplant research group, and was the first to develop ways to separate oil from sand. Our creative climate and commitment to using research outcomes to address challenges have made our university a hub for discourse on Indigeneity, climate action and high-impact research for social betterment.

The University of Alberta has always been a research leader in solving global challenges, and we will continue to strive for impact at the local, regional, national and global levels. The plan therefore identifies areas of focus where we have global excellence and where we are primed for growth in the context of addressing grand challenges for maximum impact.

To build upon our leadership in our areas of strength and in emerging directions, we must be forward-looking, deliberate and focused in how we plan, organize and support our research and innovation climate. The *Strategic Plan for Research and Innovation* is our blueprint for research with a purpose.

Guided by the direction set through *Shape: A Strategic Plan of Impact*, the *Strategic Plan for Research and Innovation* outlines how we will leverage our existing strengths and assets – and identifies clear choices to reinforce our ecosystem – to capitalize on major opportunities and ensure our talented researchers are empowered with the right tools, processes and culture to achieve and thrive.

This *Strategic Plan for Research and Innovation* has been led by the Office of the Vice-President (Research and Innovation) which supports researchers at all stages and facilitates external engagement and advocacy with government and partners in industry and local, national, and global communities. Our goal is to support diverse researchers, scholars and innovators across the full research continuum, from curiosity-driven scholarship to research in applied areas. Additionally, we recognize the importance of multidisciplinary large-scale and cross-sectoral initiatives for addressing and developing solutions to grand challenges.

## **Forward with Purpose: Connections to *Shape*, the University Strategic Plan**

In *Shape*, the University of Alberta's 10-year plan of impact, the institution outlines the following seven research and innovation goals for transformational impact. These goals inform the *Strategic Plan for Research and Innovation* and will shape research at the University of Alberta for the next 10 years.

1. Increased number of large-scale, multidisciplinary research initiatives that stimulate community-engaged research and impact.
2. Development of innovations that tangibly address major social, economic and environmental challenges facing Alberta, Canada and the world.
3. More robust and comprehensive research capacity through the durable embedding of Indigenous community engagement and Indigenous ways of knowing into research practices.
4. Spinoff and other commercialization activities that bring new products and services to the world.
5. Increased representation and research success among researchers from historically underrepresented and equity-denied groups.
6. Markedly higher research, innovation and creative collaboration across disciplines, through realized potential of the college structure.
7. Improvement in the quality of life for millions of people in communities across Alberta, Canada and the world.

## Taking Stock of Our Opportunities

### What Makes Us Unique?

As the northernmost U15 university, we are a Prairie land-based research-intensive university with strong connections to Canada's North.

Our relationships with Indigenous, rural, Francophone, local and national communities, industry and the land have cultivated innovative solutions to grand societal challenges.

Built through collaboration and consultation, the *Strategic Plan for Research and Innovation* envisions the future of research and innovation at the University of Alberta while remaining sensitive to our current research ecosystem.

In assessing our position, some key strengths and observations emerge.

The University of Alberta is a dynamic environment for generating new ideas and fostering innovation for significant societal impacts. We have a rich diversity of people, creating opportunities for fruitful multidisciplinary and intersectoral exchanges and collaborations. Through co-learning and co-creation, our researchers, partners and communities come together to develop novel and innovative perspectives, approaches and methodologies. In particular, we have:

- **Deep relations with a rich tradition and connections to land.** With campuses in both Edmonton and Camrose, and as the geographically northernmost U15 institution, our university offers a unique perspective in connection with a complex, biodiverse land and interconnected peoples. Our location enables us to learn from the rich traditions of First Nations, Métis, Inuit and all First Peoples of this place now called Canada, and to integrate those traditions into how we conceive, design and conduct research, recognizing the importance of genuine community engagement and participation at all stages of the process.

#### **Internationalization at the Heart of Research and Innovation**

The University of Alberta has more than 700 agreements with governments, universities and other organizations in over 80 countries.

- **Steadfast commitment to equity, diversity, inclusion and decolonization.** Our university demonstrates strength in research that addresses systemic inequities and injustices for equity-denied groups through numerous researchers who bring a diversity of perspectives and knowledge. We are willing to have courageous conversations in support of our national commitments to reconciliation, the Scarborough Charter and the Dimensions Charter. Our university commits to

centering the principles of equity, diversity, inclusion and decolonization to embrace diverse ways of knowing, learning and doing.

- **Significant local, regional, national and international connections.** Over many decades, our university has expanded touchpoints with post-secondary institutions, research institutes, industry and social innovation groups in our local communities and across the globe. We have a worldwide network of alumni, and each year, we attract thousands more research students and trainees to the University of Alberta.
- Demonstrated **uniqueness and strength in key areas.** Our university boasts national and global leadership and emerging strengths in several research areas – such as conventional oil and gas technologies, the transition to net-zero energy solutions, the health and well-being of women and children, Indigenous research, artificial intelligence, sustainable agriculture, virology and disease prevention, and transformative approaches to advancing social betterment.

#### **Our Research and Innovation Strengths**

The University of Alberta is known for energy innovations, discoveries in artificial intelligence, life-saving vaccines and cell-based therapies, community-engaged Indigenous pedagogical research, agricultural breakthroughs and research addressing intersectional inequities and decolonization.

- **Balanced breadth and depth:** We have a diverse and multidisciplinary research ecosystem and recognize the sensitive interplay between supporting the extensive range of our research strengths and maintaining focused excellence. Our vision is to foster a research ecosystem that empowers all our researchers and enables us to excel in areas of maximum impact.
- **New structures foster greater collaboration.** The new college structure at our university offers great potential for identifying, nurturing and seizing opportunities

for enhanced multidisciplinary collaboration – across traditional knowledge and disciplinary boundaries – and for exploring innovative methodologies. The work of the Centres of Expertise in the Vice-President (Research and Innovation) portfolio is key in these efforts, through its provision of planning, pre-award, post-award, technology transfer and general research-related support services.

## **Mobilizing for Maximum Impact**

### **Maximizing Impact through the Sustainable Development Goals**

The University of Alberta is maximizing impact on the world around us through excellence in working towards the United Nations' Sustainable Development Goals (SDG). We are ranked 1st in Canada for the SDGs of Affordable and Clean Energy and Industry, Innovation and Infrastructure. For our work to end hunger and achieve food security, we are ranked 2nd in the world for the Zero Hunger goal.

The *Strategic Plan for Research and Innovation* brings greater focus and alignment to our research, innovation and creative activities. It is intended to outline the strategic vision for research and innovation at the University of Alberta over the next five years, with the goal of working together with the university community, government and industry and external partners to maximize our impact on the world around us.

We define impact broadly and inclusively to recognize the validity of different dimensions and interpretations of impact across disciplines, research programs and all related scholarly activities. These include short- and long-term economic, environmental and social impacts and engagements.

We maximize our impact through deliberate investments and efforts – across all disciplines and domains – to enhance key drivers of an exceptional research and innovation ecosystem.



The result will be a prevailing climate of support for researchers and research: one that fosters multidisciplinary engagement; provides safety in the pursuit of various lines of inquiry; integrates principles of equity, diversity, inclusion, decolonization and reconciliation; and centres collaboration in the generation and mobilization of knowledge.

Our vision includes a strong focus on social impact and advocates for greater representation of the social sciences, humanities and performing and fine arts, and harnesses these to address the grand challenges of our time.

Over time, the University of Alberta will solidify its international reputation of leading with purpose to address the major questions and challenges in our global environment.

## Guiding Principles

The University of Alberta's guiding principles underpin everything we do, including the work laid out in this *Strategic Plan for Research and Innovation*.

- The University of Alberta is committed to **academic freedom**, where individual researchers determine their own research area, focus and pursuits, which in turn are supported at the faculty, college and institutional level.
- **Research and creative activity** are the core focus and foundation of our university. They are the drivers of new knowledge and understanding that fuel applications, innovation, knowledge mobilization, technology transfer and broad societal impacts.
- Our research excellence is underpinned by the principle of **equity** and the practices of **inclusion** and **decolonization**. By remaining accountable to these principles and practices, we strive to build a culture where **diversity** flourishes and where we work in partnership to dismantle systemic barriers with ethical integrity and social responsibility.

- We support **Indigenous-led initiatives, knowledges, communities and research engagement**, and take steps to deliver on the Truth and Reconciliation Commission of Canada's Calls to Action, particularly, though not exclusively, in relation to Education for Reconciliation. We adhere to the guiding values and principles outlined in [\*Braiding Past, Present and Future: University of Alberta Indigenous Strategic Plan\*](#). We are committed to the inclusion of Indigenous knowledges, voices and critiques, as well as physical and intellectual spaces that facilitate a plurality of Indigenous knowledges and practices.
- We are committed to **safe and responsible research, creative work, knowledge mobilization, social and technological innovation, and commercialization** activities, regardless of disciplines and our partners' geographic locations.
- We value **sustainability** and recognize the importance of data accessibility, reusability and sovereignty as well as the prudent stewardship of resources and infrastructure.
- We foster **collaboration**, within and beyond the university and across traditional boundaries. We are committed to working with government, industry and communities to co-create and co-define research areas to meet our aspirational goals as an institution.

# Strategic Research and Innovation Goals

The *Strategic Plan for Research and Innovation* identifies four goals, each underpinned by tangible objectives, actions and indicators. Together, they articulate how we will further focus, align and enhance our research and innovation ecosystem to maximize our university's impact on the world.

## Goals of the *Strategic Plan for Research and Innovation*

1. Focus on people and nurturing talented researchers.
2. Support researchers with tools and infrastructure.
3. Strengthen our research culture and broaden our impacts.
4. Enhance the University of Alberta's global research and innovation leadership.

## 1. Focus on People and Nurturing Talented Researchers

The pursuit of high-calibre research depends on our university welcoming, including and retaining high-calibre faculty members, undergraduate and graduate students, research associates, postdoctoral researchers, other research trainees and research support staff. Moreover, by integrating research into our teaching and training, we will also develop the leaders and innovators of tomorrow. Together, we will cultivate a research and innovation ecosystem that is more equitable and better positioned to explore issues from a broad range of lenses.

### Objective 1.1

Support, retain and attract exceptional researchers to build on the research strengths of the university and contribute to a research ecosystem that leads with purpose.

Actions:

1. Strategically orient the Canada Research Chair (CRC), Canada Excellence Research Chair (CERC) and other chair programs to retain and attract world-class emerging and established researchers in targeted areas of strength.
2. Encourage and enhance the inclusion of undergraduate and graduate students, postdoctoral researchers and other trainees into the research ecosystem and learning environments and within local, national and international communities to develop exceptional researchers of tomorrow.
3. Promote the research strengths of the institution to targeted external researcher demographic groups, including equity-denied groups, to attract early career researchers.
4. Encourage, create and sustain clusters of researchers in high-impact, funded research initiatives through collaboration among colleges, faculties and centres and institutes.

### **Objective 1.2**

Enhance our research ecosystem to support researchers from equity-denied groups including women, visible minorities, researchers from Indigenous, Black, 2SLGBTQ+, francophone and diasporic communities, and persons with disabilities or who identify as disabled.

#### **Actions:**

1. Expand collaboration among the Office of the Vice-President (Research and Innovation), the Office of the Provost and Vice-President (Academic), colleges and faculties to enhance funding opportunities for trainees and early-career researchers from equity-denied groups to increase researcher and faculty diversity.

2. Create new, and engage existing, programs to expand research and training opportunities and communities for equity-denied groups.
3. Create strategic workshops and training resources for targeted groups of researchers, including those from equity-denied groups and early-career researchers, to develop and strengthen research leadership and project management skills.
4. Through collaborations among the faculties, colleges and centres and institutes, increase the number of university researchers from equity-denied groups who lead or co-lead large-scale, collaborative, funded, interdisciplinary research initiatives.
5. Align strategic allocations of Canada Research Chair, Canada Excellence Research Chair and other chair and research professorship positions to increase the number of recipient researchers from equity-denied groups.

### **Objective 1.3**

Engage and support diverse researchers and research teams from broad research areas and demographic groups to apply for internal and external research awards and expand their national and international research profiles.

#### **Actions**

1. Strategically design internal research award processes and policies, incorporating, where applicable, Indigenous worldviews and furthering the principles of equity, diversity and inclusion (EDI).
2. Recognize, support and celebrate research that is community-engaged, community-led, intersectional, francophone and partnered with Indigenous communities.
3. Establish targeted internal awards to recognize and celebrate Indigenous scholars, scholars from equity-denied groups, research scholarship in the areas

of Indigenous-engaged research and research that addresses and/or achieves greater levels of EDI.

4. Strengthen capacity related to national and international research awards, ensuring that engagement and nomination processes are attentive to principles of Indigenous-led and Indigenous-engaged research and EDI.

### **Objective 1.4**

Establish an integrated network of research support for Indigenous initiatives and equity, diversity and inclusion (EDI) in research and creative activities and in multidisciplinary research initiatives.

#### **Actions:**

1. Create an EDI research centre of expertise in the Office of the Vice-President (Research and Innovation).
2. Create an Indigenous research and innovation centre of expertise in the Office of the Vice-President (Research and Innovation).
3. In collaboration with the Offices of the Vice-Provost (Indigenous Programming & Research) and the Vice-Provost (Equity, Diversity and Inclusion), develop and provide training and web-based tools on Indigenous initiatives and EDI to researchers as an integral element of research grant and ethics applications, including multidisciplinary research initiatives.
4. Formally engage researchers in integrating Indigenous-engaged scholarship, research and relationships in relevant research grant and award applications.

**Key Indicators:**

1. Increase the Canada Research Chair allocations to the institution by 15% by 2028.
2. Increase per capita funding held by researchers from equity-denied groups by 25% by 2028.
3. Increase external funding that targets the recruitment of research trainees and faculty from equity-denied groups by 30% by 2028.
4. Increase the number of university researchers from equity-denied groups who lead or co-lead large-scale, collaborative, funded research initiatives by 25% by 2028.
5. Increase the application rate for external awards by 30% by 2028.
6. Increase the number of successful national and international research awards by 25% by 2028.
7. Increase Indigenous-led grant applications by 10% by 2028.

**2. Support Researchers with Tools and Infrastructure**

To sustain creativity and fuel learning, knowledge creation and innovation, talented researchers require high-calibre research supports, tools and spaces, including technicians and research support staff. Our university will continue to provide a suite of research support services that effectively meet the day-to-day and strategic needs of researchers and innovators. We will also strategically build on our robust research infrastructure to ensure researchers across all disciplines and faculties benefit from high-quality spaces and tools, including creative and artistic workspaces, data systems, lab equipment, computing power and other necessary technological infrastructure.

**Objective 2.1**

Develop streamlined and coordinated institutional processes for integrating and supporting the operation and expansion of shared institutional infrastructure for research and creative activities.

**Actions:**

1. Expand and diversify funding to support infrastructure expansion and renewal, moving to establishing institutional core and shared research and creative activity infrastructure.
2. Develop institutionally harmonized operation of stand-alone infrastructure, research platforms and core facilities—such as the small-animal services facilities and shared computational facilities—for research and innovation across the multiple campuses of the institution.
3. Implement effective models for financial sustainability and regulatory processes for animal welfare, research ethics and clinical trials to ensure proper operations and compliance.
4. Review and audit infrastructure and equipment access and use through an EDI lens.
5. Support researchers in grant development with funding for activities such as management of proposal development processes, grant writing and editing.

**Objective 2.2**

Strengthen guidelines and develop knowledge bases for research-related administrative, financial and infrastructure operations and protocols, as well as occupational health and safety compliance activities.

**Actions:**



1. Develop communication and training assets for researchers and trainees at all stages, focusing, especially on early-career researchers.
2. Improve, coordinate and expand institutional researcher onboarding and support processes for administrative, operational, facilities, safety and financial matters.
3. Develop a searchable database with research proposal development resources, grant examples and templates for researchers, trainees and innovators.

### **Objective 2.3**

Develop and expand robust and secure safeguarding of research systems, including data storage, data exchange and data management systems.

#### Actions:

1. Strategically streamline and implement institutional processes and systems for safeguarding research, technology transfer protocols, intellectual property protections, and research data management processes.
2. Strategically support the development of research data management grounded in principles of findability, accessibility, interoperability and reusability (FAIR) and First Nation principles of Ownership, Control, Access and Possession (OCAP).
3. Develop resources and processes for evaluating the risks and mitigating any impacts of unauthorized disclosure of research information and data.

### **Objective 2.4**

Enhance development and expand access to high-performance computing and research information management system infrastructure locally, regionally and nationally.

**Actions:**

1. Align existing and emerging research areas for maximum impact with access to high-performance computing resources.
2. Lead development of information technology and library support platforms for research information management.
3. Leverage existing national research data repository platforms to expand access and sharing of research data.

**Key Indicators**

1. In order to expand core facilities and infrastructure, increase annual sponsored research revenue for infrastructure from the Canada Foundation for Innovation by 50% and from other sources by 50% by 2028.
2. Identify and implement core support platforms for high-performance computing by 2025.
3. Building on the Institutional Research Data Management Plan, increase institutional capacity to support data-intensive research activities across the university by 2026.
4. Increase open access, open data publications and works by 50% by 2028.

### **3. Strengthen Our Research Culture and Broaden Our Impacts**

Fueled by our high-calibre people and enhanced tools and infrastructure, we will continue to cultivate a research and innovation culture across the university that embraces a multitude of ways of thinking, knowing, doing and relating. We will also work to showcase and celebrate the impacts of our research, innovations, discoveries,

creative and artistic activities, community engagements, partnerships and relationships – and the people behind them. These impacts will expand academic thought, influence research paradigms and contribute to better practices, public policies and enhanced public life.

### **Objective 3.1**

Build a centralized research-driven and innovation ecosystem that brings together scholarly networks, multidisciplinary research work, entrepreneurial endeavours, creative works, knowledge mobilization and community-led research activities from across the university.

#### **Actions:**

1. Publicize and promote research outcomes and successes both internally and externally to enhance our innovation ecosystem.
2. Formulate and support institutionally-led formal training programs and activities for researchers and community partners in innovation and entrepreneurial initiatives, knowledge mobilization and community-engaged research activities.
3. Coordinate and strategically communicate the institution's innovation supports and services through centralized communication tools.
4. Engage and connect diverse funding sources to support innovation including social innovation, commercialization, mentorship, upskilling, experiential learning and training through interdisciplinary entrepreneurial and socially innovative research.
5. Develop innovation, commercialization and social impact annual reports to share with internal and external partners.
6. Create an online searchable database platform of all knowledge mobilization, commercialization and social innovation initiatives across the university.

7. Designate Research Impact Canada champions to support the social and cultural impact of research output.
8. Develop an intellectual property approach that better supports early-stage ventures and entrepreneurs and highlights ways to ensure that non-patentable inventions are adopted by local, national and international communities.

### **Objective 3.2**

Establish an institutional Innovation Fund to provide risk capital to support high-growth innovation, knowledge creation and entrepreneurial initiatives developed and led by institutional researchers.

#### **Actions:**

1. Strategically invest risk capital from the Innovation Fund in business startups by leveraging innovation, knowledge creation, artistic and entrepreneurial activities developed by researchers.
2. Create pathways for the development and support of proposals to the Innovation Fund, and establish an independent investment committee to manage the fund.
3. Use the Innovation Fund to support the mobilization of research, innovation and creative and artistic activities and initiatives for commercialization or community implementation programs.
4. Use the Innovation Fund to develop companies for scale and reinvest financial gains in the institution, highlight best practices and contribute to further research and innovation.

### **Objective 3.3**

Translate and mobilize knowledge, innovation, entrepreneurial research, research creation and creative works to enable, foster and support the formation of public, private and community partnerships.

#### **Actions:**

1. Build and support partnerships with municipal, provincial and national governments, Indigenous nations, not-for-profit organizations and the private sector to collaboratively develop and implement innovative, creative, artistic, entrepreneurial and commercial solutions to shared challenges.
2. Where appropriate, translate research and creative works outcomes into policy or regulatory frameworks to address government and societal priorities.
3. Integrate institutional commercialization assets into a cohesive network that will be a major player in the external innovation ecosystem of Alberta and Canada.
4. Refine and streamline all intellectual property and commercialization policies to stimulate and support institutional entrepreneurship activities.
5. Showcase our artwork, creative performances and collections locally, provincially, nationally and globally.
6. Develop relationships and collaborate with Indigenous, northern and equity-denied communities and civil society organizations to define and stimulate community-driven and community-led research and implementation programs.
7. Leverage the strength of centres and institutes to stimulate, nurture and enhance industry partnerships and community-led and engaged research.
8. Conduct ongoing environmental scans of municipal, provincial and national priorities and strategies to align strategic and emerging research directions.

### **Objective 3.4**

Recognize, celebrate, reward and communicate all forms of innovation, entrepreneurship and creative and artistic work and their impacts.

#### **Actions:**

1. Create events to celebrate innovation awards and showcase researchers.
2. Draw from existing initiatives, hubs and teams to create forums for researchers and university innovators to share innovation narratives.
3. Incentivize innovation, entrepreneurship, commercialization and creative activities through a framework of financial support and a reward system.
4. Develop release opportunities for researchers and innovators to facilitate and reward entrepreneurship, social innovation and commercialization activities.

#### **Key Indicators:**

1. Increase spinoffs, startups, licences and non-patentable inventions being adopted by external partners and communities by 35% by 2028.
2. Launch the Innovation Fund to directly invest in startups from early-stage concepts (pre-seed) to the first stage of company creation by 2024 and grow the Innovation Fund to \$50 million by 2028.
3. Increase sponsored research revenue from programs that support experiential learning and skills training through research by 50% by 2028.
4. By 2028, support at least two Indigenous-led initiatives that define and stimulate public, private and community-engaged research and impact.
5. Increase success rates by 15% for research in social innovation, entrepreneurial initiatives, research creation, fine arts and community-led initiatives by 2028.

## 4. Enhance the University of Alberta's Global Research and Innovation Leadership

Claiming our place among the world's top research universities will require us to be clear about and broadly showcase our areas of global excellence and growth in order to address grand challenges. We will do so by deliberately building high-priority, collaborative opportunities across our university in ways that actively leverage sole-investigator-driven research activities and encourage the formation of multidisciplinary, diverse research teams. As a leading research-intensive institution, we will continue to support fundamental research, foster emerging researchers to become experts in their fields and support established scholars to drive targeted research and innovation to generate international recognition with local and national impact. We will also strategically enhance our external engagement with funders, potential research and innovation partners and community groups, and strengthen our involvement in international research networks.

### Objective 4.1

Broaden, deepen and sustain existing areas of global excellence and growth for addressing grand challenges, while building areas of emerging strength.

Actions:

1. Prioritize multi-partner, multi-institutional and international collaborative research and funding initiatives that target areas of global excellence and growth to address grand challenges.
2. Align research chairs and allocations for infrastructure funding with areas of research strength, innovation and creative activity, while honouring our commitments to EDI and Indigeneity.
3. Leverage the colleges to conceptualize and lead large-scale, collaborative, multidisciplinary research initiatives.

4. Build high-priority collaborative opportunities across the academy, including sole-investigator-driven research activities, formation of multidisciplinary and diverse research teams, training and translation of skills to address major shared challenges with the public and private sectors and civil society.
5. Leverage the strength of centres and institutes across the university to create and nurture multidisciplinary research hubs or networks in areas of global excellence and growth in addressing grand challenges for maximum impact.
6. Leverage the strength of centres and institutes across the university to respond to targeted multidisciplinary research and training challenges, priorities and funding calls.
7. Strategically mobilize university resources to increase and leverage research funding from diverse government, industry, not-for-profit and community sources.

#### **Objective 4.2**

Strategically align areas of global excellence and growth for addressing grand challenges as well as emerging areas of strength with evolving institutional, government, community and societal priorities.

#### **Actions:**

1. Establish an institutional Strategic Research Initiatives Fund to support and leverage areas to address grand challenges for maximum impact, innovation and creative activity, and increase sponsored research funding.
2. Create strategic advisory groups of institutional, local, regional, national and international experts for each area of global excellence and growth to address grand challenges for maximum impact to provide current knowledge, critical thinking and analysis on research directions and priorities.



### **Objective 4.3**

Strengthen our participation in key municipal, provincial, national and international research networks.

#### **Actions:**

1. Secure membership and committee participation in recognized networks that align with institutional areas of global excellence and growth as well as emerging areas of research excellence.
2. Collaborate with all levels of government on mutual priorities and leverage funding support to build municipal, provincial, national and international partnerships.
3. Integrate international institutional partners in large-scale multidisciplinary research initiatives and funding opportunities.
4. Sustain participation in key international research networks to develop meaningful, mutually beneficial and sustainable research partnerships.
5. Engage in advocacy and outreach to build awareness of research, innovation and creative work, in collaboration with industry and community partners.

### **Objective 4.4**

Build or expand relationships with researchers from emerging market economies in the Global South through international research collaborations.

#### **Actions:**

1. Build bilateral relationships with institutions across the globe with a focus on countries in the Global South to enhance our global citizenship and strengthen our research through a diversity of perspectives.
2. Mobilize research activities and outcomes informed and led by researchers from countries in the Global South and emerging market economies to work in

partnership for mutual and reciprocal societal, cultural, economic and environmental benefits.

### **Objective 4.5**

Broaden the reputation of the University of Alberta locally, provincially, nationally and internationally through targeted communications and promotional activities.

#### **Actions:**

1. Targeting local communities, provincial, national and international markets, celebrate and highlight institutional strengths and accomplishments in key research areas through digital marketing and promotional assets.
2. Create a research impact framework that aligns with the San Francisco Declaration on Research Assessment (DORA) to measure and communicate the impacts of research, innovation and creative activity, including contributions to the broader civil society.
3. Expand institutionally coordinated visits to selected international priority partners and other emerging or potential partners annually to promote our research brand and build relationships.
4. Develop an annual report on research and innovation, including research outcomes, institutional rankings, funding data and success rates to share with internal and external partners.

### **Key Indicators**

1. In alignment with the University Strategic Plan, increase annual sponsored research revenue to \$650 million by 2028 and \$750 million by 2033.
2. In alignment with the University Strategic Plan, become one of the top three

- ranked U15 universities in annual sponsored research revenue by 2033.
3. In alignment with the University Strategic Plan, become one of the top 50 internationally ranked universities by 2033.
  4. Increase annual sponsored research revenue from the Tri-Agencies by 15% by 2028.
  5. Increase sponsored research revenue per faculty member by 20% by 2028.
  6. Increase the university's SDG ranking to 5th overall in the world by 2028 by addressing grand challenges for maximum impact.
  7. Create at least six new bilateral research partnerships with institutions in the Global South by 2028.
  8. Increase research grant applications involving government, industry and community partners by 30% by 2028.
  9. Establish partnerships with industry, not-for-profit organizations and communities in local and regional contexts that result in a 15% increase by 2028 in Tri-Agency partnership programs and other partnership program funding.
  10. Establish two college-led initiatives per college per year targeting interdisciplinary, high impact, collaborative funding.

# Addressing Grand Challenges for Maximum Impact

## Addressing Grand Challenges

Our university values and is committed to supporting high-calibre research and creative activities across all disciplines and in all areas of research. Highlighting research areas in which we have global excellence, as well as areas of leadership primed for further growth to address grand challenges, provides a way of focusing attention and investment in order to achieve maximum impact.

Investments and initiatives will be designed in ways that underpin the areas of excellence and growth to address grand challenges, while enhancing research and creative activities in new and emerging areas.

As a comprehensive, research-intensive university, we are proud of our commitment to high-impact research and creative activities across all disciplines. Our university has opportunities to harness this robust body of scholarship in ways that allow us to address grand societal challenges through research and innovation.

The goal of addressing these grand challenges will guide our investments and initiatives to significantly enhance capacity and multidisciplinary collaboration.

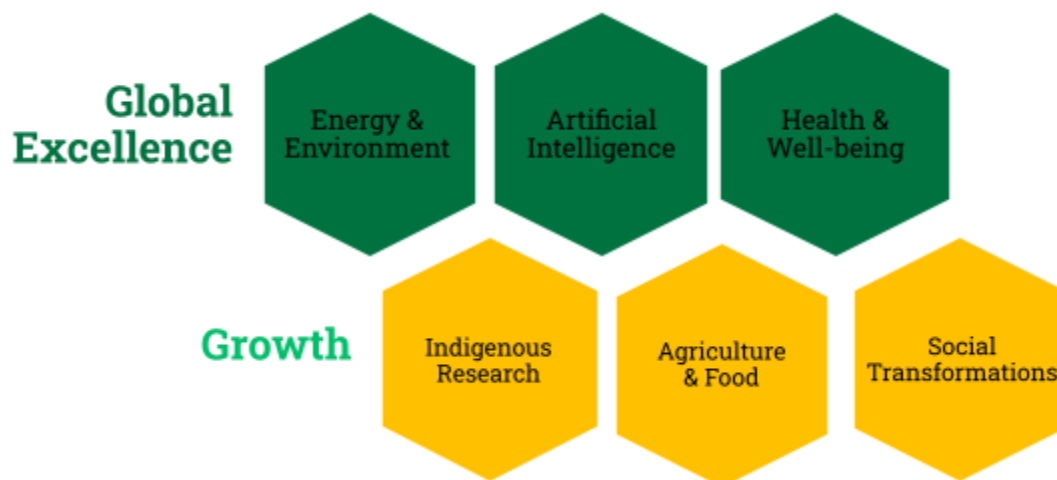
## Curiosity-Driven Research Today Produces Tomorrow's Areas of Global Excellence

We have been a national leader in fostering ideas that have long-term impact on Edmonton, Alberta, Canada and the world.

Supporting new and emerging research and scholarship activities in areas such as quantum science, security and defence, planetary health, space technologies, social implications of climate change, diasporic African and Black communities, design studies, performing arts and global mental health will set the stage for global excellence in the future.

These grand challenges will be addressed under two themes:

- **Global Excellence** in areas where our university has broad, long-term and deep institutional strength
- **Growth** in areas of leadership that will continue to further position the University of Alberta as a top global research institution.



In the context of global excellence and growth, our goal is to leverage our unique strengths by providing detailed insight into how we can make the greatest impact. We recognize the importance of the intersection between and the multidisciplinary nature of these areas for maximum impact. Our approach therefore is synergistic and collaborative, designed to bring together the depth and breadth of our researchers with industry, government and community partners to co-develop deeper understandings of, and innovative solutions to, grand challenges of our time.

# Global Excellence

## Energy and Environment

Energy systems, resilience and climate change mitigation

Our deep and renowned expertise in energy has taken on new significance in the face of the environmental crisis and the global climate emergency. It is a challenge that demands innovative solutions for stable, reliable energy in a net-zero emissions future.

Our researchers are at the leading edge of developing the technologies to produce, store, transport and deliver cleaner, reliable energy sources in ways that drive us to net-zero emissions and help meet global climate change commitments. Importantly, this research is occurring across the continuum of energy systems – from production through to transmission, storage and consumer use.

It also includes robust social science and humanities research to address policy, regulatory and ethical issues and explore the unique implications of energy transition alongside diverse peoples and communities, including Indigenous communities.

### Impact in Energy

- One of the top 10 universities globally for energy systems research
- Ranked as one of the top 50 academic institutions for energy and climate subjects
- More than 50 research chairs in energy and environment
- More than \$1B invested in over 170,000 m<sup>2</sup> of energy research infrastructure
- First to discover technology to unlock bitumen from oil sands
- Researchers inform policies, such as Alberta's Hydrogen Roadmap

Energy and Environment Research and Innovation Directions:

- Discover, develop and translate resilient renewable energy technologies and energy transition solutions, including hydrogen, wind, solar, geothermal and biomass fuel sources.
- Develop new methods and technologies to make more efficient use of conventional energy sources, reduce greenhouse gas and carbon emissions, and support carbon capture, utilization and storage.
- Address the impacts of energy systems on humans and the environment, including soil, water, air and biodiversity.
- Formulate and improve land reclamation and contaminant remediation measures to address environmental impacts.
- Address energy systems in northern climates with below-freezing temperatures many months of the year.
- Broaden our understanding of the social implications of energy use and the transition to a net-zero economy.

## **Artificial Intelligence**

Artificial intelligence, machine learning and data science

Over the past three decades, our institution has been at the foundation and forefront of global research in artificial intelligence (AI) and machine learning. Our university's innovations have already made key contributions to reinforcement learning, video game design, health informatics, precision health imaging and diagnostics, smart prosthetics and robotics, automated legal reasoning, language learning, financial forecasting, artistic practice, linguistic research, smart agriculture tools, optimization of oil and gas recovery and water treatment.

Importantly, these inquiries also extend to exploration and a deeper understanding of the social, cultural, economic, ethical, ontological and privacy implications of AI, machine learning and data science. We will continue to lead the discourse around how

these technologies will interact with diverse peoples, including the incorporation of Indigenous worldviews and epistemologies.

### **Excellence in Artificial Intelligence**

- First to launch a computer science department in Canada
- Ranked #2 in Canada for AI research (based on US News Global University AI rankings)
- Partners with one of Canada's three national AI hubs
- More than 35 Canada CIFAR AI Chairs and 15 other research chairs
- Nearly \$100M in funding for AI since 2017

Artificial Intelligence Research and Innovation Directions:

- Advance applications of artificial intelligence to autonomous systems, space technologies, smart buildings and cities, quantum technologies, smart agriculture and health.
- Integrate artificial intelligence, machine learning and data science for autonomy, adaptability and reliability of net-zero energy systems.
- Analyze the intersectional, social, cultural, ethical and educational impacts of artificial intelligence, and use AI in artistic practice to study the ways in which it shapes race and gender relations, equity and diversity.

### **Health and Well-Being**

Health, disease prevention and life-course approaches to care and well-being

Our university's health research and innovation has a planetary health focus that establishes intersections among the environment, energy, food security, agriculture and physical activity. We are a leader in integrating social determinants of health —such as income, education, social status, gender, race, ability and other intersectional identities as well as access to nutritious food, physical activity, housing and employment — into scholarly discourse and actionable interventions to address health inequities. Our work in life-course approaches to advance the physical and mental health and well-being of



children, women, as well as aging and elderly populations is locally, nationally and internationally recognized.

With this incredible and versatile strength, we are ready to respond to an array of public health issues and threats, including emerging pathogens. Our deep expertise in clinical trials and translational research will bolster our institution's impact in areas such as disease management and prevention, biomedicine and next-generation therapies.

#### **Accomplishments in Health**

- 2020 Nobel Prize Laureate in Medicine, Dr. Michael Houghton, for discovery of the Hepatitis C virus
- More than \$90M for the Li Ka Shing Institute of Virology and \$55M for pandemic preparedness
- Home to one of five national Canadian Biomedical Research Fund Hubs, The PRAIRIE Hub for Pandemic Preparedness
- More than \$100M in research funding for precision health, intelligent medical devices and therapeutics
- Leader of the \$80.5M Canadian Critical Drug Initiative to create 1,000 high-paying pharmaceutical jobs
- More than \$100M for the Women and Children's Health Research Institute.
- More than 75 research chairs in health and well-being

Health and Well-being Research and Innovation Directions:

- Expand and translate knowledge from a life-course perspective and an intersectional lens through multidisciplinary and community-engaged research to advance the health and well-being of all, including underserved populations, with a focus on women and children.
- Discover and develop new vaccines, cell-based therapies and small molecule therapeutics.
- Accelerate cutting-edge research in digital health and applications of artificial intelligence.

## Growth

### **Indigenous Research**

Indigenous research, community engagement and relationships

The University of Alberta views research, creative activities and innovation as opportunities to build meaningful relationships and engage with First Nations, Inuit and Métis Peoples. This vision is strengthened by *Braiding Past, Present and Future: University of Alberta Indigenous Strategic Plan*, an Indigenous-led and Indigenous-written five-year plan that outlines how Indigenous Peoples, languages, cultures and worldviews are reflected in everything the university does.

As we respond to reconciliation Calls to Action framed around supporting the research priorities of Indigenous Peoples and communities, our university has expanded Indigenous resiliency and resurgence research to resist narratives of Indigenous deficiency and disappearance. Our institution is recognized for long-term excellence in research and teaching, with programs that place Indigenous self-determination at the core of theory, research and technology development.

Through collaborative partnerships with local and regional Indigenous communities and multidisciplinary research programs, the University of Alberta will excel as an engaging, inclusive leader in decolonial and anti-colonial research, championing Indigenous leadership and self-determination in research and innovation. Building on these initiatives and accomplishments, our university is forging a path to strengthen international recognition of our excellence in Indigenous research, Indigenous-led and community-engaged initiatives and theoretical and methodological innovations.

### **Community through Indigenous Relationships**

- More than 50 years of education and research in Indigenous Teacher Education
- Forty years of excellence in Indigenous Studies research
- Home of a Faculty of Native Studies, unique in Canada and one of the world's leading Indigenous Studies programs
- Numerous Indigenous-led and Indigenous-engaged community research initiatives
- \$24M Ārramāt Project supporting health and well-being of Indigenous communities and environments
- Growth in the number of Indigenous doctoral research students
- Home to seven academic and affiliated institutes, centres and initiatives dedicated to Indigenous research

### Indigenous Research and Innovation Directions:

- Expand Indigenous-led research capacity and foster initiatives that promote Indigenous self-determination and positively impact Indigenous community well-being.
- Encourage and resource ethical Indigenous community engagement and research.
- Broaden the capacity and impact of Indigenous research in both existing and new initiatives.
- Concretely respond and act upon the Truth and Reconciliation Commission of Canada Calls to Action, particularly, though not exclusively, through primary, secondary and post-secondary education.

### **Agriculture and Food**

Sustainable agriculture, resilient food security and value-added diversification

The University of Alberta is a leader in innovative agriculture, resilient food systems, nutrition and human health and animal science. Research in environmentally sustainable resource development and management underpins our strength in

climate-friendly agriculture and food, including activities related to natural resources, water, soil, biodiversity, forest and land use management, ecosystem services, cropping systems and livestock. Our multidisciplinary approach has allowed us to tackle major national challenges to optimize the sustainable use of rangelands, develop technologies (e.g., “omics”), including digital technologies to create smart agriculture systems, develop new value-added oils for health, and drive innovation in Alberta’s world-recognized beef and canola sectors.

We will continue to use our expertise to shape public policy and clinical practice, such as policies to promote the provision of safe, healthy and nutritious food to children and in school food environments and defining nutritional requirements for different population groups through an intersectional lens.

#### **Leadership in Agriculture**

- More than 100 years of training and research in agriculture
- Leading innovation in 5G living lab and smart agriculture
- Ranked in the top 20 globally for UN Sustainable Development Goals of Zero Hunger and Life on Land
- Forestry school is ranked in the top five globally
- Leading growth in digital and cellular agriculture research and innovation

#### **Agriculture and Food Research and Innovation Directions:**

- Develop a deeper understanding of, and create solutions for, resilient food systems that will improve the health of individuals, enterprises and communities.
- Develop value-added products built on sustainability principles for climate-friendly economies in collaboration with local communities.
- Critically engage with and use artificial intelligence and digital technologies to create next-generation smart agriculture and food systems and to advance forest and land use management.

- Advance the future of food from petri dish to protein, developing new industries and new sustainable, climate-smart options for consumers through cellular agriculture.

## **Social Transformations**

### **Advancing social betterment in the 21st century**

Exploring what it means to live, learn, work, express ourselves and advance social change drives University of Alberta researchers engaged in critical, creative and empirical research. Across many fields of inquiry, we are tackling challenging questions about the diversity and interconnectedness of the human condition, through the interpretation of cultural, historical, literary, political, religious and social narratives, and by understanding societies through their legal traditions, organizational structures, pedagogical practices and creative, performing and fine arts as well as research creation.

There has never been a more urgent need for artistic, cultural, educational, legal, organizational and social sciences expertise to address global conflicts, violence and ongoing colonialism. Intersections with environmental and health crises, growing racism, high levels of transphobia, ableism, gender inequities and other forms of societal injustices are part of this complicated picture.

Our creative practices, critical analyses and local, provincial, national and international community-based interventional research continue to explore and implement social improvements for individuals and communities. We also recognize the value of community-led, industry and government partnerships for the co-creation of knowledge and solutions for local, regional, national and global challenges.

### **Social Responsibility through Research**

- The University is a top seven global leader in achieving the United Nations' Sustainable Development Goals
- Long-term multi-million dollar funding, and multiple awards for excellence, in the histories of race, gender and colonialism
- More than 1,500 trainees involved in community service learning and research
- Significant growth in energy policy research, health law, and criminal justice and injustice
- Multiple Canada Research Chairs in critical disability studies, feminism and intersectionality, deaf education, politics of citizenship and human rights, Black global studies and decolonial practice, and educational measurement
- Internationally-recognized centres and institutes dedicated to people, community and change

#### Social Transformations Research and Innovation Directions:

- Advance knowledge, social innovation and public policy to tackle inequities and better address intersectional forms of social oppression.
- Deepen community-engaged research commitments, methods and impacts to collaboratively redress social injustices.
- Engage interdisciplinary, arts-based and social sciences expertise necessary to effectively address complex human behaviours in the face of the global climate crisis.
- Develop international partnerships for further research and solutions in support of the UN Sustainable Development Goals that aim to confront the most pressing issues affecting our world today.

## Next Steps

This plan is a living and evolving strategic vision for research and innovation at the University of Alberta. The next steps for implementation will:

- Continue to integrate and align this plan with the implementation of the *University Strategic Plan*.
- Support the colleges, faculties, centres and institutes to develop their own strategic plans, including guidance on how their individual strategic plans can be integrated with this plan.
- Conduct annual reviews of progress made in achieving the goals and objectives of this plan, including measurement of key indicators.
- Review the plan, including the focus areas to address grand challenges for maximum impact, after three years.
- Support the development of a comprehensive research impact framework that recognizes the importance of assessing research impact fairly, inclusively and holistically.
- Ensure an ongoing commitment to reconciliation through engagement, dialogue and consultations with Indigenous researchers and communities.

## Note on the Timeline

Our journey to sustained research and innovation excellence is measured in milestones and marked by clear targets. This vision will propel the university forward over the next five years, with specific indicators to help us chart our progress.

- One Year (2024): As we strengthen our strategic foundations, we will foster new partnerships, enhance interdisciplinary and local, national and international collaborations, and further reinforce principles of academic freedom, equity, diversity inclusion and decolonization.

- Three Years (2026): Our intended goal is a diverse research and innovation portfolio with global impact that addresses grand challenges and contributes to enhancing our societies, the economy and the environment.
- Five Years (2028): By the end of five years, we aim to establish the University of Alberta as a global leader in research and innovation in the areas of Indigenous research, agriculture and food and social transformations for advancing social betterment, in addition to creating broader and deeper local, global and national impacts in our established areas of excellence. Our success will be marked by significant contributions to policies and practices at local, regional, national and international levels, thereby enhancing our global impact.

In addition to the milestones outlined above, the Office of the Vice-President (Research and Innovation) will undertake an annual assessment of our progress in achieving the plan's key indicators.

The Office of the Vice-President (Research and Innovation) is dedicated to regular and transparent engagement with all university partners. We will not only share updates and seek feedback but also celebrate our achievements together, reflecting the shared nature of our journey.

This *Strategic Plan for Research and Innovation* will guide us through each step, from today's efforts to tomorrow's successes, and beyond.

## **Conclusion**

Through decades of research and creative activities across a wide range of disciplines, the University of Alberta has built a proud and impressive legacy of learning, knowledge creation and innovation. It is a legacy that has been fashioned through the curiosity, dedication and tenacity of high-calibre researchers and a fervent belief in the transformative power of knowledge.



Now, our university will harness these strengths to even greater effect – to maximize our impact for the betterment of Edmonton, Alberta, Canada and the world. Energized by a forward-looking, aligned research and innovation ecosystem, and an ongoing commitment to multidisciplinary collaboration, we will pursue a new chapter in our legacy of knowledge generation, mobilization and impact through innovation.

2023

# What We Heard: Strategic Plan for Research and Innovation Consultation Sessions

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Prepared by Berlin Communications



# Executive Summary

This report presents an overview of the consultation sessions conducted to inform the development of the University of Alberta's **Strategic Plan for Research and Innovation** (SPRI). A total of 16 sessions took place between April 28th and May 18th, 2023, aiming to capture diverse perspectives by accommodating different groups, including faculty members, researchers, administrators, government partners, and industry representatives.

We had 269 participants engage within the formal consultation process. This figure does not include participants such as the Working Group members or University of Alberta staff involved in drafting the SPRI. Of the 269 total participants, 77 participants attended virtually, 9 submitted comments through an online feedback form, and 44 participants remained mostly silent throughout the sessions.

Valuable feedback, recommendations, and actionable insights were shared throughout these sessions, leading to several noteworthy changes and actions, broadly categorized into three sections: content, format/language, and strategic communications. We have outlined a series of recommendations for updating the SPRI document to reflect the feedback we heard.

**Content Changes:** Key areas addressed included highlighting areas of world-leading expertise, promoting work-life balance, emphasizing overall researcher support, prioritizing quality of outcomes over quantity, exploring co-ownership of data and research, improving communication of research goals, clarifying the role of centres and institutes, integrating Indigenous perspectives, and focusing on social disparities.

**Format/Language Changes:** Recommendations in this category centered around using inspiring language, avoiding exploitative terms, highlighting community-led research, incorporating visual elements, ensuring consistent formatting, and appropriately engaging with Indigenous perspectives in language usage.

**Strategic Communications:** Participants stressed the importance of engagement with industry and community, alignment with innovation strategies, establishment of a research impact and community engagement unit, clarifying how the plan captures research impact for external partners, and creating an inspiring narrative for the SPRI.

Each consultation session was a crucial step towards shaping a comprehensive, inclusive, and future-focused SPRI. This final report serves as a testament to the collective effort and collaborative dialogue that underpins the University of Alberta's commitment to driving research and innovation.

# Summary Themes

During the consultation process for the **Strategic Plan for Research and Innovation** at the University of Alberta, participants shared valuable insights that shaped the high-level themes and overarching perspectives on the plan. These themes provide a comprehensive understanding of the participants' perspectives and expectations.

**Embracing Narrative and Identity:** Participants expressed a desire for a compelling and inclusive narrative that goes beyond traditional disciplinary boundaries. They emphasized the importance of recognizing the university's unique strengths and diverse research areas. Participants sought a narrative that reflects the province's impact, highlights the University's transformative nature, and showcases its global leadership in research. They also underscored the significance of language and messaging that demonstrates the university's commitment to reconciliation and inclusivity.

**Expanding Areas of Focus:** Participants called for a broader focus that encompasses social justice, Indigenous studies, and land-based knowledge. They recommended highlighting specific areas such as arts and fine arts, health research, and the university's expertise in sectors like oil and gas. Participants emphasized the need to align the plan with global challenges, sustainability goals, and growth areas such as agriculture and agri-food. They also emphasized the importance of interdisciplinary collaboration and bridging the gap between different disciplines to create well-rounded students and citizens.

**Cultivating Collaboration and Partnerships:** Participants emphasized the importance of fostering collaboration and partnerships with industry, government, and external organizations. They stressed the need to engage and involve Indigenous communities, incorporating their perspectives and research needs. Participants also highlighted the significance of strengthening relationships with countries in the Global South and positioning the University as a desirable partner. They called for clearer pathways and roadmaps for engagement, aligning with national innovation conversations, and leveraging existing partnerships and networks.

**Enhancing Support and Development:** Consultation participants recommended efforts to address infrastructure needs, administrative burdens, and support for research administration. They emphasized the importance of addressing these challenges to facilitate research activities. Participants called for greater support in areas such as recruitment, retention, and early career academic development. They also stressed the need for mentorship, teaching, and support for undergraduate and graduate research. The value of nurturing future research leaders, promoting entrepreneurship, and fostering interdisciplinary collaboration were heavily emphasized.

**Effective Plan Communication and Implementation:** Participants highlighted the need for effective communication of the SPRI to all relevant groups. They suggested the importance of clear and specific goals and objectives that are ambitious yet achievable. Participants pointed to the need for transparency, accountability, and ongoing engagement throughout the implementation process. They called for incorporating feedback, monitoring progress, and adjusting as needed to ensure the successful execution of the plan. Participants also emphasized the importance of user-friendly language, clarity in key indicators and actions, and effective dissemination of the plan's goals and achievements.

# Appendix A: Key Insights by Consultation Question

## **Question 1: What story (or stories) do you see evolving in the SPRI about research and innovation at the University of Alberta? Do you think this story (or these stories) will distinguish the U of A uniquely when compared to other institutions, and highlight the impact it has?**

- Attendees expressed a desire for a more comprehensive narrative that includes diverse research areas, acknowledges the province's impact, and recognizes and expands upon the University's unique strengths.
- The document should focus more on tangible impacts and include research beyond discovery-based fields, highlighting the importance of Indigenous and community-led research.
- Attendees emphasized the need for an inspiring narrative that reflects the University's transformative nature, commitment to innovation, and global leadership in research.
- Concerns were raised about the document's approach to expansion, growth, redundancies, clarity, and its sensitivity to non-named faculties and different research areas.
- Attendees indicated a desire for more self-reflection, focus on personal growth, emphasis on inquiry, and exploration of different ways of thinking. They also suggested addressing barriers to collaboration and clarifying the term "global".
- The document could consider climate change and Indigenous research, as well as provide support for a broader range of research areas.
- The SPRI could emphasize the importance of resiliency and acknowledge the challenges faced by researchers, including recruitment and pandemic-related issues.
- The document could also highlight the need for more specific goals, research applications support, funding for graduate students, and increasing awareness.
- The SPRI could be more user-friendly and highlight areas of leadership, including infrastructure, undergraduate involvement, and research support

## **Question 2: After reading the goals, objectives, and tactics, which ones resonate with you the most? Why? / (External) When you view the plan holistically, is it focused and targeted to engage with communities and support the needs of industry or government? / (Indigenous and Native Studies) If you're familiar with the Braiding Past, Present and Future: University of Alberta Indigenous Strategic Plan, how do you see both documents aligning?**

- Attendees expressed a desire for a heightened focus on teaching and education, emphasizing how nurturing future leaders can be achieved through better support for undergraduate research, strengthened early career support, and preparation for future challenges.
- Participants suggested prioritizing global partnerships, particularly with developing countries, to broaden the University's impact.
- Attendees suggested that the communication of the plan's applicability could be improved across all disciplines, including social sciences, humanities, and fine arts.

- Attendees appreciated and further encouraged the emphasis on infrastructure needs and reducing administrative burdens to facilitate research activities.
- There were suggestions to specify the role of centres and institutes within the research ecosystem and provide sufficient resources for them to support research and collaboration.
- Consider Indigenous perspectives, language, and values throughout the plan and a stronger emphasis on social justice, and land-based knowledge.
- Strengthened collaboration with industry, government, and external partners and clearer engagement roadmaps was articulated as an important piece.
- Highlight the University's strengths, aligning the plan with national innovation conversations and provide more specific examples.
- Prioritizing health-related research and enhancing knowledge mobilization strategies was recommended.
- Tackling recruitment, retention, development, and support challenges for researchers and their families was frequently highlighted as a need.
- Attendees consistently suggested aligning the plan with global challenges.
- Attendees stressed the importance of entrepreneurship and providing robust support for spin-offs and startups.

**Question 3: In your opinion, do the goals, objectives, and tactics adequately respond to the significant trends, drivers, challenges, and opportunities shaping research and innovation in the world today? If yes, how does it do this? If not, what is missing?**

- Balancing between university rankings, reputation, and research impact is considered important.
- Attendees urged the use of language that promotes mutual benefits and reciprocity in partnerships.
- They also highlighted the need to connect community involvement in research to student recruitment and engagement.
- It was suggested that the definition of health should be consistent and broad, focusing on holistic solutions.
- Attendees recommended the prioritization of mentorship, teaching, and students' roles within the plan, advocating for the fostering of a supportive, inclusive research culture that adeptly manages workload and environmental concerns.
- Attendees believe it is crucial to acknowledge the University's historical shortcomings with honesty and to intensify the focus on the humanities, showing a commitment to continuous improvement and diverse academic fields.
- Addressing faculty renewal, attrition, capacity concerns, and the importance of competitive salaries is regarded as important.
- Attendees emphasized the importance of open access, open education, and open science.
- They also suggested incorporating long-term impact considerations and democratic institutions into the plan.
- It was proposed that some acknowledgement of the feasibility of achieving stated tactics and indicators is important.

- Attendees consider the balance between commercialization and knowledge generation important and understand it is difficult.
- Attendees recommend increasing community engagement and translating knowledge to the community, focusing on Indigenous relationships.

**Question 4: Do you have any feedback on the key indicators or suggestions for additional key indicators? / (External) Does this Plan align with the priorities of your organization or sector? Does it motivate you to engage or partner with the University on research and innovation activities? Are there any major areas of focus that are missing?**

- Attendees emphasized the importance of aligning the plan's indicators with internal processes and international goals such as the 2030 Sustainable Development Agenda.
- Clear and appropriate language throughout the document was highlighted, with specific attention to terms like "tactics" and language surrounding Indigeneity and Indigenous research.
- Suggestions were made to consider alternative metrics for research impact and foster an entrepreneurial culture within the institution.
- Attendees stressed the need for effective data collection methods to capture diverse research outcomes.
- Key indicators should be relevant to different audience needs, qualitative to provide a more holistic view, and better aligned with the plan's priorities.
- Incorporating support systems for securing Tri-Council funding and implementing efficient measures to track progress was recommended.
- The plan should acknowledge the impact of the pandemic and address decolonization and anti-oppression.
- Attendees emphasized the importance of involving partners in decision-making processes and ensuring transparency in indicator data production.

**Question 5: Will this plan advance the impact of the University of Alberta? If so, in what ways? If not, what is missing?**

- Attendees believed the plan could enhance the University's societal impact and position it as a desirable partner by providing a framework for research efforts.
- Successful implementation and effective communication were seen as catalysts to energize researchers and administrators, fostering hope and positivity.
- The importance of interdisciplinary collaboration and community impact was emphasized, along with better alignment with the Indigenous Strategic Plan.
- Balancing ambition for funding with a focus on humanities and arts may not be as financially lucrative was suggested for consideration.
- Exploring synergies with other institutions in Alberta was seen as a way to strengthen the University's impact.
- Continuous engagement and incorporating feedback into ongoing implementation were deemed essential.
- Providing incentives to encourage exploration of new research areas and ensuring infrastructure and funding support were seen as crucial.
- The achievement of key indicators would demonstrate impact, but attention to implementation details, milestones, and setting realistic expectations was also emphasized.

**Question 6: What immediate successes/achievements do you see this plan enabling when it is implemented? [NOTE: this question was often not asked or reworded as final advice]**

- The recognition and acknowledgment of attendee input and the importance of policies were seen as immediate successes, further ensuring attendees feel informed, interested, inspired, and involved.
- The role of the Indigenous Strategic Plan as a model for strategic planning should be recognized.
- Addressing the need for tangible change and alleviating concerns about potential inaction were seen as positive outcomes.
- Attendees highlighted the importance of mitigating tensions and competition among equity-denied groups.
- Recognizing the importance of tangible change, interdisciplinary collaboration, and clear pathways for researchers were seen as immediate successes.
- Acknowledging achievements in faculty renewal and critical infrastructure recognition were noted.
- Consideration of social betterment as a key pillar was suggested.



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**Decision**  **Discussion**  **Information**

**ITEM OBJECTIVE:** To approve the creation of a new Bachelor of Science in Mechatronics and Robotics Engineering Cooperative Program.

<b>DATE</b>	September 6, 2023
<b>TO</b>	GFC Academic Planning Committee
<b>RESPONSIBLE PORTFOLIO</b>	Faculty of Engineering

MOTION THAT the GFC Academic Planning Committee recommends that the Board of Governors approve the proposed Bachelor of Science in Mechatronics and Robotics Engineering Cooperative Program for implementation upon final approval.

**EXECUTIVE SUMMARY**

In collaboration with both industry and academic stakeholders, a multidisciplinary undergraduate engineering cooperative program in Mechatronics and Robotics has been developed to deliver technological innovation and foster talent for local, national and global businesses, and to respond to society's need for engineers with the skills and hands-on experience to approach, understand, design, and debug complex systems. The Mechatronics and Robotics Engineering program integrates mechanical, electrical, and computer engineering in a curriculum that incorporates Indigenous worldviews, histories, and perspectives. This multidisciplinary approach recognizes that the best solutions arise from a rich diversity of perspectives, discussion, and inquiry. The proposed program includes an experiential project-based design course in each year of the program and culminates in a two-term capstone design project. In their final year of study, students can tailor the curriculum to their own interests by choosing a set of technical electives under one of the following five themes: Aerospace; Advanced Manufacturing; Cyber-physical Systems; Intelligent Robotics; and Biomechatronics.

The proposed program will be the first of its kind in the Prairie provinces and the University is well positioned to close this skills gap, contributing to the Government of Alberta's strategic vision for advancing innovation and prioritizing artificial intelligence (AI) and technological diversification. The proposed program also aligns with the strategic priorities of the University, and the Canadian Engineering Accreditation Board. The proposed program was developed in consultation with a diversity of stakeholders, including industry representatives, academics, students, and Indigenous representatives.

Consultation with current learners in Engineering suggests that demand should be robust for this program, so the risk of lower than projected enrollment in the program is believed to be minimal. From our demand analysis, upwards of 70% of all engineering students are choosing one of Mechanical Engineering, Electrical Engineering, or Computer Engineering as their first choice of program, with the existing programs being oversubscribed at the current time.

**GOVERNANCE OUTLINE**

**FINAL ITEM NO. 6**

To maintain relevance and avoid program stagnation, we have built multiple risk mitigation mechanisms into the implementation plan for the proposed program, including forming an Industry Program Advisory Committee to review and provide on-going feedback to ensure graduates of the program are able to meet the needs of industry as part of the Faculty's robust continuous improvement process, which also includes student feedback.

Planned implementation includes admitting 100 additional students to the Faculty of Engineering's common first-year program in Fall 2024, and then in Fall 2025, 100 students will be admitted to the proposed Mechatronics and Robotics Engineering co-op program in their 2<sup>nd</sup> year of study. Communications, marketing, and student recruitment activities will commence after the program receives Ministry approval.

**Supporting Materials:**

1. **Template A (System Co-ordination Review)**
2. **Template B (Campus Alberta Council Quality Review)**
3. [Appendices A–E](#)

**SCHEDULE A:****Engagement and Routing**

Consultation and Stakeholder Participation / Approval Route (parties who have seen the proposal and in what capacity) <[Governance Resources Section Student Participation Protocol](#)>

**Those who are actively participating:**

- Dr. Pierre Mertiny, Associate Dean, Undergraduate programs, Faculty of Engineering
- Dr. David Nobes, Vice-Chair, Mechanical Engineering Department
- Dr. Ashwin Iyer, Vice-Chair, Electrical and Computer Engineering Department
- Bryan Rapati, Acting Faculty Operations Manager, Faculty of Engineering
- Faculty members in Mechanical, and Electrical & Computer Engineering Departments with teaching and subject matter expertise in mechatronics and robotics engineering, including Alan Lynch, Steven Knudsen, Mahdi Tavakoli, Qing Zhao, Ehsan Hashemi, Mike Lipsett, Hossein Rouhani, Ahmed Qureshi, and also Martin Jagersand (Faculty of Science, Computing Science Department)

**Those who have been consulted:**

- Carrie Smith, Vice-Provost (Equity, Diversity & Inclusion)
- Florence Glanfield, Vice-Provost (Indigenous Programming & Research)
- Andrea Menard, Lead Educational Developer, Centre for Teaching and Learning
- Edith Finczak, Director, Academic Budget and Planning, Office of the Provost
- Sherri Kuss, Director, Engineering Co-op Office
- Oksana Feculak, Student Recruitment Partner, College of Natural & Applied Sciences
- Annie Aguilar, Communications & Marketing, College of Natural & Applied Sciences



- Alison Henry, Subject Librarian, University of Alberta Library
- Members of the Office of the Provost
- Registrar’s Advisory Committee on Fees (RACF)
- Canadian Engineering Accreditation Board (CEAB)
- Undergraduate students in the Faculty of Engineering who participate in clubs and groups related to mechatronics and robotics
- Industry stakeholders (see list in Appendix C)

Those who have been **informed**:

- All academic faculty members in the Faculty of Engineering
- Undergraduate students in the Faculty of Engineering
- Broader University of Alberta community (outside Engineering) informed through Program Support Team proposal review

**Approval Route:**

**Reviewed**d by Program Support Team (PST), March 2, 2023

Approved by Engineering Coordinating Committee (ECC), Faculty of Engineering, April 25, 2023

Approved by Executive Faculty Council (EFC) , Faculty of Engineering, May 18, 2023

- GFC Programs Committee, June 22, 2023
- GFC Academic Planning Committee, DATE
- Board Learning Research and Student Experience Committee, September 29, 2023

**Supplementary Notes / Context:**

## Proposal Template: New Bachelor’s Degree Programs and Specializations (Part A: System Co-ordination Review)

Complete this template for proposals for new bachelor’s degree programs or specializations. Institutions should:

- ensure that submission content is concise. Any additional information may be appended;
- indicate “not applicable” when questions are not relevant to a particular proposal; and
- ensure that applicable supporting documents are attached to the proposal.
- when submitting the final proposal to CAQC (i.e., Part A and Part B), group all appendices together sequentially at the end of the proposal or include as a separate document.

### SECTION A: PROPOSAL OVERVIEW

**Basic Information** *(Complete the table below)*

<b>Institution</b>	University of Alberta
<b>Program Name</b>	Bachelor of Science in Mechatronics and Robotics Engineering Cooperative Program
<b>Specialization Name</b>	Not applicable
<b>Credential Awarded</b>	Bachelor of Science in Mechatronics and Robotics Engineering Cooperative Program
<b>Proposed Effective Date</b>	July 1, 2024

**Type of Initiative** *(Answer the following questions)*

*This is a proposal for (select one from the drop-down menu):*

New program

### SECTION B: OVERVIEW OF PROPOSED PROGRAM OF STUDY

#### 1. Program Description *(Answer the following questions)*

- a. Attach (as an appendix to this proposal) a concise program description document.
- Please refer to Appendix A for a description of the proposed program including:
    - term-by-term proposed program of study including course names, descriptions, credits and prerequisites;
    - co-op program sequence; and

- o program learning outcomes.

b. Where applicable, identify planned collaborations with other post-secondary institutions, departments within the institution or other organizations that this program respectively facilitates or provides for.

- The Mechatronics and Robotics Engineering Program (the program) will be housed administratively within the Mechanical Engineering Department. The development of the program has been a joint collaboration between both the Mechanical Engineering (MECE) Department and Electrical and Computer Engineering (ECE) Department with equal partnership and influence in developing the program structure and requirements.
- Each department nominated one individual to be a Co-Lead for program development, and the Co-Leads have been responsible for achieving consensus on any decisions made during the development of the program.
- Administration of the operation of the Mechatronics and Robotics Engineering Program will be the responsibility of two Co-Directors, one each from the MECE and ECE departments, and appointed by the Chairs of those departments prior to the start of operations.
- Development of the program curriculum was a collaborative process led by a team of subject matter experts (SMEs) from both the MECE and ECE departments, and from the Computer Science department.
- Collaboration within the institution includes:
  - o the leveraging of existing MECE and ECE courses and the sharing of equipment, lab, and teaching facilities and resources between multiple engineering departments;
  - o on-going collaboration with the Faculty of Science and Faculty of Arts to deliver courses in the common first year;
  - o collaboration with University of Alberta International and International Student Services so that international students can get the support they need with immigration matters (study permits, visas), health insurance, feeling connected to a community, and with adjusting to Edmonton and to working in Canada so they have the best chance of succeeding in the proposed program; and
  - o on-going collaboration with the Vice-Provost of Indigenous Programming and Research and the Vice-Provost of Equity, Diversity, and Inclusion in order to fulfill the Indigenization and EDI Strategies (both strategies can be found in Appendix B).
- Proposed future and on-going collaboration with other post-secondary institutions includes:
  - o University of Waterloo: On-going discussions with the Director of Mechatronics are planned in order to seek further program guidance and feedback in terms of overall curriculum development, instructional equipment, and detailed technical elective content.
  - o University of Calgary: Members of the Program Development Team visited the University of Calgary in February 2023 in order to further develop collaborative relationships with the academic and technical support staff involved in their

Mechatronics minor program. Valuable input included a strong recommendation to provide students with open access to lab spaces, to consider mental health in terms of student workload, to focus on providing students with opportunities to integrate knowledge through experiential learning (hands-on experiences improve retaining theoretical knowledge from term to term).

- o NAIT: The Program Development Team will be investigating potential collaboration with the Northern Alberta Institute of Technology's (NAIT) continuing education program "Siemens Mechatronics Systems" in terms of both a further integration of Work Integrated Learning practices and a possible source of transfer students.

**Reviewer's Comment:**

**2. Work Integrated Learning (If applicable, answer the following questions)**

- a. Identify the number of placements required in the program (including type of work setting and duration/timing of activities).
- Co-op placements are required for 100% of enrolled students. Please refer to the Projected Student Enrolment table in Section C below.
  - Each student in the program will complete two co-op placements as shown in Table 1 below. The first co-op placement (8-month duration) starts after the Winter semester in the 2nd year of study (i.e., upon completion of Study Term 4). The second co-op placement (12-month duration) starts after the completion of Study Term 6 at the end of the 3rd year of study.

**Table 1. Timing/Duration of Co-op Terms**

Year	Semester	Term	Duration / Activity
Year 1	Fall	Study Term 1	Study 8 months
	Winter	Study Term 2	
	Spring-Summer		[4 months off]
Year 2	Fall	Study Term 3	Study 8 months
	Winter	Study Term 4	
	Spring-Summer	Work Term 1	Co-op Work Term 8 months
Year 3	Fall	Work Term 2	Study 8 months
	Winter	Study Term 5	
	Spring-Summer	Study Term 6	
Year 4	Fall	Work Term 3	Co-op Work Term 12 months
	Winter	Work Term 4	
	Spring-Summer	Work Term 5	
Year 5	Fall	Study Term 7	Study 8 months
	Winter	Study Term 8	

- Co-op work placements for the proposed Mechatronics and Robotics program will likely take place in a variety of settings, including manufacturing and production facilities, research and development labs, and consulting or engineering firms in a variety of industries.
- The work setting will vary depending on the employer, but generally students will be working in a professional engineering environment and will be expected to conduct themselves in a professional manner. They will be supervised by experienced engineers and will have the opportunity to work on projects alongside other professionals in the field, which will provide them with a variety of hands-on experiences, such as solving real-world engineering problems, project management, and teamwork. It will also give them the chance to learn about industry standards and practices and to develop a professional network.

b. Summarize communications with employers (append applicable letters of support, minutes of program advisory committee meetings, etc.) showing that sufficient placements will be available when needed.

- Please refer to the Record of Stakeholder Consultation in Appendix C and the Letters of Support in Appendix D.
- Early engagement with industry stakeholders was an important step in the development of the proposed mechatronics engineering program. The key messages for prospective industry stakeholders and co-op employers included the opportunity to collaborate with one of Canada's top engineering faculties in order to shape the program to meet their immediate and future workforce needs, to develop the innovation ecosystem to their benefit, and to contribute to the economic diversification of Alberta.
- By sharing a Primer about the program and the program vision statements (see Appendix A), we helped prospective employers understand the purpose and value of the program, and how program graduates will be well-positioned to contribute to advancing their organization's goals. This early engagement also provided valuable feedback and insights that shaped the program and ensured that it will deliver highly trained students who are prepared to meet the needs of modern industry.
- To date, the response from industry stakeholders to the proposed mechatronics engineering program at the University of Alberta has been overwhelmingly positive. We have engaged in short, but meaningful consultations with these stakeholders to better understand their needs and discuss how the program can best meet them. We have received letters of support from over a dozen organizations and companies, from local to multinational and from small to large enterprises, expressing demand for the very attributes and skills that Mechatronics and Robotics co-op students and graduates will possess.

c. Comment on whether/how work integrated learning placements in other programs (at the institution or at other institutions within the Alberta Adult Learning System) may be impacted as a result of this program.

- The Co-op program at the University of Alberta exists in all engineering disciplines and comprises approximately 42% of all Engineering students after the common first year.
- The overall placement rate for co-op students in all Engineering programs over the most recent 16 months is 95%, which indicates there is high demand for co-op students. See Table 2 for the overall placement rate by term for the four terms starting Fall 2021 to present.
- The Engineering Co-op program is sufficiently robust to scale to meet the demands of the proposed program. Before the Spring-Summer term of 2026 when the first cohort of students enter their first 8-month co-op term, the Engineering Co-op Office will create the number of net new co-op placements required in order to not negatively impact the availability of placements in related disciplines (Mechanical, Electrical, Computer, etc.). To accomplish this, the Engineering Co-op Office will add additional Program Advisors and Employer Relationship Managers in order to maintain the level of service and support that leads to a placement rate as high as 97%. If it's not possible for a student without a co-op placement to resequence the program, the Faculty will support co-op placements in university research labs.

**Table 2. Overall Placement Rates by Co-op Term**

Dates	Co-op Term	Overall Placement Rate
Sep - Dec 2021	Fall 2021	96%
Jan - Apr 2022	Winter 2022	96%
May - Aug 2022	Summer 2022	91%
Sep - Dec 2022	Fall 2022	97%

**3. Endorsement of and/or Support for Program (If applicable)**

a. Describe endorsement(s) from relevant professional organizations, regulatory bodies, advisory committees, employers, and/or industry.

- The University of Alberta has received support from professional organizations, regulatory bodies, potential employers, and industry partners in the form of letters of support and other forms of communication expressing positive support for the development and launch of the proposed program.
- The Association of Professional Engineering and Geoscientists of Alberta (APEGA), the Canadian Engineering Accreditation Board (CEAB), the Canadian Society of Mechanical Engineers (CSME), and various industry stakeholders were engaged in consultation to ensure the program is relevant to current engineering practices and meets industry needs.



These endorsements and expressions of support indicate strong support for the Mechatronics and Robotics Engineering program. Please see Appendix C for the record of stakeholder consultation and a detailed description of feedback and endorsements received, and see Appendix D for letters of support received.

**Reviewer's Comment:**

## SECTION C: ENROLMENT PLANNING

### 1. Projected Student Enrolment *(Complete the table below as applicable).*

The Faculty of Engineering currently admits students into a first-year program with a common curriculum, which serves as an introduction to all of the specialized programs offered by the Faculty (e.g., Mechanical, Electrical, Civil, Chemical, etc.). The proposed Mechatronics and Robotics Engineering program would be one of the specialized programs students could select when they make their program selection in the Winter Term of first year. Students are admitted to the specialized program for their second and subsequent years. All admissions are on a competitive basis. Students are admitted to a specialized program based first of all on academic performance in first year, and secondly on their program preferences.

The expectation is that 100 additional students will be admitted to first-year in Fall 2024, and that 100 students will be admitted to the proposed Mechatronics and Robotics Engineering program in their 2nd year of study starting in Fall 2025. Please see Table 3 for proposed program enrolment during the first five years of program implementation. At steady-state, total headcount would be 500.

**Table 3. Proposed Enrolment 2024-2029**

Proposed Enrolment	1 <sup>st</sup> Year of Implementation 2024-2025	2 <sup>nd</sup> Year of Implementation 2025-2026	3 <sup>rd</sup> Year of Implementation 2026-2027	4 <sup>th</sup> Year of Implementation 2027-2028	5 <sup>th</sup> Year of Implementation 2028-2029	Annual Ongoing
<b>Total Headcount</b>	100	200	300	400	500	500
● 1 <sup>st</sup> Year of Study	100	100	100	100	100	100
● 2 <sup>nd</sup> Year of Study	0	100	100	100	100	100
● 3 <sup>rd</sup> Year of Study	0	0	100	100	100	100
● 4 <sup>th</sup> Year of Study	0	0	0	100	100	100
● 5 <sup>th</sup> Year of Study	0	0	0	0	100	100
<b>Anticipated No. of Graduates</b>	0	0	0	0	100	100

**Reviewer's Comment:**

a. Indicate the percentage of international students in the enrolment projections and provide a brief rationale regarding how the percentage was established.

- The projected student enrolment above includes 20% international students. This percentage was established based on the historical percentage of international students in all Engineering programs over the last five years, as shown in Figure 1.

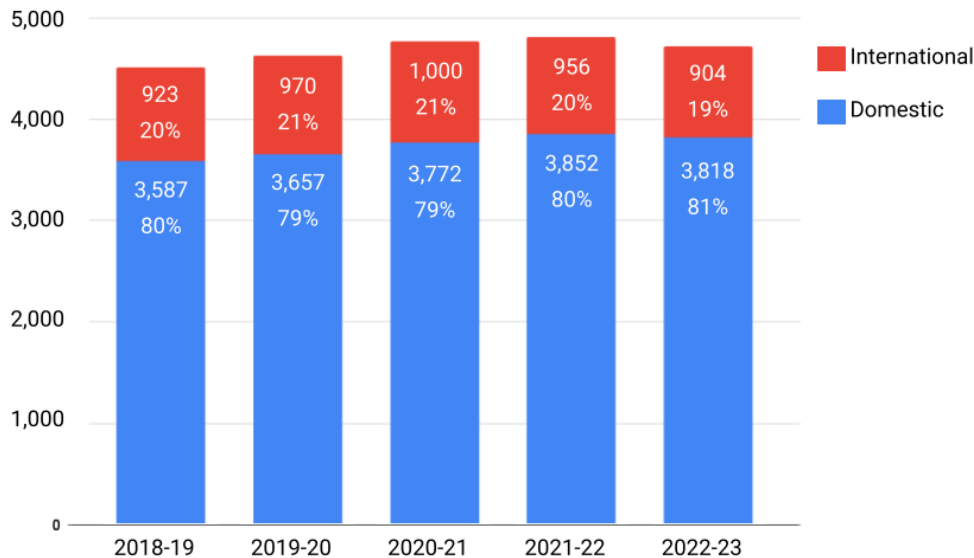


Figure 1. Number and percentage of international and domestic undergraduate students in Engineering

## 2. Learner and Labour Market Demand (*Answer the following questions*)

a. Provide evidence of labour market demand for graduates, detailing how such demand was forecasted and substantiated regionally and provincially. (Append supporting documentation, as appropriate.)

- As mechatronics engineering is a multidisciplinary combination of electrical, computer, and mechanical engineering disciplines, it follows that employment outlooks and forecasts for those three disciplines can be combined to create a complete picture for employment prospects and labour market demand in mechatronics engineering.
- According to the 2021-2025 Alberta Regional Occupational Demand Outlook, the employment outlook in terms of annual growth rate is forecast as 1.9%, 2.1%, and 1.8% for Electrical Engineer<sup>3</sup>, Computer Engineer<sup>4</sup>, and Mechanical Engineer<sup>5</sup>, respectively. In particular, the demand for Computer Engineers is rated as “High” according to the 2022-2024 Alberta Short-Term Employment Forecast.
- The occupation “Mechatronic Engineer” belongs to the occupational grouping for Mechanical Engineers (NOC 21301)<sup>1</sup>. For the 2022-2024 period, the employment outlook is rated as “Moderate” to “Good” across the country according to the Department of

Employment and Social Development Canada (ESDC) Job Bank. Regionally, in Alberta, for the 2022-2024 period, the employment outlook for Mechatronics Engineers is defined as “Good” according to the ESDC Job Bank<sup>2</sup>.

- According to the Canadian Occupational Projection System (COPS), mechanical engineering is a profession that will be in continual demand for the foreseeable future<sup>6</sup>. This wider occupational group, which includes Mechatronics Engineers, is expected to face labour shortage conditions across Canada as the number of job openings and job seekers are projected to be relatively similar over the 2019-2028 period. For that period, job openings in Canada arising from both expansion demand (employment growth) and replacement demand (retirements) are expected to total 11,300, and the number of job seekers is expected to be a similar number. For computer engineering<sup>7</sup>, employment over the same time period is projected to grow at a rate substantially higher than the average for all occupations.
- In particular, computer systems design will continue to outperform most industries in terms of production and employment growth, as rapid technological innovation in areas such as artificial intelligence and 3D printing will result in demand for workers in this occupation. In terms of labour supply, it is expected that over the 2019-2028 time period the majority of job seekers will come directly from Canadian post-secondary institutions.
- Please refer to Appendix C for a summary of what we heard from employers regarding their need for graduates from mechatronics programs. Appendix D includes letters of support from many of the employers we consulted.

1 <https://www.jobbank.gc.ca/outlookreport/occupation/25070>

2 <https://www.jobbank.gc.ca/marketreport/outlook-occupation/25070/AB>

3 <https://alis.alberta.ca/occinfo/occupations-in-alberta/occupation-profiles/electrical-engineer/>

4 <https://alis.alberta.ca/occinfo/occupations-in-alberta/occupation-profiles/computer-engineer/>

5 <https://alis.alberta.ca/occinfo/occupations-in-alberta/occupation-profiles/mechanical-engineer/>

6 <https://occupations.esdc.gc.ca/sppc-cops/occupationsummarydetail.jsp?tid=70>

7 <https://occupations.esdc.gc.ca/sppc-cops/occupationsummarydetail.jsp?tid=76>

b. Identify which stakeholder groups were consulted regarding demand/need for this program:

- |   |   |
|---|---|
| <input checked="" type="checkbox"/> Student/learners                      | <input checked="" type="checkbox"/> Employers and professional associations |
| <input checked="" type="checkbox"/> Faculty                               | <input type="checkbox"/> Community organizations                            |
| <input checked="" type="checkbox"/> Program advisory committee            | <input checked="" type="checkbox"/> Other post-secondary institutions       |
| <input checked="" type="checkbox"/> Regulator and/or accreditation bodies | <input checked="" type="checkbox"/> Indigenous stakeholders                 |

c. Briefly discuss the results of the identified consultations and attach supporting documentation (e.g., minutes of meetings, letters of support, etc.), when available.

- In terms of internal stakeholder engagement, the Program Development Team engaged with faculty support staff, academic staff, student groups, library staff, the Office of the Provost, the Vice-Provost of Indigenous Programming & Research, and the Vice-Provost of Equity, Diversity & Inclusion in the development of the proposed Mechatronics and

Robotics Engineering program. This engagement included presentations, a Town Hall event, focus groups, recurring meetings, and surveys, as shown in the Record of Consultation found in Appendix C.

- In terms of external stakeholder engagement, the Program Development Team has consulted with industry stakeholders and sought letters of support from over a dozen companies, as shown in the Record of Consultation in Appendix C. The feedback gathered helped inform the program's vision and curriculum design, and has built support and excitement among prospective employers.
- Engagement with the stakeholder groups noted above has been crucial in developing the program and will continue to be vital as the program moves forward. The success of the program depends on the consultations identified in Appendix C not being the final step in our stakeholder engagement process. To this end, terms of reference are being developed for multiple program advisory committees so engagement and consultation can continue during the remaining phases of program development, during program implementation, and during steady-state program operation. Minimally, the Faculty commits to developing terms of reference to establish the following:
  - Indigenous Program Advisory Council,
  - Mechatronics Industry Advisory Committee (MIAC),
  - Equity, Diversity, and Inclusion (EDI) Committee.
- See Appendix D for letters of support from 17 industry stakeholders who are members and/or leads of the following organizations/businesses (listed in alphabetical order):
  - Avidbots
  - Canadian Space Agency
  - Copperstone Technologies
  - Epcor
  - General Dynamics Mission Systems International
  - Hexagon Positioning Intelligence
  - Mathworks
  - MDA
  - OroraTech
  - Pegasus Imagery
  - PCL Industrial Management Inc.
  - QinetiQ Target Systems
  - Rockwell Automation
  - Siemens Corporation, Corporate Technology
  - University of Alberta, Engineering Co-op Program
  - Wyvern Inc.
- Ten of the industry stakeholders we consulted explicitly stated an interest to support in an advisory capacity as the program develops, and we will invite them to serve on the Mechatronics Industry Advisory Committee (MIAC).

- Please refer to the Record of Consultation in Appendix C for a record of meetings, consultation, and engagement with stakeholders from all groups listed above in 2b.

d. Provide evidence of learner demand for this program. How was this demand determined? (Append supporting evidence, as appropriate e.g., survey results, waitlists, demand in similar programs at other institutions etc.)

- As mechatronics engineering is a multidisciplinary combination of electrical, computer, and mechanical engineering disciplines, it follows that one way to provide evidence of learner demand for mechatronics is to examine the learner demand for those three disciplines.
- The expectation is that there is sufficient learner demand to fill all of the proposed 100 seats per year in the program based on a level of student demand for mechatronics that is consistent with the existing level of demand for mechanical, electrical, and computer engineering programs in recent years.
- The existing level of demand for mechanical, electrical and computer engineering programs at the University of Alberta is shown in Table 4 for the years 2019-2022. The demand is shown as the percentage of all first-year students who indicated their first choice would be Mechanical, Electrical or Computer Engineering programs.

**Table 4. Learner demand amongst first-year students for Mechanical, Electrical and Computer Engineering**

	2019	2020	2021	2022
Percentage of all first-year engineering students who selected Mechanical, Electrical, or Computer engineering as their first choice of program	70.8%	69.6%	71.3%	72.9%

- As discussed above in the Projected Student Enrolment Section, students are admitted to a specialized program on a competitive basis based first of all on academic performance (GPA) in first year, and secondly on their program preferences. Figure 2 and Figure 3 below indicates there is consistently unmet learner demand for Mechanical, Electrical, or Computer Engineering. Figure 2 shows the number of first-year students in 2019-2022 who had selected Mechanical, Electrical, or Computer Engineering programs as their first choice but were placed into other programs. Figure 3 shows this unmet demand in terms of percentage of first-year students. For example, in 2022, 152 students were not able to be placed into Mechanical, Electrical, or Computer Engineering due to the high demand for those programs.

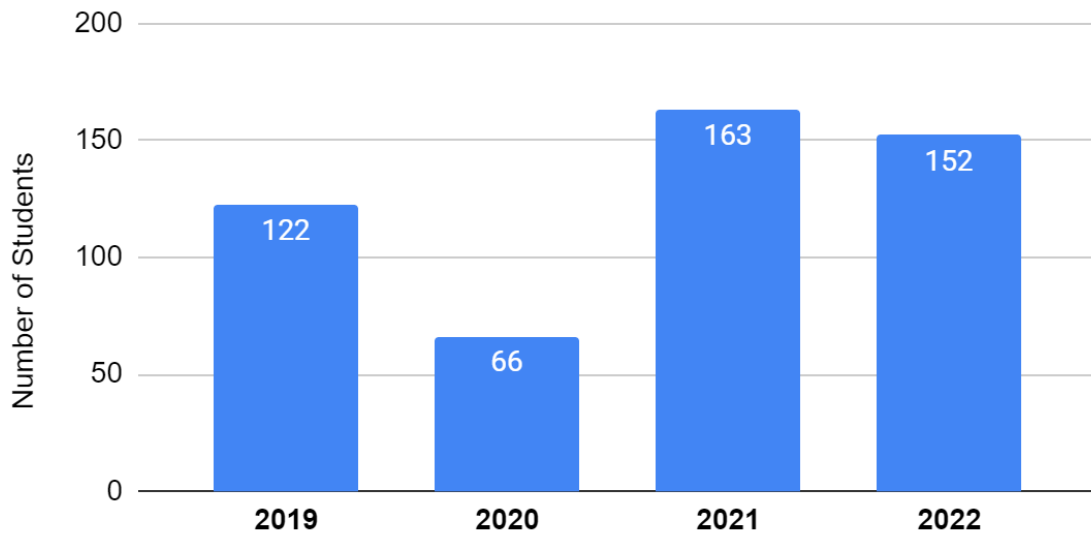


Figure 2. Unmet learner demand for Mechanical, Electrical, and Computer Engineering programs

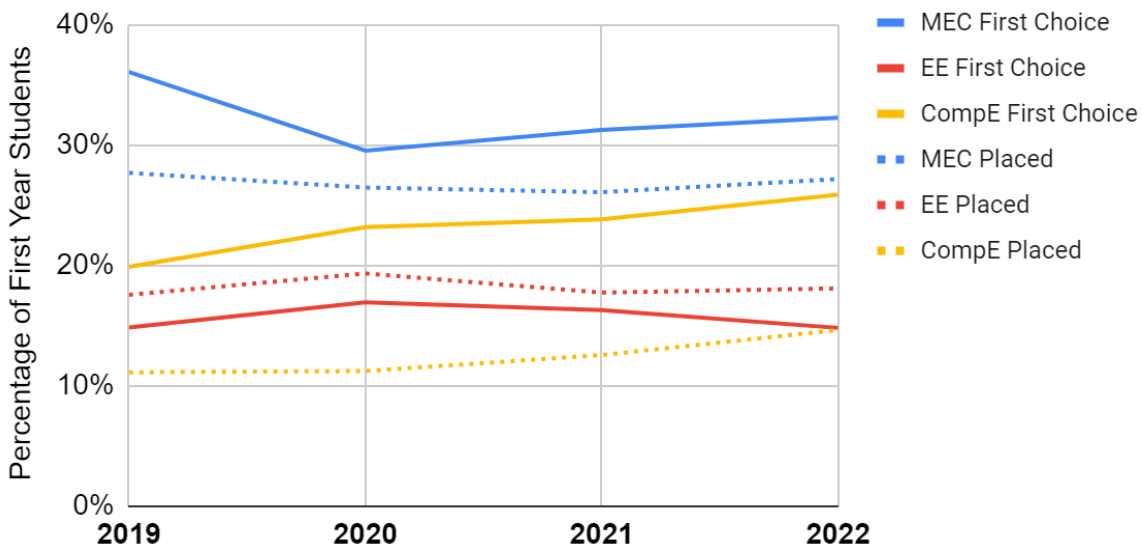


Figure 3. Percentage of first-year students choosing Mechanical, Electrical, and Computer Engineering programs and the percentage of first-year students who are admitted to the program of their choice.

- Student survey results indicate that 69% of undergraduate engineering students would choose the proposed Mechatronics and Robotics program if they could travel back in time to when they completed their Program Selection Form to indicate their first choice of program. The students who completed the survey are presently enrolled in 11 of the engineering programs offered by the Faculty, so although we received fewer survey responses than anticipated, the respondents are broadly representative of undergraduate students in the faculty. When asked how likely they would be to recommend the Mechatronics and Robotics program to students they know who are presently in junior

high or high school, 85% of respondents chose “very likely” or “definitely likely” as a response. When asked how important experiential learning is in an engineering program (e.g., hands-on projects, design courses, design competitions, co-op program), 97% of survey respondents responded “important to very important”. The survey results indicate that current undergraduate students are very interested in the program, which can be reasonably extrapolated to mean there will be high learner demand for the program. For more information about consultation with undergraduate students, please refer to Appendix C.

- Another indicator of learner demand for a program in mechatronics and robotics is the popularity of student groups in Engineering at the University of Alberta. These interdisciplinary student groups are founded, organized, and led by undergraduate students, most often for the purpose of participating in design challenges and competitions at the national or international level. The overwhelming majority of the student-organized, student-led, student-founded clubs heavily feature robotics and mechatronics system design, including the following:
  - UAlberta Formula Racing
  - Student Team for Alberta Rocketry Research (STARR)
  - University of Alberta EcoCar Team
  - Albertaloop (University of Alberta Hyperloop Group)
  - Autonomous Robotic Vehicle Project
  - University of Alberta Aerial Robotics Group
  - University of Alberta Aero Design
  - University of Alberta Biomedical Technologies Development Group
  - AlbertaSat
  - Space Exploration Alberta Robotics
  - Mission SpaceWalker
  - RoboMaster Robotic Competition Team
- At the provincial level, our discussions with the University of Calgary provided further evidence that there is sufficient (and growing) learner demand in Alberta for mechatronics such that our student enrolment projections are reasonable. In discussions with faculty members of the University of Calgary’s Department of Mechanical and Manufacturing Engineering, we were informed that their Mechatronics Minor program is heavily oversubscribed and they can only admit a portion of existing student demand.
- The first graduates of the proposed program would be newly licensed Professional Engineers in 2033, and the population in Alberta is projected to increase 17% between now and 2033. We expect this increase in population will be correlated roughly proportionately with the need for additional licensed Professional Engineers. With recent advances in robotics, AI and automation, it is generally accepted that demand for Mechatronics Engineers will exceed the baseline demand for Engineers in general.
- Several mechatronics programs are well-established in Ontario and Quebec, and learner and labour market demand for mechatronics programs have grown in Eastern Canada to the point where three new programs have been approved in the most recent few years (an increase of almost 50% in terms of programs offered). In Eastern Canada (east of Manitoba),

there is sufficient demand presently to support seven accredited programs, plus one new program that will graduate its first cohort in 2025, and two newly approved programs, for a total of 10 mechatronics programs. Given the population of Eastern Canada is 26.2 million (2022 data), there is one mechatronics program offered for each 2.6 million people. In comparison, if the proposed program is approved at the University of Alberta, there would be only two mechatronics degree programs in Western Canada, which would equate to one program for each 6.1 million people per program (i.e., more than twice the demand for mechatronics programs compared to Eastern Canada).

- Another indicator of learner demand is the organic engagement with the webpage. The webpage that introduces the proposed program as being in development is not linked from a main UAlberta page, nor has it been promoted. Between September 21, 2022 (page launch) and February 13, 2023, there were 772 organic pageviews. It is worth noting that of the 36 inquiries submitted via that webpage, more than 50% were prospective students, and almost 15% of inquiries were submitted by parents whose children are interested in studying mechatronics and robotics in the future.
- It is also important to note that there is still a significant gender gap in all STEM fields, and the Faculty will make continued efforts to support equitable access to and full participation in engineering for women and other historically underrepresented groups. A comprehensive equity, diversity, and inclusion (EDI) strategy has been developed for the proposed Mechatronics and Robotics Engineering program in order to increase the diversity of the student population (please refer to Appendix B). When the EDI strategy is fully implemented, we expect to attract applications and increase learner demand amongst historically underrepresented groups in engineering.

e. Identify and discuss any additional factors that may impact learner demand for this proposed program.

- Community awareness and understanding of engineering, and mechatronics engineering in particular, can impact the level of interest and demand for the program.
  - To raise awareness of engineering, the DiscoverE program operated by the Faculty of Engineering aims to promote engineering and technology to younger students, teachers, and the general public. The organization runs various outreach programs and events, including summer camps. The summer camps provide students with hands-on engineering and technology experiences, which will increase awareness of mechatronics and robotics engineering amongst primary and middle-school aged children.
- Learner demand in the field of mechatronics engineering is closely related to the development trends for advanced technologies such as artificial intelligence and robotics. Therefore, an increase in the rate of advancements in these fields can impact both the level of demand for mechatronics engineers and the learner demand for the program. It is expected that these advancements will lead to mechatronics systems becoming increasingly indispensable to a wide range of industries. Examples of this include drones and robots being used in agriculture, logistics and transportation, and resource extraction;



artificial intelligence (AI) being used in mechatronics systems to predict when equipment is likely to fail so maintenance can be scheduled before that happens; and rehabilitation robots, assistive devices, and prosthetics being used in medicine.

- The overall economic conditions in Alberta and Western Canada can impact the level of learner demand for the program. For example, during times of economic growth, there may be more job opportunities for mechatronics engineers, which can attract learners to the proposed program. Although the oil and gas industry has traditionally been one of the main drivers of economic growth, in recent years the province has been investing in sectors that develop and benefit from advanced technologies, which has led to economic growth in other sectors such as manufacturing, logistics, and agriculture industries, all industries that will increasingly employ mechatronics systems.
- The level of interest and preparedness of high school students in science and math can impact the level of demand for the program. In general, there has been an increasing interest in science, technology, engineering, and math (STEM) fields among high school graduates in Alberta and Canada due in large part to a growing awareness of the increasing number of job opportunities in STEM fields. The current Bridge2Engg program aims to help prepare incoming first-year engineering students for the transition to university, and the Faculty is also working to build partnerships with transfer colleges to improve access to engineering and improve the level of preparedness of students entering engineering programs.
- Canada is a popular destination for international students, and the demand for engineering programs among international students can be a factor that impacts the level of demand for the proposed program. International students are attracted to Canada for its high-quality education, diverse culture, welcoming society, and safe and stable environment. The most popular STEM fields among international students are computer science and engineering. Given this proposed program is a blend of mechanical, electrical, and computer engineering and given that it offers the opportunity to focus on the study of robotics, it is expected that it will be an attractive program for international students.

f. Briefly describe how the enrolment plan aligns with the anticipated demand for this program, taking into account the identified labour market demand and other Alberta program providers.

- The 95% overall placement rate for co-op students over the most recent 16 months indicates there is demand for co-op students, and that the Co-op program is sufficiently robust to scale to meet the demands of increased enrolment as a result of implementing the proposed program.
- The University of Alberta's *U of A for Tomorrow* (UAT) plan is to increase enrollment 25% by 2026 from 2020 levels, and the Faculty of Engineering is being asked to increase Full Load Equivalents (FLEs) to approximately 6,000 by 2026 (domestic + international students)

combined). The implementation of the proposed program would contribute to meeting those enrolment targets.

- Labour market demand in the field of mechatronics is expected to increase due to employment growth, retirements, and demand for professionals with experience in advanced technologies, such as cyber-physical systems design and artificial intelligence.
- The only other Alberta program provider for accredited engineering education in mechatronics is the University of Calgary, which offers a Minor in Mechatronics option to students who have been admitted to their Mechanical Engineering, Electrical Engineering, or Software Engineering programs. In discussions with faculty members of the University of Calgary's Department of Mechanical and Manufacturing Engineering, we were informed that their Mechatronics Minor program is heavily oversubscribed and there is unmet learner demand for their program.
- Due to the projected increase in population in Alberta and the expected labour shortage conditions across Canada for Professional Engineers, the proposed enrolment of 100 students per year in the program is in alignment with the learner and labour market demand, while also meeting the institution's expectations for cost-effectiveness.
- It is important to note that once the program is established and operational, the program will be reviewed regularly and enrollment size will be adjusted as necessary to ensure that it is meeting both learner demand and labour market demand.

g. Comment on the overall sustainability of learner demand for this program over the longer term.

- The overall sustainability of learner demand for the proposed Mechatronics and Robotics program will depend on a variety of factors that may change over time. To ensure the sustainability of learner demand, the program will need to continue to remain aligned with industry needs and be responsive to changes in the labour market. As such, an Mechatronics Industry Advisory Committee (MIAC) will be formed to provide input and feedback on a recurring basis to ensure the relevance and sustainability of the program. Nine industry stakeholders have already indicated their interest in serving on the committee in this capacity.
- The following positive trends can be considered when assessing the sustainability of learner demand for the program.
  - According to the Office of Statistics and Information – Demography and Social Statistics's most recent population projections, the Government of Alberta expects the population of the province to grow significantly over the next several decades, with the majority of the growth coming from net migration. The projections indicate that the population is expected to grow by about 1.89 million people between 2021 and 2046, with net migration accounting for 70% of population growth.

- Technology advancements and growing interdisciplinarity in mechanical, electrical, and computer engineering will lead to new applications and job opportunities for mechatronics graduates, which will in turn lead to growth in learner demand for the program. The continued integration of artificial intelligence and machine learning techniques in mechatronics systems will create new opportunities for graduates to work in a growing number of industries. An increase in the diversity of industries in which graduates can work will expand the learner demand for the program.

**Reviewer's Comment:**

## SECTION D: GRADUATE OUTCOMES AND PATHWAYS

### 1. Employment Outcomes (*Answer the following questions*)

- a. For what types of career paths (including entrepreneurial and/or self-employment paths) and employment opportunities does the proposed program/specialization prepare graduates?
- The primary career path for this program is that of licensed Professional Engineer. Graduates of the BSc program will be able to practice in Alberta as an Engineer-in-Training (EIT) (registered with APEGA), and after 48 months of work experience under the direct supervision of a professional engineer, an EIT can apply to APEGA for a license to practice as a Professional Engineer (P. Eng).
  - The proposed Mechatronics and Robotics Engineering program at the University of Alberta could prepare graduates for a wide range of career paths and employment opportunities.
  - In terms of traditional career paths, graduates could pursue roles such as:
    - Mechatronics engineer: working in the design, development, and maintenance of mechatronics systems, such as robots, drones, and advanced manufacturing systems.
    - Control systems engineer: working in the design, development, and implementation of control systems for a wide range of applications, including industrial automation and robotics.
    - Systems integration engineer: working in the design, development, and integration of mechatronics systems into other systems, such as transportation systems, medical devices, and industrial equipment.

- A Mechatronics and Robotics Engineering program graduate can work in private practice, in research & development, as a self-employed independent consultant, for a consulting firm, for government, for utilities, or for industry.
- In terms of entrepreneurial and/or self-employment paths, graduates could also start their own businesses in the field of mechatronics, such as:
  - Designing and developing mechatronics systems and products for various industries
  - Consulting on mechatronics engineering projects
  - Providing mechatronics engineering services such as control systems design, systems integration, and mechatronics system testing and validation.
  - Examples of successful start-up companies in the field of mechatronics that were founded by or that employ University of Alberta graduates include Copperstone Technologies, Wyvern, and Pegasus Imagery.
- Engineers may advance to administrative or management positions. Career paths in management include project engineer, or project manager, and can include duties related to the design, evaluation, installation, operation and maintenance of mechatronics systems.
- Graduates of the Mechatronics and Robotics program will be well prepared for a wide range of employment opportunities including in research, design and development of robotics, process automation, embedded devices, artificial intelligence for autonomous systems, sensors and control systems, and systems for process monitoring and measurement for a wide range of industries, including but not limited to:
  - aerospace and defence,
  - agriculture and food production,
  - heavy industry (including in extreme environments),
  - automotive and transportation,
  - forestry,
  - smart cities and Internet of Things (IoT),
  - robotics and automation,
  - manufacturing,
  - energy and utilities,
  - renewable and natural energy systems,
  - medical devices, healthcare and precision health,
  - engineering management and safety.

b. In cases of regulated professions, how was the regulatory body consulted and what feedback did it provide in terms of labour market factors?

- The regulatory body, the Association of Professional Engineers and Geoscientists of Alberta (APEGA), indicated that they do not capture labour market data for the engineering profession in Alberta. For this reason, APEGA was not able to provide any feedback on labour market factors and advised that we consult with industry to determine labour market factors. Please refer to Appendix C for a summary and record of industry

consultation, and see Appendix D for letters of support from employers of Professional Engineers.

- Through consultation with industry, we heard that the following labour market factors are responsible for the growing demand for graduates of mechatronics engineering co-op programs:
  - Advanced technologies are needed to provide on-demand data collection and analytics at a scale suitable for industry and government demands.
  - Decision makers require large amounts of data to be collected and fused with edge-AI to enable real-time data analytics.
  - Aerospace engineering is just one example of a highly complex field that is multidisciplinary in nature and requires a systems approach.
  - The speed and pervasiveness of the technological transition to data-driven mechatronic systems is happening across all heavy industries.
  - Project-based, team-based, and industrially-embedded experiences are of critically important value to future engineering program graduates entering the workforce.

c. Identify existing or planned program or institutional supports that enable transition from post-secondary institution to work for graduates.

- The Faculty of Engineering provides support to graduates through *Engineering Career Connections* (formerly the Engineering Employment Centre) by organizing employer recruitment events, networking opportunities, and career and professional development workshops.
- Engineering students at the University of Alberta can access *VMock*, a virtual resume review tool, to see how their resume complies with best practices and stacks up against the relevant UAlberta benchmark.
- The University of Alberta's Career Centre is a resource for career and employment information and expertise. The Career Centre offers a Transition to Career (T2C) Program designed to help new graduates successfully navigate career transitions during and after university.
- The Innovation, Creativity and Entrepreneurship (ICE) Program is an initiative comprising curricular, co-curricular, and extra-curricular entrepreneurial resources developed by the Faculty of Engineering to provide students with experience and exposure to tech-based entrepreneurship. The ICE Technology Incubator is part of our experiential learning offerings and integrates with campus makerspaces to provide a dedicated space for students and recent alumni interested in commercializing technology and launching new start-ups and social ventures. An introductory course on entrepreneurship is an available elective for students looking to gain a foundational understanding of how to plan, design, and build a tech start-up.

**Reviewer's Comment:**

## 2. Learner Pathways

- a. To what extent will learners be able to transfer credits to and from other post-secondary institutions?
- Students may complete their first year of study in Engineering at any of the approved postsecondary institutions in Alberta or in BC with which the University of Alberta has a transfer agreement in place, including Northwestern Polytechnic (formally Grande Prairie Regional College), Keyano College, Medicine Hat College, Red Deer Polytechnic, University of Lethbridge, Vancouver Island University, Northern Lights College, and College of the Rockies. These transfer programs provide a pathway into Engineering for both rural students and Indigenous students. Students who complete the Engineering Transfer Program at one of those institutions may apply to enter second-year Engineering at the University of Alberta and will be considered for program placement on an equal basis with continuing University of Alberta Engineering students.
  - If there isn't an existing transfer agreement in place with the other post-secondary institution, each individual transfer application is reviewed to assess transfer credit (the application and review process applies in the case of transferring within the institution and in the case of transferring from other institutions).
  - Students interested in a transfer to the University of Alberta from Alberta Institutes of Technology (e.g., NAIT, SAIT) would need to consult the Alberta Learning Information Service through Transfer Alberta and also contact the Faculty of Engineering concerning transfer of credit.
  - Undergraduate students already enrolled in existing engineering programs (e.g., Electrical, Computer or Mechanical Engineering) will not be able to transfer into the Mechatronics and Robotics program due to the unique arrangement and subject matter of the courses in the program. Only students entering first year in Fall 2024 or later and then starting in the proposed Mechatronics and Robotics program in their second year will be eligible to complete the proposed program.
- b. What types of further studies, if not within the same field, would graduates be most likely to pursue?
- The University of Alberta intends to propose a graduate program in Mechatronics and Robotics at a future date.
  - There are graduate programs in many fields of engineering leading to the degrees of Master of Science (MSc), Master of Engineering (MEng), and Doctor of Philosophy (PhD). At the University of Alberta, a combined Master of Business Administration/Master of Engineering (MBA/MEng) degree program is also available.
  - Graduates of the proposed Mechatronics and Robotics Engineering program at the University of Alberta may choose to pursue further studies in a variety of related fields,

depending on their interests and career goals. Graduates of the proposed program could pursue further studies in mechatronics, or in related fields such as biomedical engineering, mechanical engineering, electrical engineering, computer engineering, computer science, or in business and management (MBA).

- **Advanced Mechatronics and Robotics:** Graduates may choose to pursue advanced studies in mechatronics engineering, such as a Master of Engineering or PhD, to develop expertise in specialized areas of mechatronics engineering.
- **Artificial Intelligence and Machine Learning:** With the integration of AI and machine learning techniques in mechatronics systems, graduates may choose to pursue further studies in these fields to develop expertise in these areas.
- **Biomedical Engineering and Biomechatronics:** Graduates may choose to pursue further studies in the area of biomedical engineering and biomechatronics, to develop expertise in areas such as design, bio-materials, and biomedical process.
- **Robotics:** Graduates may choose to pursue further studies in robotics, to develop expertise in the design, development, and control of robots and other autonomous systems.
- **Computer Science:** Graduates may choose to pursue further studies in computer science, to develop expertise in software development, computer programming, and other areas related to mechatronics engineering.
- **Business and management:** Graduates may choose to pursue further studies in business and management, such as an MBA, to develop the skills needed to start their own businesses, become managers or leaders in industry and understand the business aspects of engineering.
- **Electrical Engineering:** Graduates may choose to pursue further studies in electrical engineering, to develop expertise in areas such as control systems, power systems, and communication systems.
- **Mechanical Engineering:** Graduates may choose to pursue further studies in mechanical engineering, to develop expertise in areas such as design, materials, and thermodynamics.

**Reviewer’s Comment:**

### 3. Societal and Community Benefits *(if applicable)*

a. In cases where labour market demand is not the primary reason for this program, identify anticipated benefits from implementation of the proposed program to the wellbeing of communities in Alberta, particular those that your institutions serves:

- Not applicable. Labour market demand is the primary reason for this program.

**Reviewer’s Comment:**

## SECTION E: FINANCIAL VIABILITY AND SUSTAINABILITY

### 1. Budget and Funding Sources (*Answer the following questions*)

- a. Describe how the institution plans to finance the program, (e.g. tuition, grants etc.):
- Due to the high utilization of existing human and capital resources within the Departments of Mechanical and Electrical & Computer Engineering, the program is expected to be revenue positive during steady-state operations.
  - During program start up, the Faculty of Engineering has committed to funding the program ramp up and growth through a combination of operating funding and endowed funding sources.
  - There is no requirement for additional external funding in order for the program to be successful, and tuition alone will fund the program.
- b. Discuss risk mitigation plans should full revenue(s) not be achieved or should costs exceed amounts budgeted.
- Consultations with current and prospective learners in the program suggest that demand should be robust for this program, so the risk of lower than projected enrollment in the program is believed to be minimal. From our demand analysis, upwards of 70% of all engineering students are interested as a first choice of program one of Mechanical Engineering, Electrical Engineering, and Computer Engineering with the existing programs oversubscribed at the current time.
  - Notwithstanding the above, from a revenue mitigation standpoint, as the program relies on a common first year where students rank their preferences, the ability to fill the majority or all of the seats planned for the program is significantly within the control of the Faculty of Engineering.
  - As the Mechatronics and Robotics program will be housed administratively within the existing Department of Mechanical Engineering, nearly all of the administrative supports required to manage the program already exist, including Academic Leadership (Chair, Vice-Chair, Academic Department Manager), Technical Support (Technical Manager and Technicians), and Administrative support, both at the Department and the Faculty levels (Student Services, Co-op Services, etc.).
  - In terms of projected incremental costs to mitigate, these primarily include the following:
    - **Academic salaries:** The Faculty has a strong level of control over this area. Academic teaching for this program will be supported through a combination of Tenured or



Tenure-Track Faculty and Academic Teaching Staff (ATS). As Academic Teaching Staff have higher teaching loads, the appropriate balance of ATS and Tenured or Tenure-Track Faculty provides a strong measure of control.

- **Teaching support:** The two major components of teaching support are teaching assistants (TAs) and technicians. As regular salaried employees, technician costs are predictable and controllable. Teaching assistant costs can be controlled holistically by allocating resources between courses based on a set available budget and the duties of the TAs can be managed with conversations with individual course instructors to modify assessments and other course support duties
- **Service teaching costs:** These are the costs for those courses which are delivered outside of the Mechatronics and Robotics program. The majority of the service teaching costs are associated primarily with courses delivered by the Faculty of Science and Faculty of Arts for the common first year courses shared amongst all Engineering programs. Increases in enrollments to those common courses as a result of implementing the proposed program have only moderate effects on the cost to deliver those courses. Further, the large size of these classes make them by definition revenue positive for the University.

**Reviewer's Comment:**

**2. Tuition and Student Cost Considerations (Answer the following questions)**

a. Document tuition and fee projections for students (specify domestic student tuition fees, international student tuition fees, compulsory student fees), and other costs likely to be incurred by students (texts, equipment etc.). Provide rationale where appropriate such as comparisons with similar programs. (Consult with the Ministry as needed.)

- Tuition and fees for domestic and international students are detailed below in Table 5 and Table 6, respectively.
- The breakdown of tuition and fees shown in the tables are based on the Sample Tuition Assessment provided by the Office of the Registrar via the online Cost Calculator.
- The domestic tuition fee is based on the approved exceptional tuition increase for Fall 2023.
  - The one-time cost for a laptop is also included in Tables 5 and 6 below.

**Table 5. Domestic student tuition, fees, and other costs**

Fee	Amount	Note
Tuition	\$9,099	Tuition amount for one year of study in engineering (domestic)
Athletics and Recreation	\$186	This fee supports and provides free or discounted access to athletic and recreation opportunities including varsity athletics, group exercise, intramural sports, aquatics, instructional recreation, sport clubs, personal training, and sport development.
Books, Supplies and Instruments	\$1,200	Average cost for books, supplies and instruments.
Laptop	\$1,500	Average cost for computer equipment (one-time cost)
PAW Centre Fee	\$58	This fee confers access to the Physical Activity and Wellness (PAW) Centre.
Student Academic Support	\$524	This fee supports a range of academic support services delivered by the Dean of Students office, the Registrar's Office, International Student Services, etc.
Student Health and Wellness	\$129	This fee supports a range of health and wellness services available to students, including medical services, mental health treatment and support, sexual assault services, and health promotion and community building initiatives.
Students' Union Dedicated Fees	\$172	These fees are administered by the Students' Union and/or independent groups on campus.
Students' Union Dental Plan	\$156	This fee covers the cost of enrolment in the Students' Union Dental plan for a 12 month period, from September 1 to August 31.
Students' Union Health Plan	\$159	This fee covers the cost of enrolment in the Students' Union Health plan for a 12 month period, from September 1 to August 31.
Students' Union Membership Fees	\$113	These fees are administered by the Students' Union and/or independent groups on campus.
U-Pass	\$360	This fee provides eligible students with access to regular transit services on the Edmonton and surrounding services for the Fall and Winter terms (and Spring and Summer terms if enrolled).
<b>Estimated costs for one academic year</b>	<b>\$13,664</b>	<i>(domestic student)</i>

Please note that this is an estimate only, based on costs for the Fall 2023 academic year, and that all fees are subject to change.

**Table 6. International student tuition, fees and other costs**

Fee	Amount	Note
Tuition	\$42,707	Tuition amount for First Year engineering (international)
Books, Supplies and Instruments	\$1,200	Average cost for books, supplies and instruments.
Laptop	\$1,500	Average cost for computer equipment (one-time cost)
Fees	\$3,057	Estimated non-tuition costs
<b>Estimated costs for one academic year</b>	<b>\$48,464</b>	<i>(international student)</i>

Please note that this is an estimate only, based on costs for the Fall 2023 academic year, and all fees are subject to change.

Table 7 shows a comparison of tuition at peer universities in Canada that offer similar programs in mechatronics and robotics.

**Table 7. Comparison of domestic tuition fees for similar degree programs in Canada**

	UAlberta	Waterloo*	Queen's*	SFU*
<b>Domestic tuition for one academic year (i.e., 2 study terms)</b>	\$9,099	\$13,970	\$13,160	\$9,191

\*Based on publicly available 2022 or 2023 tuition fee schedules

Under the Alberta Tuition Framework, the Faculty of Engineering received approval from the Government of Alberta to implement a tuition increase that will enhance the Bachelor of Science in Engineering programs and the Masters of Engineering programs. These changes apply to all domestic students admitted to the Bachelor of Science in Engineering or Masters of Engineering program in Fall 2022 and later.

The additional funds will contribute to continuing to deliver top quality academic courses and allow the Faculty to continually improve while supporting key priority areas identified through on-going student consultation<sup>1</sup>:

- 24.5% of the increase will be allocated to improving course delivery by:
  - Increasing access to teaching assistants
  - Enhancing the qualifying-year program
- 33% of the increase will be allocated to improving course content by:
  - Modernizing the laboratory experience
  - Modernizing program content
- 16.8% of the increase will be allocated to increasing experiential and work-integrated learning opportunities by:
  - Establishing a work and research internship program
  - Expanding the Engineering Connects program
  - Increasing accessibility to the ELKO Engineering Garage (makerspace for student projects and extracurricular activities)
- 15.0% of the increase will be allocated to bursaries and hybrid awards established to support students from underrepresented demographics, students with families, or students with a demonstrated financial need
- 5.8% of the increase will be allocated to enhancing student services and support by:
  - Increasing access to career advisors
  - Investing in student well-being
- 5.0% of the increase will be allocated to emerging priorities of the student body; improvement areas to which these funds will be allocated will be determined based on feedback from ongoing student consultations.

<sup>1</sup> Report: <https://www.ualberta.ca/engineering/media-library/about-us/tuition-proposal-student-consultation-findings.pdf>

b. Does the proposed program align with the Tuition and Fees Regulation?  Yes; or  No

c. Please elaborate on above answer, if necessary.

The tuition fees for the proposed program are the same as the fee index approved for Engineering (based on an exceptional tuition fee increase approved by the Ministry, as described above).

**Reviewer's Comment:**

## SECTION F: INSTITUTIONAL IMPACT

### 1. Institutional Capacity (*Answer the following questions*)

- a. Briefly describe how the proposed program aligns with the institution's mandate and government priorities.
- In line with the University's Institutional Strategic Plan, *For the Public Good*, the implementation of the Mechatronics and Robotics program will (i) modernize curricula, (ii) develop and implement new, forward-focused programs that reflect engineering disciplinary trends, and (iii) encourages collaboration, interdisciplinary research, and co-curricular experiences. The proposed program is also aligned with the University's strategic goal of student enrollment expansion.
  - An Indigenization Strategy (see Appendix B) has been developed for the Mechatronics and Robotics program in alignment with the goals of the University of Alberta Indigenous Strategic Plan, *Braiding Past, Present and Future*. The Mechatronics and Robotics program will:
    - Acknowledge the impact of engineering on Indigenous peoples and communities
    - Understand what it means to be in relationship with Indigenous lands
    - Weave a variety of Indigenous worldviews, histories and perspectives into the program
    - Amplify Indigenous voices
    - Engage in consultation with Indigenous communities and businesses
    - Improve Indigenous access to the Mechatronics and Robotics Engineering program
    - Provide Indigenous-centered training for faculty and staff
  - The equity, diversity, and inclusion (EDI) strategic initiatives described in the program's EDI Strategy (refer to Appendix B) will enable the Mechatronics and Robotics program to be in alignment with the institution's EDI strategic plan by having a plan in place to do the following:
    - Recruit and hire academic faculty members from historically underrepresented groups in academic engineering
    - Improve access to the mechatronics engineering program for historically underrepresented groups

- Challenge norms in engineering
  - Incorporate EDI principles into the curriculum
  - Create an inclusive environment
  - Engage in on-going consultation
  - Provide training for faculty and staff
- 
- In addition to its alignment with Faculty and institutional priorities, the proposed Mechatronics and Robotics program is also aligned with provincial priorities in the areas of artificial intelligence (AI), and technological diversification. The Mechatronics and Robotics program will be the first of its kind in the Prairie provinces and the University of Alberta is well positioned to take advantage of this skills gap, contributing to the Government of Alberta's strategic vision for advancing innovation and diversification.
  - The proposed Mechatronics and Robotics Co-op program offers every enrolled undergraduate student in the program a work-integrated learning opportunity, which responds directly to the aim of the *Alberta 2030: Building Skills for Jobs* strategy.
  - Implementation of the proposed program would contribute to Alberta becoming a leading destination for top talent in Western Canada given there isn't another BSc program in Mechatronics and Robotics offered in the Prairie provinces.
  - In alignment with the needs identified in the *Alberta 2030: Building Skills for Jobs* strategy, post-secondary education in mechatronics plays an important role in meeting the needs of the priority sectors of energy, agriculture, health, and technology. Because mechatronics combines the principles of mechanical engineering, electrical engineering, and computer engineering, the program provides graduates with the strong multidisciplinary foundation needed to design, develop, and maintain complex systems that are relevant to the aforementioned priority sectors. The development of technologies such as smart agriculture, precision health, and new energy technologies requires individuals with a deep understanding of the integration of hardware and software systems, as well as an ability to apply problem-solving skills. Mechatronics and robotics education provides students with the necessary skills and knowledge to meet the demands of these industries and contribute to the growth of these sectors, building Alberta's reputation as a technology hub.
  - In alignment with the *Alberta 2030* strategy, the proposed program allows researchers at the University of Alberta to capitalize on the ground-breaking research they undertake by offering undergraduate students the opportunity to collaborate with their industry partners on capstone projects, which will lead to further advances in Alberta's innovation ecosystem and next-generation industries.
  - In alignment with the summary of public feedback in the *Alberta 2030 engagement summary*, the professional practice, equity, diversity and inclusion, and Indigenization components of the program will ensure every student has the skills, knowledge and competencies to participate in civic life and enjoy fulfilling lives and careers (see Appendix B). To ensure that students are provided with greater transparency around

labour market outcomes, the Mechatronics Industry Advisory Committee will provide input, engage in consultation, and participate in program review on a regular basis.

- The program aligns with the provincial government's mandate to support economic growth by developing a highly skilled workforce in areas related to the development of advanced technologies. Robotics, automation, and the Internet of Things are critical to addressing a wide range of societal challenges, such as improving productivity, reducing costs, and increasing safety and efficiency. Mechatronics engineering is a field that is in high demand, and the program would provide graduates with the skills and knowledge needed to pursue a wide range of high-paying, high-demand jobs, which would contribute to the competitiveness of Alberta's economy in various industries such as manufacturing, transportation, agriculture.
- The program aligns with the Alberta government's priority to diversify the economy and reduce dependence on the oil and gas industry. As Mechatronics engineering is a field that has applications in a wide range of industries, the program would help to support the growth of other industries in Alberta, such as manufacturing, agriculture, and transportation.
- Mechatronics post-secondary education plays an important role in meeting the needs of the priority sectors of energy, agriculture, health, and technology. The multidisciplinary approach of the Mechatronics and Robotics program provides graduates with a strong foundation in working with complex systems, which is especially relevant to the aforementioned priority sectors. The development of technologies such as smart agriculture, precision health, and new energy technologies requires individuals with a deep understanding of the integration of hardware and software systems, as well as an ability to apply problem-solving skills. Mechatronics education provides students with the necessary skills and knowledge to meet the demands of these industries and contribute to the growth of these sectors.

b. To what extent does the program build on the institution's existing programs, infrastructure, resources and experience from offering programs in related fields?

- The proposed Mechatronics and Robotics Engineering program at the University of Alberta would capitalize on existing strengths and build on the institution's existing programs, infrastructure, resources, and experience from offering in Mechanical Engineering, Electrical Engineering, and Computer Engineering programs. These programs have already established a strong foundation in the areas of mechanics, materials, thermodynamics, control systems, power systems, and computer programming, and this knowledge would provide a strong foundation for the proposed Mechatronics and Robotics program.
- The program would also build on the University's existing infrastructure and resources. For example, the University already has well-equipped mechanical, electrical, and computer engineering labs, which would be suitable for mechatronics engineering. Additionally, the University has a variety of research centers and institutes that focus on

areas such as robotics, automation, and advanced manufacturing, and these resources would be leveraged to support the Mechatronics and Robotics program.

- Experience from existing programs in related fields would also be leveraged. For example, the University already has a strong reputation for its engineering programs, and the faculty members and staff who teach and support these programs would be well-positioned to teach and support the Mechatronics and Robotics program as well.
- The existing Mechanical Engineering Department and the Electrical and Computer Engineering Department will collaborate to provide a strong foundation for the new program. According to U.S. News, the existing programs at the University of Alberta rank as follows:
  - Mechanical Engineering ranks #2 in Canada, and #77 globally;
  - Electrical Engineering ranks #4 in Canada and #93 globally;
  - Computer Science ranks #5 in Canada and #100 globally;
  - Artificial Intelligence ranks #2 in Canada and #52 globally.
- The academic faculty members named as instructors in the proposed program (see Staffing Plan section of Part B, and see Appendix F for Instructor CVs) are engaged in research and scholarly activities related to mechatronics and robotics with a total awarded funding amount of \$28.2 million (award start date: 2017-01-01 and end date: 2027-12-31).
  - Their projects touch on the following areas of mechatronics and robotics: controls systems, automation, advanced manufacturing, electronics engineering, industrial robots, intelligent control, intelligent systems, aerospace, cyber-physical systems, electromechanical systems, biomechatronics, sensors, actuators, and embedded systems.
  - Their many research and funding partners include the following:
    - *Research partners in mechatronics research (Universities/Government agencies/Non-profit organizations):* Alberta Innovates, Mitacs, NSERC, CIHR, Tri-agency Inst Programs Secretariat, University of Waterloo, University of Alberta, Aurora College, Yukon University, Alberta Health Service, Western Economic Diversification, Alberta Spine Foundation, Transport Canada, CFI, Labour, Canadian Networks of Centres of Excellence, University Health Network, Scoliosis Research Society, Canadian Space Agency, and endowment funding.
    - *Industry partners in mechatronics research:* Syncrude, Imperial Oil, Suncor, Enbridge, EPCOR, Groupe BBA, Hybrid Global, Landmark Group of Companies, and Honeywell International. The total matching funding from industry is \$2.4 million.
- The program would capitalize on the abovementioned existing collaborations and partnerships with industry and other organizations in related fields. This would provide students with opportunities for experiential learning, co-op placements, industry-driven capstone projects, and potential job opportunities.

**Reviewer's Comment:**

<b>2. Internal Review and Approval</b>
<p>a. Indicate which internal governance body recommended approval and specify date of approval.</p> <ul style="list-style-type: none"> <li>• Program Support Team approval, March 2, 2023</li> <li>•</li> </ul>
<b>Reviewer's Comment:</b>

**SECTION G: SYSTEM IMPACT**

<b>1. Program/Specialization Duplication (<i>Answer the following questions</i>)</b>
<p>a. Does the proposed program/specialization potentially duplicate existing programming in the Alberta Adult Learning System?   <input type="checkbox"/> Yes; or <input checked="" type="checkbox"/> <b>No</b></p>
<p>b. If yes, list these programs.</p>
<p>c. If proposed program/specialization potentially constitutes program duplication, explain why such duplication is appropriate and beneficial in this circumstance.</p> <ul style="list-style-type: none"> <li>• Not applicable.</li> </ul>
<b>Reviewer's Comment:</b>

**SECTION H: OTHER CONSIDERATIONS**

<b>Other considerations</b>
<p>a. Are there other factors or considerations the Ministry should take into account when reviewing this proposal?</p> <p>The <b>unique dimensions</b> that set the proposed program apart from other similar programs and provide new educational opportunities for students include the following:</p> <ul style="list-style-type: none"> <li>• Work integrated learning is provided via two co-op terms, one 8-month term and one 12-month term, which were informed by the feedback we heard from industry that co-op</li> </ul>



terms of 8 months or longer are more valuable to industry than co-op terms that are 4 months in duration.

- Experiential learning is delivered in each year of the program through a series of design-focused courses wherein students will have the opportunity to both physically and virtually build their designs in response to open-ended design challenges.
- Interactive and group learning opportunities are offered in both fundamental and design courses.
- A robotics-focused core program has been designed with an emphasis on the fundamentals while keeping industry needs and employability in mind.
- The program features exciting elective themes/streams selected from the most current topics in mechatronics: Aerospace; Advanced Manufacturing; Cyber-physical Systems; Intelligent Robotics; and Biomechatronics.
- The academic staff who will teach in the program are also accomplished researchers conducting world-class mechatronics and robotics research.
- Indigenous worldviews, histories, and perspectives are woven throughout the curriculum in a meaningful way, and equity, diversity and inclusion are also addressed to foster an equitable, diverse, and inclusive working and learning environment (see Appendix B).
- The perspectives and recommendations of industry stakeholders, and of Indigenous and EDI knowledge holders will be considered in the context of on-going consultation and during more formal regularly-scheduled program reviews.

**Student workload:** Because the curriculum is drawn from reputed and longstanding Electrical, Computer, and Mechanical Engineering programs and includes more than 20 new mechatronics- and robotics-specific courses (see Appendix A), its multidisciplinary nature has the potential to result in an increased workload for students relative to other programs. For this reason and to ensure students will succeed in the program, special attention has been paid to be mindful of student workload in the design of the curriculum and to ensure the lab-component of courses are used to provide experiential hands-on learning. The total number of instructional hours (lecture, seminar, and lab combined) for the proposed program positions it on par with other existing programs offered by the Faculty of Engineering. The introduction of new courses and the renewal of existing courses as part of this new program will provide opportunities to leverage online and asynchronous learning tools in select course components (such as seminar activities), and thus enable students to engage in self-paced learning with the goal of using learner time most efficiently and improve learning outcomes.

**Reviewer's Comment:**

**RECOMMENDATION (FOR DEPARTMENT USE)**

**Recommendation(s):**

**Rationale for Recommendation:**

**Reviewer(s):**

**Date Completed:**

## Proposal Template: New Degree Programs and Specializations

### (Part B: Campus Alberta Quality Council Review)

If a proposed program receives a positive outcome from the System Coordination Review, the Minister may refer the program to the Campus Alberta Quality Council for quality assessment, the second stage of review.

The onus is on the applicant institution to satisfy CAQC that the level of learning to be achieved is consistent with that which is expected at the proposed degree level, that the program has sufficient breadth and rigour to meet national and international standards as outlined in, for example, the Canadian Degree Qualifications Framework (CDQF) and the Alberta Credential Framework (ACF), and that the program is comparable in quality to similar programs (if any) offered in Alberta and elsewhere. The program proposal should demonstrate how CAQC's program quality standards and any applicable guidelines have been addressed and describe any unique dimensions that set the program apart from similar programs thus providing new educational opportunities for students.

NOTE: Part A of the program proposal may undergo changes as a result of the System Coordination Review. It is important that Part A be up-to-date and complete before it is forwarded to CAQC. Building on the information provided in Part A, the program proposal that is sent to CAQC should contain the additional information requested below. When possible, links to existing policy documents and institutional policies should be provided, rather than recopying them in response to questions.

## SECTION A: PROGRAM SPECIFICS

### 1. Program Learning Outcomes (PLO)

a. Provide the program's learning outcomes (as presented in Part A of the proposal).

**PLO 1.** A knowledge base for engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.

**PLO 2.** Problem analysis: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.

**PLO 3. Investigation:** An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.

**PLO 4. Design:** An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.

**PLO 5. Use of engineering tools:** An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.

**PLO 6. Individual and team work:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.

**PLO 7. Communication skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.

**PLO 8. Professionalism:** An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.

**PLO 9. Impact of engineering on society and the environment:** An ability to analyze societal and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.

**PLO 10. Ethics and equity:** An ability to apply professional ethics, accountability, and equity.

**PLO 11. Economics and project management:** An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.

**PLO 12. Life-long learning:** An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

## 2. Program Structure

- a. Provide a comprehensive outline of the entire program curriculum, listing the course names, course numbers, and credits for all required courses and specified electives. Indicate which courses are new for this program. Where applicable, specify the requirements for any minors, work-integrated learning (WIL), specific general education or breadth elements, or other elements that are part of the program.

See Appendix A for a list of the calendar entries for all required courses and specified electives, including the calendar designation for credits and numbers of lecture, lab seminar, tutorial hours, etc. For new courses under development, a tentative calendar entry has been provided. For additions/revisions to existing courses, the Faculty commits to approving the calendar changes before program implementation.

The **unique dimensions** that set the proposed program apart from other similar programs and provide new educational opportunities for students include the following:

- Work integrated learning is provided via two co-op terms, one 8-month term and one 12-month term, which were informed by the feedback we heard from industry that co-op terms of 8 months or longer are more valuable to industry than co-op terms that are 4 months in duration.
  - Experiential learning is delivered in each year of the program through a series of design-focused courses wherein students will have the opportunity to both physically and virtually build their designs in response to open-ended design challenges.
  - Interactive and group learning opportunities are offered in both fundamental and design courses.
  - The curriculum is drawn from reputed and longstanding Electrical, Computer, and Mechanical Engineering programs, but with >20 new mechatronics-specific courses.
  - A robotics-focused core program has been designed with an emphasis on the fundamentals while keeping industry needs and employability in mind.
  - The program features exciting elective themes/streams selected from the most current topics in mechatronics: Robotics, Aerospace; Advanced Manufacturing; Cyber-physical Systems; Intelligent Systems; and Biomechatronics.
  - The academic staff who will teach in the program are also accomplished researchers conducting world-class mechatronics research.
  - Indigenous perspectives are woven throughout the curriculum in a meaningful way.
  - The most current best practices in equity, diversity and inclusion are incorporated into the core part of the program.
  - Industry, Indigenous, and EDI perspectives will be incorporated in regular program reviews.
- b. If the curriculum includes a WIL component(s), provide the following information:
    - i. how placements will be arranged, and what resources and/or personnel the institution will make available to undertake these processes.

Since 1981, the Faculty of Engineering's Co-op program at the University of Alberta has been a national leader in cultivating student talent by preparing tens of thousands of students for the demands of an ever-changing global economy so they can fast-track

their careers. The Co-op program exists in all engineering disciplines and comprises approximately 42% of all Engineering students after the common first year.

The Co-op Office provides students with a committed team of employment professionals who administer the work term component of the Engineering Co-op Program and bring students and potential employers together.

The team includes Employer Relationship Managers (ERM) and Co-op Program Advisors (PA) who:

- market the program to employers with suitable engineering-related jobs to encourage them to participate in the program;
- foster long-term professional relationships with organizations to maintain ongoing participation in the program;
- administer the technical details of each recruitment cycle, including advertisement of co-op opportunities to students, scheduling employer co-op information sessions and interviews, and communicating offers of employment;
- ensure that the interests of both employers and students are protected within the recruitment and work periods;
- provide significant assistance in identifying appropriate employment opportunities and provide insight and up-to-date information on the current job market;
- counsel students in their job search, and advise students on employment application decisions and final job selections;
- provide program orientation through group and individual instruction in the course *ENGG 299 - Orientation to Cooperative Education*;
- provide ongoing employment/recruitment counseling on topics such as resume writing, interview skills, and job search techniques;
- provide individual advising and assistance to students whose attempts to find employment are unsuccessful;
- guide students to make the most of their work term placements;
- meet with students each semester so they can become familiar with their skills and interests;
- evaluate student performance on the job through on-site evaluations and assignments, and facilitate conversations where students reflect on their co-op experience as it pertains to their academic program;
- provide students with personalized advice; and
- uphold the policies of the Engineering Co-op Office.

The ultimate responsibility for obtaining suitable employment for each work term rests with the student. It is possible for students to secure employment independently through their own search, but they must notify the Co-op Office immediately to ensure it qualifies for the program.

ii. expectations and obligations of student and host and how these will be coordinated.

**Expectations of students:**

- Students must actively participate in the co-op recruitment process in addition to conducting a personal job search
- Students must follow certain recruitment processes, comply with the Co-op Program Terms & Conditions, and comply with employment regulations.

- Students are expected to conduct themselves professionally regarding all aspects of their job search and employment term.
- Engineering co-op students are obligated to uphold the University of Alberta Code of Student Behaviour, APEGA Code of Ethics, Alberta Engineering & Geoscience Professions Act.
- If the co-op student is completing their final work term, they will complete a work-related technical report.

The Program may withdraw its recruiting services from students who, without just cause, violate the established regulations. In these cases, students would be expected to find their own employment.

**Employer responsibilities:**

- Hiring a co-op student is just like hiring any other temporary employee and employers must follow all labour laws and regulations.
- The employer must facilitate a mid-term onsite visit by a Co-op Program Advisor or Employer Relationship Manager.
- At the end of the student's placement, the employer will be asked to complete an evaluation form.

The mid-term onsite meeting between the employer, student and a Co-op Program Advisor or Employer Relationship Manager is an integral part of the Co-op Program. More than just a performance evaluation, it is the opportunity for the Co-op program to ensure that both student and supervisor are finding the co-op experience valuable.

iii. how mentoring and supervision of students during their WIL experience will take place.

As with any employee, co-op students require a certain amount of mentoring and supervision. The degree of direct supervision varies depending upon the nature of the assignment and personal supervisory styles. It is safe to say, however, that because the students have completed a full 50% of their studies before beginning their first co-op placement, they are quite capable of working independently. As a partner in the process of educating future engineers, employers will have many opportunities to introduce students to progressively more challenging tasks.

iv. how evaluation of student performance will occur.

Co-op students are required to submit a work term report on an assigned topic each work term. Failure to submit a report that scores satisfactory or better will result in a grade of Fail (NC) for that work term.

At the end of the placement, the employer will complete an evaluation form based on non-technical skills such as attitude, initiative, communication skills, planning, and organizational abilities. The Co-op Program Advisor / ERM will send the evaluation form to the employer. This final evaluation, in conjunction with the mid-term on-site evaluation and a work term report prepared by the student, will determine whether or not the student receives credit for the work term.

The evaluation and documentation of student performance on work term placements includes:

- Visiting students at work sites to conduct on-site evaluations
- Evaluating ENGG 299 and work term reports
- Recommending that credit be awarded for each work term
- Maintaining student records
- Recommending students for graduation following the successful completion of the required months of work experience

- v. how opportunities will be afforded to students to reflect on how the WIL experience contributed to their degree program.
- Students will have the opportunity to reflect on their co-op experience and how it contributes to their degree program during the mid-point on-site evaluation meeting between the student and the Program Advisor. Students are asked questions pertaining to their experience, including some version of the following question: "*Tell me how your co-op experience is related to your program*". There is an oral reflection at every on-site meeting at each co-op placement.
  - Students are also offered an opportunity to reflect on the value of their co-op experience during the writing of their work experience reports. Both the WKEXP 901 and WKEXP 904 assignments include an opportunity to reflect, as described below.
  - WKEXP 901 report assignment includes the following criteria:
    - Describe the opportunities available for learning in the organization.
    - Based on this information, provide an analysis of your work preferences, which can help you in deciding the direction of your future work terms. Discuss your preferences regarding
  - WKEXP 904 report assignment includes the following criteria:
    - Create an ideal career path/plan for yourself based on your co-op and other work experiences.
    - Develop a plan for your job search.
    - In order to provide perspective on your career plan, interview three or more graduate engineers at varying stages of their careers.
    - Describe any similarities or differences between the information provided by the engineers to your planned career path. Analyze how your perceptions relate to real world experiences of the graduate engineers.
  - In the WKEXP 904 assignment, the student is required to reflect on their WIL experience, have discussions with engineers, and then reflect on their career plan and how it relates to their degree program.
- vi. If not already included above, indicate the resources and/or personnel that the institution will make available to undertake these processes as well as any other relevant features of the WIL component.

A relevant feature not already included above is that up to one year of the 20-months of completed work experience can be used towards Professional Engineering (P. Eng)



designation. When applying for P. Eng designation, the work will be assessed by the Association of Professional Engineers and Geoscientists of Alberta (APEGA).

- c. Provide a summary outline of the program structure and requirements in a table that indicates the number of junior and senior courses, and credit totals, for the components listed in the sample table below. Additional components, such as minors or general education may be added as appropriate.

**Table 8: Program structure**

Component		Junior courses (maximum)	Credits	Senior courses (minimum)	Credits
Requirements	Required courses	25	70	19	55
	Program technical electives	0	-	4	12
	Complementary studies elective	0	-	1	3
	ITS ( <i>Impact of Technology on Society</i> ) elective	0	-	1	3
Total		25	70	25	73

- d. For undergraduate degrees, demonstrate (in a table, if possible) how the program meets the structural requirements for the relevant degree type as set out in CAQC's Expectations for Design and Structure of Undergraduate Degrees (Handbook s. 4.3.3.).

### **Bachelor's Degree: BSc in Mechatronics and Robotics Engineering**

*This degree is awarded to students who have demonstrated:*

*This expectation is developed through the following Program Learning Objectives:*

<b>Depth and Breadth of Knowledge</b>	a) Knowledge and critical understanding in a field of study that builds upon their secondary education and includes the key assumptions, methodologies, and applications of the discipline and/or field of practice	1, 2, 3, 4
	b) Basic understanding of the range of fields within the discipline/field of practice and of how the discipline may intersect with fields in related disciplines	5, 6, 10, 12
	c) The ability to gather, review, evaluate, and interpret information, including new information relevant to the discipline, and to compare the merits of alternate hypotheses or creative options relevant to one or more of the major fields in a discipline	2
	d) The capacity to engage in independent research or practice in a supervised context	1, 2, 3, 4
	e) Critical thinking and analytical skills inside and outside the discipline	5, 6, 7
	f) The ability to apply learning from one or more areas outside the discipline	9, 10, 11, 12

<b>Knowledge of Methodologies and Research</b>	a) An understanding of methods of enquiry or creative activity, or both, in their primary area of study that enables the student to <ul style="list-style-type: none"> <li>(i) evaluate the appropriateness of different approaches to solving problems using well established ideas and techniques,</li> <li>(ii) devise and sustain arguments or solve problems using these methods, and</li> <li>(iii) describe and comment upon particular aspects of current research or equivalent advanced scholarship in the discipline and on their relevance to the evolution of the discipline</li> </ul>	1, 2
	b) The ability to review, present, and critically evaluate qualitative and quantitative information to <ul style="list-style-type: none"> <li>(i) develop lines of argument;</li> <li>(ii) make sound judgments in accordance with the major theories, concepts, and methods of the subject(s) of study;</li> <li>(iii) apply underlying concepts, principles, and techniques of analysis, both within and outside the discipline; and</li> <li>(iv), where appropriate, use this knowledge in the creative process</li> </ul>	2, 3, 4, 7, 8, 10
<b>Application of Knowledge</b>	a) The ability to use a range of established techniques to <ul style="list-style-type: none"> <li>(i) initiate and undertake critical evaluation of arguments, assumptions, abstract concepts, and information;</li> <li>(ii) propose solutions;</li> <li>(iii) frame appropriate questions for the purpose of solving a problem;</li> <li>(iv) solve a problem or create a new work</li> </ul>	1, 2, 3, 4, 5
	b) The ability to make critical use of scholarly reviews and primary sources.	3, 5, 8
<b>Communication Skills</b>	The ability to communicate information, arguments, and analyses accurately and reliably, orally and in writing, to specialist and non-specialist audiences, using structured and coherent arguments, and, where appropriate, informed by key concepts and techniques of the discipline.	6, 7, 8, 9, 10
<b>Awareness of Limits of Knowledge</b>	An understanding of the limits to their own knowledge and ability; an appreciation of the uncertainty and ambiguity of and limits to knowledge, and an appreciation of how this might influence analyses and interpretations.	5, 7, 8, 9
<b>Professional Capacity/Autonomy</b>	Qualities and transferable skills necessary for further study, employment, community involvement, and other activities requiring	
	(i) the exercise of initiative, personal responsibility and accountability in both personal and group contexts,	5, 8, 9, 10, 12
	(ii) working effectively with others, and (iii) behaviour consistent with academic integrity	

### 3. PLO Mapping

- a. Provide a mapping of the courses to the PLOs. Although proponents may choose alternative ways to present a curriculum map, the following example represents one way required and elective courses in a specialization can be mapped to PLOs to demonstrate

- how the courses that fulfill the requirements for the specialization (major) contribute to the achievement of the learning outcomes, and
- a progression in the development of the PLOs across these courses.

Although all courses in a program contribute to PLOs, the focus in this map is on the courses that constitute the specialization.

### Legend for PLO mapping table below

- I:** Indicates that knowledge and skills to help learners achieve this PLO are introduced in this course
- D:** Indicates that knowledge and skills to help learners achieve this PLO are further developed in this course
- M:** Indicates that knowledge and skills to help learners achieve this PLO are mastered (appropriate to the degree level) in this course

Course number and name	Program learning outcomes											
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
<b>Required core courses in the program</b>												
<b>TERM 1</b>												
CHEM 103 Intro Chemistry I	I											
ENGG 100 Success in Engineering								I	I	I	I	I
ENGG 130 Engineering Mechanics	I	I										
MATH 100 Calculus I	I											
PHYS 130 Wave Motion, Optics, & Sound	I	I										
ENGL 199 English for Engg Students						I	I, D					
<b>TERM 2</b>												
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CHEM 105 Intro Chemistry II	I											
ENCMP 100 Computer Programming for Engineers	I	I		I	I							
ENGG 160 Intro to Engg Design, Communication, and Profession					I	I	I	I	I	I	I	I

EN PH 131 Mechanics	I	I										
MATH 101 Calculus II	I											
MATH 102 Applied Linear Algebra	I											
<b>TERM 3</b>												
	<b>PLO 1</b>	<b>PLO 2</b>	<b>PLO 3</b>	<b>PLO 4</b>	<b>PLO 5</b>	<b>PLO 6</b>	<b>PLO 7</b>	<b>PLO 8</b>	<b>PLO 9</b>	<b>PLO 10</b>	<b>PLO 11</b>	<b>PLO 12</b>
MCTR 202 Electric Circuits for Mechatronics	D	D		I	I							
MCTR 274 Programming with Data Structures and Algorithms for Mechatronics I		D			D							
CIV E 270 Mechanics of Deformable Bodies I	D	D										
MATH 209 Calculus III	D											
MCTR 240 Signals and Systems	I	I										
MATH 201 Differential Equations	D											
<b>TERM 4</b>												
	<b>PLO 1</b>	<b>PLO 2</b>	<b>PLO 3</b>	<b>PLO 4</b>	<b>PLO 5</b>	<b>PLO 6</b>	<b>PLO 7</b>	<b>PLO 8</b>	<b>PLO 9</b>	<b>PLO 10</b>	<b>PLO 11</b>	<b>PLO 12</b>
MCTR 260 Mechatronics and Robotics Design I	D	D	D	D	D	D	D	D	D	D	D	D
MCTR 265 Computer-Aided Design for Mechatronics				D	D	D	D	D	D	D	D	D
MEC E 230 Introduction to Thermo-Fluid Sciences	D	I										
MCTR 210 Digital Logic Design and Microprocessors		I										

ECE 342 Probability for Electrical and Computer Engineers	D											
MEC E 250 Engineering Mechanics II	D	D										
ENGG 299 Orientation to Cooperative Education												
<b>TERM 5</b>												
	<b>PLO 1</b>	<b>PLO 2</b>	<b>PLO 3</b>	<b>PLO 4</b>	<b>PLO 5</b>	<b>PLO 6</b>	<b>PLO 7</b>	<b>PLO 8</b>	<b>PLO 9</b>	<b>PLO 10</b>	<b>PLO 11</b>	<b>PLO 12</b>
MCTR 320 Feedback Control Systems	D	D										
MCTR 374 Programming with data structures and algorithms for mechatronics II		D		D	D							
MCTR 300 Electronics, Sensors, and Data Analysis	D	I	D	D								
MCTR 355 Introduction to Systems Engineering for Mechatronics	D	D			D				D	D	D	D
MCTR 357 Robotic Manipulators	M	D	D	D	D							
MCTR 350 Advanced Dynamics	M		D		D							
<b>TERM 6</b>												
	<b>PLO 1</b>	<b>PLO 2</b>	<b>PLO 3</b>	<b>PLO 4</b>	<b>PLO 5</b>	<b>PLO 6</b>	<b>PLO 7</b>	<b>PLO 8</b>	<b>PLO 9</b>	<b>PLO 10</b>	<b>PLO 11</b>	<b>PLO 12</b>
MCTR 360 Mechatronics and Robotics Design II	M	D	D	D	D	D	D, M	D	D	D	D	D
MCTR 365 Computer-Aided Machine Design		D		M	M	D	D, M	D	D		D	D
ECE 315 Computer Interfacing		I			D							
MCTR 332 Actuators, Machines, and Power Electronics	D	I	D	D	D							

MCTR 399 Analytical and Numerical Methods for Mechatronics		D	D									
MCTR 370 Machine Learning for Mechatronics	M	D	D	D								
<b>TERM 7</b>												
	<b>PLO 1</b>	<b>PLO 2</b>	<b>PLO 3</b>	<b>PLO 4</b>	<b>PLO 5</b>	<b>PLO 6</b>	<b>PLO 7</b>	<b>PLO 8</b>	<b>PLO 9</b>	<b>PLO 10</b>	<b>PLO 11</b>	<b>PLO 12</b>
MCTR 460 Design Project I	M	M	M	M	M	M	M	M	M	M	M	M
MCTR 420 Modern Control Theory for Mechatronics	M	D		D								
ENG M 401 Financial Management for Engineers								D, M				
Complementary Elective									D	D		D
<b>TERM 8</b>												
	<b>PLO 1</b>	<b>PLO 2</b>	<b>PLO 3</b>	<b>PLO 4</b>	<b>PLO 5</b>	<b>PLO 6</b>	<b>PLO 7</b>	<b>PLO 8</b>	<b>PLO 9</b>	<b>PLO 10</b>	<b>PLO 11</b>	<b>PLO 12</b>
MCTR 461 Design Project II	M	M	M	M	M	M	M	M	M	M	M	M
MCTR 421 Estimation Theory for Mechatronics	M	D										
ENGG 400 The Practice of the Engineering Profession								M	M	M	M	
MCTR 465 Mobile Robotics	M	M	D	M	M							
Impact of Technology on Society Elective								D	D, M			D
<b>PROGRAM / TECHNICAL ELECTIVES</b>												
	<b>PLO 1</b>	<b>PLO 2</b>	<b>PLO 3</b>	<b>PLO 4</b>	<b>PLO 5</b>	<b>PLO 6</b>	<b>PLO 7</b>	<b>PLO 8</b>	<b>PLO 9</b>	<b>PLO 10</b>	<b>PLO 11</b>	<b>PLO 12</b>
Program and Tech Electives	M	M	M	D	M	D	D	D	D	D	D	M

#### 4. Alignment with Alberta Credential Framework (ACF)

Since graduates are also expected to demonstrate the degree-level expectations in each of the six knowledge and skill areas set out in the ACF (see the CAQC Handbook), describe how the proposed program meets the expectations in each of the areas listed below, and how the academic culture helps learners achieve these expectations.

As indicated in the mapping table above (Program Structure Section 2-d), because the curriculum is designed to meet the Canadian Engineering Accreditation Board criteria (graduate attributes and program learning outcomes), the curriculum as such provides ample opportunities for students to develop the knowledge and skills and meet the expectations set out in the ACF.

a. Depth and breadth of knowledge:

The Mechatronics and Robotics program is designed to provide students with in-depth knowledge and hands-on experience in multiple areas of engineering, including mechanical, electrical, computer, controls, systems and software engineering. This will equip them with a well-rounded understanding of the field and the ability to apply their knowledge to solve complex problems. Although the field of mechatronics spans three disciplines, the program is designed to strike a balance between breadth and depth.

b. Conceptual awareness and/or knowledge of research: (i.e., knowledge of approaches to inquiry and/or creative work)

The Mechatronics and Robotics program includes a comprehensive set of design courses that provide opportunities for students to conduct independent inquiry and research in order to solve open-ended design problems. This will help students understand how to approach complex problems and develop a mindset for inquiry and creative work. In other words, the approaches to inquiry are addressed in the design courses wherein students will make sound judgments in accordance with the major theories, concepts, and methods, apply underlying concepts, principles, and techniques of analysis, both within and outside the field of mechatronics, and use this knowledge in the creative process to answer open-ended design problems and challenges.

c. Communication skills:

The Mechatronics and Robotics program includes coursework and team design projects that require students to present their work, collaborate with others, and communicate effectively with different audiences (peers, clients, instructors, the public, etc.). This will help students develop their communication skills and prepare them for real-world situations.

d. Application of knowledge:

The Mechatronics and Robotics program includes hands-on projects that require students to apply their knowledge to design, build, and test mechatronic systems. This will help students develop their technical skills and problem-solving abilities, and prepare them for situations in which they will need to both design and debug complex mechatronics systems.

e. Professional capacity and autonomy:

The Mechatronics and Robotics program includes coursework and projects that require students to work independently, take responsibility for their own learning, and develop their professional skills. This will help students develop their professional capacity and prepare them for autonomous roles in the workplace.

Both the EDI and Indigenization strategies (see Appendix B) include initiatives to weave diverse perspectives throughout the curriculum will produce graduates with a wider lens and a broader set of perspectives with which to view personal responsibility and accountability in both personal and group contexts.

f. Awareness of limits of knowledge:

The Mechatronics and Robotics program includes courses that introduce students to the interdisciplinary nature of the field and provide opportunities for them to learn about the limitations and uncertainties of various engineering approaches. This will help students develop an awareness of the limits of their knowledge and prepare them for lifelong learning and professional development. In particular, the systems engineering course will introduce students to Indigenous Ways of Knowing so that students will develop an awareness of more than one knowledge system, which will contribute further to an understanding of the limitations of any one single approach and of the need for lifelong learning.

## 5. Requirements and Pathways for Admission and Academic Progression

a. Provide the following information:

i. admission criteria (including any provision for prior learning assessment)

Admissions to the Faculty of Engineering at the University of Alberta are done on a competitive basis. High school students are only admitted into the first year program (i.e., qualifying year), and students with less than 30.0 engineering units of postsecondary transfer credit are also admitted into the first-year program. The minimum high school average for students entering directly from high school is reviewed annually and may be adjusted based on demand and space availability. After completing the first-year program, students are admitted to specialized programs based on their academic performance and program preferences, which are communicated through a Program Selection Form.



High School Applicants must meet the following Subject Requirements:

1. English Language Arts 30-1
2. Chemistry 30
3. Mathematics 30-1
4. Mathematics 31
5. Physics 30

Students whose final high school average across the five required subjects (or their equivalents if the applicants are from other provinces or territories of Canada) is at or above the minimum average are admitted to first year. The minimum average will be publicly available on the Faculty of Engineering website.

ii. residency requirements

The expectation for a student working towards a Bachelor of Science degree in Engineering is to complete half of the total credit requirements through courses offered by the University of Alberta, either on or off-campus during Fall/Winter or Spring/Summer. Typically, a majority of these University of Alberta courses will be from Terms 5 through 8, as outlined in the program requirements for the Faculty of Engineering traditional and co-op programs. Credits earned through special assessment at the University of Alberta may also be included in fulfilling the residence requirements. In cases where a student has transferred from another accredited engineering program at a Canadian university and has the equivalent of six full terms of transfer credit, reducing the residence requirement to one academic year consisting of two full terms may be considered.

iii. academic performance progression requirements

**Promotion:** A student's progress is evaluated on completion of academic studies for Fall/Winter and on completion of any academic term occurring in Spring/Summer that is a scheduled term within the student's degree program. Evaluation is on the basis of the Fall/Winter GPA or Spring/Summer GPA.

**Satisfactory Standing:** Fall/Winter or Spring/Summer GPA of 2.0 or greater. Promotion, repeating any failed course(s).

**Marginal Standing-Academic Warning:** Fall/Winter or Spring/Summer GPA of 1.7 to 1.9 inclusive. Proceed to next term on academic warning, repeating any failed course(s) and other courses as specified by the Dean, unless one of the following conditions applies, in which case the student must withdraw:

- occurs immediately upon completion of the qualifying year
- previously on academic warning on two or more occasions
- previously required to withdraw and previously on academic warning
- already on academic warning or probation

Students on academic warning or probation will be evaluated at the end of each term. Spring/Summer is not considered a term unless it is a scheduled term within the student's degree program. To clear academic warning or probation, a student must

achieve an engineering term average of at least 2.0 while carrying a minimum course load of 14.0 units.

iv. graduation requirements applicable to the program

**Requirements to Graduate:** To graduate, a student must pass all courses required by the specific program; have an Engineering Graduation Average (EGA) of 2.0 or greater (calculated based on the final four academic terms); be in satisfactory academic standing, i.e., have a Fall/Winter GPA of 2.0 or greater.

A student who is otherwise eligible to graduate but has an EGA of less than 2.0 and/or a Fall/Winter GPA in the range 1.7 to 1.9 is permitted to return for one additional term provided this term falls within the 72 month degree time limit as specified in Time Limit for Completion of Degree. Courses to be taken during this additional term are specified by the Dean. If the student's EGA and Fall/Winter GPA following this term are not both 2.0 or greater, the student will not qualify for a degree and will not be allowed to continue in the Faculty.

v. grading scale/system.

The university uses a four-point letter-grading system for calculating Grade Point Averages (GPA). Grade points reflect judgements of student achievement performance in a class. The instructors mark in terms of raw scores, rank the papers in order of merit, and assign an appropriate grade to each paper.

Descriptor	Letter Grade	Grade Point Value
Excellent	A+	4.0
	A	4.0
	A-	3.7
Good	B+	3.3
	B	3.0
	B-	2.7
Satisfactory	C+	2.3
	C	2.0
	C-	1.7
Poor	D+	1.3
Minimal Pass	D	1
Failure	F	0

- b. Note any program specific regulations (e.g., for doctoral programs, note any candidacy or dissertation requirements, examination requirements, time to completion requirements, etc.).

Not applicable.

- c. Identify potential opportunities for transfer/laddering into the proposed program from other institutions or other programs within the institution, and for transfer/laddering from the proposed program to other programs within the institution or at other institutions. List any formal agreements for internal or inter-institutional transfer/laddering that have been negotiated to this point.

The Faculty of Engineering at the University of Alberta offers one-year **Engineering Transfer Programs** through the following Alberta and British Columbia post-secondary institutions:

- Northwestern Polytechnic (formally Grande Prairie Regional College)
- Keyano College
- Medicine Hat College
- Red Deer Polytechnic
- University of Lethbridge
- Vancouver Island University
- Northern Lights College
- College of the Rockies

Students in the engineering transfer programs will take equivalent courses to those completed by first year Engineering students at the University of Alberta and will be considered for admission into a second year Engineering at Alberta program based on their first year results and will be considered for program placement on an equal basis with continuing University of Alberta Engineering students.

**Transferring from another post-secondary institution:**

If there is not an existing transfer agreement in place between the University of Alberta and the other postsecondary institution, each transfer application is reviewed to assess transfer credit (the same application and review process applies in the case of transferring within the University of Alberta and in the case of transferring from other postsecondary institutions).

Admission for students with previous post-secondary experience into the Faculty of Engineering at the University of Alberta will depend on space availability within the faculty. Available seats will be offered on a competitive basis, considering the applicant's most recent fall/winter GPA and the amount of transferable coursework that they have completed. As admission is competitive, the faculty cannot predict how many transfer students will be admitted on a yearly basis or what the cut-off GPA will be; however, students must have at least a 3.0 GPA on 8 or more courses in their most recent fall/winter in order to be considered. Students with previous post-secondary experience, regardless of whether it is several courses, a degree, or a diploma, will likely be assessed as transfer applicants. Transfer applications will be evaluated based on transferable post-secondary coursework.

**Transferring from an Engineering Technologist Program:**

Students who complete Engineering Technologist Diploma programs can be considered for admission to the Faculty of Engineering at the University of Alberta. Students will be considered for admission to the qualifying year of Engineering where they will be expected to maintain a full course load. Upon the successful completion of the qualifying year, students will then be placed into an Engineering discipline on a competitive basis determined by their course load and GPA.

### **First Year Engineering in French**

While technically not a transfer program, it is possible to take most of the first-year courses in French through the Faculté Saint-Jean at the University of Alberta. Academic conditions and content of the courses are equivalent to their English counterparts.

## **6. Engaged and Active Learning / Delivery Methods**

- a. Discuss the pedagogical strategies used in the program, including rationale and resource implications where possible.

The pedagogical approach for educating students in the Mechatronics and Robotics program will undertake a similar approach to the other engineering undergraduate programs at the University of Alberta in the Faculty of Engineering.

In the common first year, students are not only introduced to **foundational technical knowledge** for first-year engineering, but also to the nature of the profession, through courses such as ENGG 100 (Success in Engineering) and ENGG 160 (Introduction to Engineering Design, Communication, and Profession). Technical courses are accompanied by tutorial and/or lab sessions where students have the opportunity to apply the material and explore their understanding of the subject matter.

Courses which focus on design and other professional skills implement **active learning strategies** such as **gamification, blended learning, and team-based learning** in order to support students in developing professional skills such as teamwork, communication, ethics and leadership.

Assessment of student knowledge also varies by course. In more technical courses, students receive formative feedback through regular assignments and summative assessment is typically through a final exam. ENGG 160 uses competency-based grading; this innovative and student-centered form of assessment allows students and teams to receive regular feedback on their work, resubmitting assignments if necessary until a specific level of competency is achieved, and a credit rather than a grade is given. All course summative assessments are also governed by requirements of CEAB to allow accreditation of the program.

Resources for these courses include existing lecture-style theaters that can accommodate large numbers of students along with suitable tutorial and lab rooms. For the majority of courses in the program, no further resources are planned at this point.

One of the unique experiences that a student undertaking an engineering degree will have is the opportunity to express their knowledge through addressing a **design challenge** that will often integrate a multitude of different areas. As described above, the design experience starts in the first common year where the students are introduced to the design process and work in teams to solve an open-ended design problem. This is continued throughout the remainder of the Mechatronics and Robotics program with a design course in the second semesters of the 2nd and 3rd year (MCTR 260 and MCTR 360, respectively). These design challenges will be interactive and hands-on with the students physically building their solutions in some courses. In 2nd year, students will investigate manufacturing techniques while doing component design. In 3rd year, the design-build solution will comprise system design with strong integration of control and software. At the same time, both in 2nd and 3rd year, computer-aided design using industry-standard computer aided design (CAD) tools will also allow students to explore and interact with their solution in the virtual world. Resources for these activities and designated manufacturing spaces are provided to the students to undertake their design and build activities. Design spaces, including different facilities for group meetings, components fabrication and testing of built design solutions, are already available in the Faculty of Engineering. The culmination of the design experience will be a two-term, two course (MCTR 460 & MCTR 461) **capstone design project** where students will interact with a real design problem and a real-world client. While the main focus will not be on building a physical device, the students will get the opportunity to develop a design solution using design theory and the knowledge they have gained throughout their degree in a real-world situation.

b. Describe how engaged, active, and experiential learning will be encouraged.

Throughout the program, labs in a variety of courses provide students an opportunity to engage in active experiential learning. It is through the design theme and design courses that students will have the best opportunity to be engaged in experiential learning. The teamwork, communication and leadership skills they develop in these courses will complement the analytical knowledge gained in other courses in the program. Experiential activities in the 2nd and 3rd year design subjects where the students physically build their design solution include the manufacture of individual components, assembly of components into complete systems, development and testing of the software. The students will also typically compete in a competition at the end of the course where students can experience and evaluate the performance of their design solutions.

The students will also have opportunity in two other areas to be engaged in experiential learning: the Co-op program, and student groups.

**Co-operative work experience:** After 2nd year, students will complete an 8-month co-op work term, and after 3rd year, they will complete a co-op work term with a duration of 12 months. Following the requirements of CEAB, these work terms will be paid positions that will typically be arranged through the Faculty of Engineering's Co-op Office. This office will also evaluate the position to ensure that it is suitable for the student learning experience and also carry out site visits and evaluate student reports to ensure excellence of the experience.

**Student groups:** Students can also choose to engage in a large variety of student teams that are hosted within the Faculty of Engineering. These are typically vehicle teams such as the FSAE vehicle project, AlbertaLOOP, Alberta SAT, Heavy Lift Aircraft etc. These are student-founded, student-led teams with a faculty advisor and the student groups are partially funded by the Faculty of Engineering. Students also source funding from industry partners and endowments. The student groups/teams often enter their vehicles in regional or national competitions with student teams from other universities. Students have the opportunity to use the technical knowledge that they are learning in the program to solve a design problem of their choosing in collaboration with an interdisciplinary group of students in a student-led and student-managed context.

Resources for both of these activities are well-established and well-funded through the Faculty of Engineering.

- c. Where applicable, demonstrate how CAQC's Additional Quality Assessment Standards for Programs Delivered in Blended, Distributed or Distance Modes will be met (Handbook s. 4.5).

Not applicable.

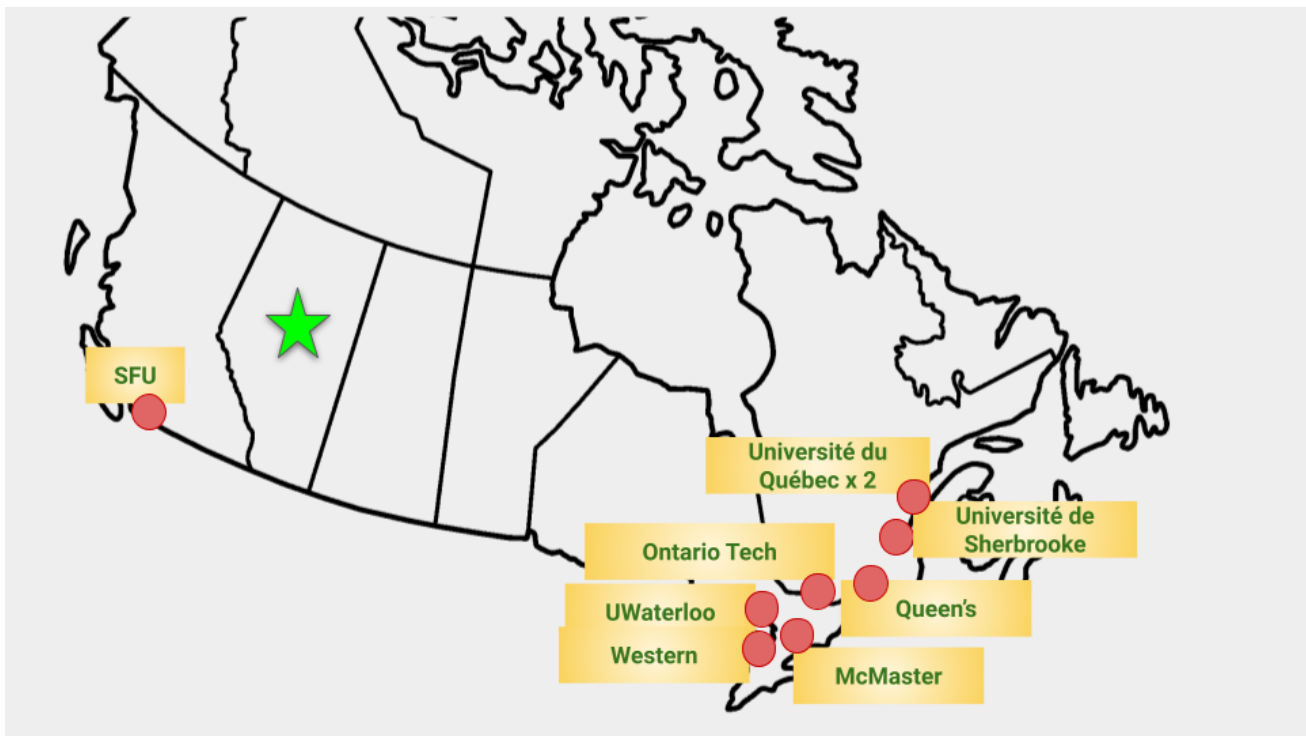
## 7. Program Comparison

- a. Provide a comparative analysis of the proposed program (curriculum, structure, admission requirements, etc.) with similar programs offered in Alberta or elsewhere (see sample table below). Provide a rationale for which comparator programs were chosen. Illustrate the similarities and differences. Include hyperlinks to comparator programs, if possible.
- Based on information from Engineers Canada, there are five accredited mechatronics-related programs in Canada outside Quebec, and there are three accredited programs in Quebec in “Electromechanical Engineering”, “Electromechanical Systems Engineering”, and “Robotics”. The accredited degree programs are listed below in Table 9.
  - As shown on the map of full program locations (see Figure 4 below), there is a void of programs in the Prairie provinces, which have natural resources and agriculture as primary economic drivers.

**Table 9: Accredited degree programs in mechatronics in Canada\***

Accredited degree	Institution	Accreditation date
Mechatronic Systems	Simon Fraser	2011 – present
	Western Ontario	2014 – present
Mechatronics	McMaster	2009 – present
	Ontario Institute of Technology	2020 – present
	Waterloo	2008 – present
Génie électromécanique	Québec en Abitibi-Témiscamingue	2000 – present
Génie des systèmes électromécanique	Québec à Rimouski	1998 – present
Génie robotique	Sherbrooke	2021 – present

\* <https://engineerscanada.ca/accreditation/accredited-programs>



**Figure 4. Map of mechatronics programs in Canada (8 accredited programs plus Queen's University)**

For the purpose of program comparison, three universities were selected as shown in Table 10. Simon Fraser was selected given its proximity to Alberta and because it is the only Mechatronics Engineering program west of Ontario. Waterloo was selected given its notable reputation and because it is the largest engineering school in the country. Queen's University was selected because it is the newest mechatronics program (students were first admitted to the program in Fall 2021).

**Table 10. Program comparison**

<b>Program component</b>	<b>University of Alberta (proposed)</b>	<b><u>Simon Fraser University</u></b>	<b><u>University of Waterloo</u></b>	<b><u>Queen's University*</u></b>
<b>Name of credential</b>	Bachelor of Science (BSc) in Mechatronics and Robotics Engineering	Bachelor of Applied Science (BASc) in Mechatronic Systems Engineering	Bachelor of Applied Science (BASc) in Mechatronic Systems Engineering	Bachelor of Science (BSc) in Mechatronics and Robotics Engineering
<b>Program entry</b>	Students make their program selection after completing a qualifying first-year program that is common to all engineering degree programs	Direct entry program (i.e., starting in first year)	Direct entry program (i.e., starting in first year)	Direct entry program (i.e., starting in first year)
<b>Areas of study (options, streams, concentrations)</b>	Students may select from approved technical electives. Suggested electives are provided for five streams: Aerospace; Advanced Manufacturing; Cyber-physical Systems; Intelligent Systems; Biomechatronics	Options: BASc Honours program; Double degree program (Mechatronics Systems Engineering and Business), 5-year flexible degree	None	Students choose one of four concentrations for technical electives in their final year: Automation, Robotics, Biomedical, or Intelligent Systems
<b>Work Integrated Learning</b>	Co-op program 1 x 8-month term + 1 x 12-month term = 20 months total	Co-op program 3 x 4-month terms = 12 months	Co-op program 6 x 4-month terms = 24 months total	None
<b>Number of courses</b>				
Natural Sciences	4	3	1	3
Mathematics	6	6	6	6
Engineering Science (Mechanical)	4	5	6	5
Engineering Science (Electrical)	5	4	6	7
Engineering Science (Computer)	4	2	3	3
Engineering Design	6	6	4	6
Mechatronics, Robotics, & Controls	8	5	5	6
Professional Practice	5	5	8	2
Complementary Studies	3	3	4	3
Technical Electives	4	6	5	8



<b>Graduation requirements</b>	143 credits	149 credits	21.5 credits (equivalent to 136 UAlberta credits)	<i>Not available</i>
<b>Program duration</b>	8 study terms, 5 co-op work terms, 5 years total	8 study terms, 3 co-op work terms, 4 years total	8 study terms, 6 co-op work terms, 5 years total	8 study terms, 0 co-op work terms, 4 years total

\*Curriculum development is still in progress.

## 8. Other Elements Affecting Quality

- a. Note any other relevant aspects of the proposed program that might affect quality (e.g., fast-tracking, individual study, parts of the program to be offered in cooperation with another institution, prior learning assessment, transfer agreements (e.g., 2+2 type programs, etc.).

Not applicable.

## SECTION B: IMPLEMENTATION AND RESOURCES

### 1. Program Implementation Plan

- a. Provide a program implementation plan by academic year (start to maturity) that includes any elements to be phased in (e.g., new academic staff hires, courses, minors, co-op option). If introduction of this program is dependent on a similar program being phased out, the implementation plan should include how both programs are being supported until the phase out and start up are completed. Confirm that students will be given the option to complete the program in which they are originally registered, within the normal time to degree completion regulations, or to transfer to the new program. If this will not be the case, explain why.

The Faculty of Engineering has experienced teaching staff in ECE and MECE with subject matter expertise in mechatronics (refer to the Staffing Plan section, and refer to Appendix F for the academic CVs of existing faculty members who will teach in the program). The implementation of the Mechatronics and Robotics program is not dependent on any existing program being phased out. A detailed look at student enrolment and cohort progress through the program during the first five years of program implementation is shown below in Table 11.

Students already enrolled in existing ECE and MECE programs will not be able to transfer into the Mechatronics and Robotics program due to the unique arrangement and subject

matter of the program courses. Only students entering first year and then starting in Mechatronics and Robotics in their second year will be eligible to complete the program.

The intention is to develop course-based and thesis-based graduate programs in the future, which would be phased in to allow MECE and ECE graduates to complete a graduate degree in Mechatronics and Robotics.

**Table 11. Student Enrolment by Program Implementation Year, Academic Year, Term, and Cohort**

Year	Academic Year 1			Academic Year 2			Academic Year 3			Academic Year 4			Academic Year 5		
	2024	2025	2025	2025	2026	2026	2026	2027	2027	2027	2027	2028	2028	2028	2029
Term	Fall	Winter	Spring Summer	Fall	Winter	Spring Summer	Fall	Winter	Spring Summer	Fall	Winter	Spring Summer	Fall	Winter	Spring Summer
Term 1	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0
Term 2	0	100	0	0	100	0	0	100	0	0	100	0	0	100	0
Term 3	0	0	0	100	0	0	100	0	0	100	0	0	100	0	0
Term 4	0	0	0	0	100	0	0	100	0	0	100	0	0	100	0
WKEXP 1	0	0	0	0	0	100	0	0	100	0	0	100	0	0	100
WKEXP 2	0	0	0	0	0	0	100	0	0	100	0	0	100	0	0
Term 5	0	0	0	0	0	0	0	100	0	0	100	0	0	100	0
Term 6	0	0	0	0	0	0	0	0	100	0	0	100	0	0	100
WKEXP 3	0	0	0	0	0	0	0	0	0	100	0	0	100	0	0
WKEXP 4	0	0	0	0	0	0	0	0	0	0	100	0	0	100	0
WKEXP 5	0	0	0	0	0	0	0	0	0	0	0	100	0	0	100
Term 7	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0
Term 8	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0
Academic Students	100	100	0	200	200	0	200	300	100	200	300	100	300	400	100
Work Term Students	0	0	0	0	0	100	100	0	100	200	100	200	200	100	200
Total Students	100	100	0	200	200	100	300	300	200	400	400	300	500	500	300

**Legend**

First cohort	Second cohort	Third cohort	Fourth cohort
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The program implementation plan detailed below includes the number of new hires in each academic year, the number of co-op placements required, the number of students in study terms, and the program implementation steps to be undertaken during the academic year. The ramp up in terms of new instructors hired to teach in the program is based on the net

number of new courses offered in each academic year. Note: TT denotes Tenure-Track academic staff, and ATS denotes Academic Teaching Staff.

Please note that while the Staffing Plan (in the following section) indicates only two new hires, the program as a whole will require hiring an additional 14 instructors (both Tenure Track and ATS). These new instructors will add redundancy in delivering the proposed new courses as each course should have two or more qualified instructors, and will also backfill the existing instructors within ECE and MECE departments who would vacate their current teaching appointments to instruct in Mechatronics and Robotics. The hiring for all positions noted in the implementation plan will adhere to the practices described in the proposed program's EDI Strategy (found in Appendix B).

## Program Implementation Plan

### Academic year 2022-2023 (Current Year)

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Number of new hires: 0 TT ; 0 ATS

Program implementation actions taken during the year:

- Sourcing quotes for lab and seminar equipment
- Finalizing course design
- Establishing Mechatronics Industry Advisory Committee (MIAC)
- Establishing Indigenous Program Advisory Council
- Establishing EDI Program Advisory Committee
- Determining Program Co-Directors and governance procedures

### Academic year 2023-2024 (Year 0)

---

Number of new hires: 0 TT ; 0 ATS

Number of new technician hires: 0

Program implementation actions to be taken during the year:

- Procuring specialized equipment
- Increasing the number of staff in Co-op office
- Training recruiters
- Creating and disseminating promotional materials in consultation with committees established above

### Academic year 2024-2025 (Year 1)

---

Number of new hires: 2 TT ; 0 ATS

Number of new technician hires: 1

Number of students in 1st year: 100

Net new courses taught for the first time: 0

Program implementation actions to be taken during the year:

- Increasing the number of staff in Co-op office
- Training recruiters
- Working with employers to identify net new co-op placements
- Promoting the Mechatronics and Robotics program to first year students prior to discipline selection (May 2025)
- Invite CEAB to conduct a preliminary curriculum review

### Academic year 2025-2026 (Year 2)

---

Number of new hires: 3 TT ; 2 ATS  
Number of new technician hires: 1  
Number of students in 1st year: 100  
Number of students in academic terms 3-4 (2nd year): 100  
Net new courses taught for the first time (in academic terms 3-4): 6  
First cohort starts 8-month co-op term in Spring  
Number of co-op placements needed for 8-month work term: 100  
Program implementation actions to be taken during the year:

- Working with employers to identify net new co-op placements
- Creating new functional lab spaces for robotics

### **Academic year 2026-2027 (Year 3)**

---

Number of new hires: 2 TT ; 1 ATS  
Number of new technician hires: 1  
Number of students in 1st year: 100  
Number of students in academic terms 3-4 (2nd year): 100  
Number of co-op placements needed for 8-month work term: 100  
Second cohort starts 8-month co-op term in Spring  
Number of students in academic terms 5-6: 100  
First cohort starts 3rd year courses in Winter term  
Net new courses taught for the first time (in academic terms 5-6): 11  
Program implementation actions to be taken during the year:

- Working with employers to identify net new co-op placements

### **Academic year 2027-2028 (Year 4)**

---

Number of new hires: 3 TT ; 1 ATS  
Number of new technician hires: 1  
Number of students in 1st year: 100  
Number of students in academic terms 3-4 (2nd year): 100  
Number of co-op placements needed for 8-month work term: 100  
Number of students in academic terms 5-6: 100  
First cohort starts 12-month co-op term in Fall term  
Number of co-op placements needed for 12-month work term: 100  
Net new courses taught for the first time: 0  
Program implementation actions to be taken during the year:

- Creation of graduate program, both thesis- and course-based
- Exploring adding a traditional program option for Mechatronics and Robotics

### **Academic year 2028-2029 (Year 5, reaches maturity/steady state)**

---

Number of new hires: 0 TT ; 0 ATS  
Number of new technician hires: 0  
Number of students in 1st year: 100  
Number of students in academic terms 3-4 (2nd year): 100  
Number of co-op placements needed for 8-month work term: 100  
Number of students in academic terms 5-6: 100  
Number of co-op placements needed for 12-month work term: 100  
First cohort starts 4th (final) academic year in Fall term  
Number of students in academic terms 7-8: 100  
Net new courses taught for the first time: 5 core courses + 4-6 technical electives  
First CEAB accreditation visit (when first cohort is in Winter Term 8)

## 2. Staffing Plan

- a. Provide a comprehensive staffing plan. Show how the number (headcount and FTE) and qualifications of teaching staff meet CAQC's requirements and the objectives of the program as a whole. If the hiring of additional staff is planned, include the academic staff expertise to be recruited. Provide summary information of current academic staff and new hires who will be teaching in the proposed program in the following format (see sample table below).

As described in the above sections, the first year of the proposed program is a common first year for all students in the Faculty of Engineering and has well-developed support from the Faculties of Science and Arts; therefore, the table below includes only those courses taught within the Faculty of Engineering starting in the 2nd year of the program. Moreover, the implementation of this program does not introduce specialized teaching needs to any of the approved complementary studies electives or Impact of Technology on Society (ITS) electives, so those courses are also excluded from Table 12 below.

**Table 12: Courses taught by academic staff including credentials and specialization**

Courses	NAME Last, First	Earned credentials and specialization	Professional designation (if applicable)	Academic staff status
<b>TERM 3</b>				
MCTR 202 Electric Circuits for Mechatronics	Karamudi, Rambabu	Ph.D. (Electrical and Computer Engineering)	PEng	Tenure
MCTR 274 Programming with Data Structures and Algorithms for Mechatronics I	NEW HIRE #1	Ph.D. (Computer Engineering)	PEng	
CIV E 270 Mechanics of Deformable Bodies I	Bindiganavile, Vivek  (and various professors in Civil)	PhD in Civil Engineering	PEng	Tenure
MCTR 240 Signals and Systems	Tellambura, Chintha	Ph.D. (Electrical Engineering)	PEng	Tenure
<b>TERM 4</b>				

MCTR 260 Mechatronics and Robotics Design I	Nakashima, Benjamin	Ph.D. (Engineering Management)	PEng	ATS (full-time academic teaching staff)
MCTR 265 Computer-Aided Design for Mechatronics	Nobes, David	Ph.D. (Mechanical Engineering)	PEng	Tenure
MEC E 230 Introduction to Thermo-Fluid Sciences	Martin, Andrew	Ph.D. (Mechanical Engineering)	PEng	Tenure
MCTR 210 Digital Logic Design and Microprocessors	Lou, Edmond	Ph.D. (Electrical and Computer Engineering)	PEng	Tenure
ECE 342 Probability for Electrical and Computer Engineers	Jing, Yindi	Ph.D. (Electrical Engineering)	PEng	Tenure
MEC E 250 Engineering Mechanics II	Cheung, Ben	Ph.D. (Mechanical Engineering)	PEng	ATS (full-time academic teaching staff)
ENGG 299 Orientation to Cooperative Education	Staff from the Co-op Office			
<b>TERM 5</b>				
MCTR 320 Feedback Control Systems	Koch, Bob	Ph.D. (Mechanical Engineering)	PEng	Tenure
MCTR 374 Programming with data structures and algorithms for mechatronics II	NEW HIRE #1	Ph.D. (Electrical, Computer or Mechanical Engineering)	PEng	Tenure-Track
MCTR 300 Electronics, Sensors, and Data Analysis	Moez, Kambiz	Ph.D. (Electrical and Computer Engineering)	PEng	Tenure
MCTR 355 Introduction to Systems	Lipsett, Mike	Ph.D. (Mechanical Engineering)	PEng	Tenure

Engineering for Mechatronics				
MCTR 357 Robotic Manipulators	Tavakoli Afshari, Mahdi	Ph.D. (Electrical and Computer Engineering)	PEng	Tenure
MCTR 350 Advanced Dynamics	Tang, Tian	Ph.D. (Theoretical and Applied Mechanics)	PEng	Tenure
<b>TERM 6</b>				
MCTR 360 Mechatronics and Robotics Design II	Nakashima, Benjamin	Ph.D. (Engineering Management)	PEng	ATS (full-time academic teaching staff)
MCTR 365 Computer-Aided Machine Design	Qureshi, Ahmed	Ph.D. (Mechanical Engineering)	PEng	Tenure
ECE 315 Computer Interfacing	Cockburn, Bruce	Ph.D. (Computer Science)	PEng	Tenure
MCTR 332 Actuators, Machines, and Power Electronics	Kish, Gregory	Ph.D. (Electrical Engineering)	PEng	Tenure
MCTR 399 Analytical and Numerical Methods for Mechatronics	NEW HIRE #2	Ph.D. (Electrical, Computer or Mechanical Engineering)	PEng	Tenure-Track
MCTR 370 Machine Learning for Mechatronics	Dick, Scott	Ph.D. (Computer Engineering)	PEng	Tenure
<b>TERM 7</b>				
MCTR 460 Design Project I	Lipsett, Mike or Knudsen, Steven	Ph.D. (Mechanical Engineering)  Ph.D. (Electrical Engineering)	PEng  PEng	Tenure  ATS Full Lecturer
MCTR 420 Modern Control Theory for Mechatronics	Chen, Tongwen	Ph.D. (Electrical Engineering)	PEng	Tenure

ENG M 401 Financial Management for Engineers	Nakashima, Benjamin	Ph.D. (Engineering Management)	PEng	ATS (full-time academic teaching staff)
<b>TERM 8</b>				
MCTR 461 Design Project II	Lipsett, Mike	Ph.D. (Mechanical Engineering)	PEng	Tenure
	or Knudsen, Steven	Ph.D. (Electrical Engineering)	PEng	ATS Full Lecturer
MCTR 421 Estimation Theory for Mechatronics	Zhao, Qing	Ph.D. (Electrical and Computer Engineering)	PEng	Tenure
ENGG 400 The Practice of the Engineering Profession	Lazaruk, Tyson	Masters of Business	-	ATS Assistant Lecturer, Teaching and Student Support Specialist
MCTR 465 Mobile Robotics	Hashemi, Ehsan	Ph.D. (Mechanical and Mechatronics Engineering)	Will have PEng designation before Fall 2025	Tenure-Track
<b>NEW PROGRAM / TECHNICAL ELECTIVES</b>				
MCTR 467 Design of UAVs	Lynch, Alan	Ph.D. (Electrical and Computer Engineering)	PEng	Tenure
MCTR 469 Numerical Control of Machine Tools	Rouhani, Hossein	Ph.D. (Biotechnology and Bioengineering)	PEng	Tenure
MCTR 481 Mechatronic Welding and Joining	Yakout, Mostafa	Ph.D. (Mechanical Engineering)	Will have PEng designation before Fall 2025	Tenure-Track
MCTR 462 Designing Mechatronics Systems for BioMedicine	Vette, Albert	Ph.D. (Biomedical Engineering)	PEng	Tenure



The intention is to hire a minimum of two new tenure-track academic faculty members to teach in two specific areas of mechatronics and robotics: (1) Object-oriented programming, data structures and algorithms for mechatronics; and (2) Analytical and numerical methods with mechatronics applications. Hiring of new faculty members will follow the practices described in the proposed program's EDI Strategy (found in Appendix B).

**New Hire #1** would teach the following two new courses:

- MCTR 274 Introduction to object-oriented programming in C/C++ for mechatronic applications. Introduction to data structures and classes, algorithm analysis and design. Concepts illustrated on a physical mechatronic system.
- MCTR 374 Programming with data structures and algorithms for mechatronics II Advanced topics in object-oriented programming in C/C++ for mechatronic applications. Advanced data structures, and algorithm analysis and design. Concepts illustrated using a physical mechatronic system and practical mechatronic applications.

**New Hire #2** would teach the following new course:

- MCTR 399 Analytical and Numerical Methods for Mechatronics Analytical and numerical methods with mechatronics applications: Complex numbers, analytic functions, elementary functions, mappings, integrals, series, residues and poles, integral formulas. Statistical tests. Numerical integration and differentiation, solution methods of initial value and boundary value problems, ordinary differential equations, linear regression.

- b. Explain the workload expectations for teaching, scholarship, and service of all of the academic staff categories involved in teaching this program.

The workload expectations for teaching, scholarship and service are as follows:

Tenured or Tenure-Track Faculty members in Engineering have a workload expectation of:

- 40% teaching
- 40% research (scholarship)
- 20% service

For Faculty members with exceptional teaching or research programs, or those involved in leadership positions within the Department or the Faculty (Chair, Associate Dean, etc), the workload expectations can be adjusted, but the majority of Faculty members follow this 40/40/20 distribution. The typical teaching load is 3 courses per year:

- 1-2 core undergraduate courses
- 0-1 elective courses
- 1 graduate course

Academic Teaching Staff (full-time) in Engineering have a workload expectation of:

- 80% teaching
- 20% service

As with Tenured or Tenure-Track Faculty members, ATS staff may have individual expectations that deviate from this, but the majority of ATS staff follow this 80/20 distribution. The typical teaching load is 6 courses per year:

- 3-4 core undergraduate course
- 1-2 elective courses
- 1-2 graduate courses

Industrial Professors (sessional instructors) typically support a single specialized technical elective or graduate course in the program. They usually have part-time, short term contractual commitments with the Department to deliver a non-core course and have no service or scholarship commitments.

- 1 elective OR 1 graduate course

- c. Clearly indicate how many academic staff will be teaching in the program at launch and at maturity.

During program launch, there are no new academic staff required for the program. Year 1 of the program is a common first year for all students with existing capacity to deliver the first-year program to the new cohort of students.

At steady-state (Year 5 of the program), Engineering expects to have recruited 10 net new tenured or tenure-track faculty members, 4 new full-time academic teaching staff, and 2–4 Industrial Professors.

Taking into account the existing 24–26 tenured, tenure track, or academic teaching staff with existing mechatronics and robotics expertise already within Mechanical and Electrical and Computer Engineering, we expect around 40 academic staff members will be teaching within the program.

- d. Identify any academic staff who will be teaching in the program who do not meet CAQC's requirements with respect to qualifications of academic staff as noted in s. 4.3.4.3 of the Handbook (normally an acceptable Master's degree or equivalent in the discipline in which the staff member is assigned to teach), and provide the rationale for claiming equivalence.

Not applicable.

- e. For graduate programs, provide a detailed plan regarding the academic advising, supervision, and monitoring of graduate students, and state the credentials, graduate teaching experience, master's committee work/supervision, and PhD supervision experience of academic staff. For doctoral programs, a summary table such as the following would be helpful.

Not applicable.

- f. Include CVs of academic staff teaching courses that comprise required or elective courses in the specialization. Be sure their permission has been given.

Please refer to Appendix F.

### 3. Scholarly and Creative Activity

- a. Describe what constitutes scholarship and/or creative activity for academic staff teaching in this program. Explain the institution's and if relevant, the faculty's, school's, and/or department's formal policies articulating expectations of scholarly performance for instructors in the proposed program, and how evaluations of this performance are taken into account in overall assessments of instructors' performance.

The Faculty of Engineering recognizes that people are, and will continue to be, our greatest strength. We celebrate creativity, diversity, perseverance, and a co-operative spirit.

While the Faculty Evaluation Committee (FEC) is mandated to evaluate performance on a yearly basis, the Faculty of Engineering values long-term scholarship, success, and development of its academic faculty members. The Faculty of Engineering encourages its academic faculty members to strive for scholarly excellence while maintaining an appropriate balance between teaching, research, and service to the University, the engineering profession, and society. In a similar spirit, the Faculty of Engineering encourages its academic faculty members to strive for an appropriate work-life balance.

As outlined in the **Collective Agreement**, an Academic Faculty member shall be a scholar, active in teaching, in research, and in service. The responsibilities of an Academic Faculty member shall include Teaching, Research and Service as described below. The proportion of Teaching, Research and Service shall be determined by agreement of the Department Chair and Academic Faculty Member for the upcoming year, or as set out in the Academic Faculty member's Letter of Appointment.

**Teaching responsibilities** include participation in teaching programs, including classroom teaching, supervision of graduate students and personal interactions with and advising students.

**Research responsibilities** include active participation in research (defined as including the preparation or performance of creative works and reflective inquiry), the dissemination of the results of research by means appropriate to the discipline, and seeking financial support (research funds) for such research from granting agencies or other sources.

**Service responsibilities** include provision of service to the discipline of the Academic Faculty member; participation in the governance of the University, the Faculty and the Department; and dissemination of knowledge to the general public by making available

the Academic Faculty member's expertise and knowledge of the discipline all of which shall be carried out according to the standards of professional conduct expected of an Academic Faculty member.

The Faculty of Engineering **values teaching** that educates, inspires, challenges, and brings out the best in students. We appreciate a diversity of teaching styles, outcomes, and measures.

The Faculty of Engineering **values research** that is courageous and impactful, expands our knowledge on important frontiers, confronts the greatest global and local challenges, and improves the quality of life for generations to come. We appreciate a diversity of research styles, dissemination venues, and sizes of research programs.

The Faculty of Engineering **values service** that supports the operation of, encourages the evolution and growth of, and builds the local and/or international reputation of, the University, our Faculty, the engineering profession, and society. We appreciate a diversity of avenues of service and encourage paths of passion and ability.

While understanding that teaching, research, and service are required of all academic faculty members, the Faculty recognizes that individual academic faculty members' strengths and efforts will vary amongst these three areas.

**Evaluation of Teaching:** According to the Collective Agreement, the evaluation of teaching shall be multi-faceted and, in particular, shall not be based primarily on any one method of evaluation. The standards for evaluation of teaching performance shall be broadly based, including course content, course design and performance in the classroom. Such evaluation may take into account information such as reviews of teaching dossiers and other materials provided by the Academic Faculty member; reviews by peers and administrative officials; comprehensive reviews of student commentary; and the frequency distribution of responses to student questionnaires.

- b. Describe current and anticipated support for scholarly activities and professional development of academic staff (see CAQC's expectations regarding scholarship, research, and creative activity in s. 3.7.3 of CAQC's Handbook). Highlight some of the existing strengths in scholarship relevant to the program, as well as key challenges.

The Faculty of Engineering and the Departments of Mechanical Engineering and Electrical & Computer Engineering provide resources to academic staff members to support their scholarly activities and professional development.

- Professional expense allowance of \$1400 that can be applied towards professional development activities including books, subscriptions, conferences, equipment, membership dues.
- Internal research funding is available through endowments, and the engineering research fund.
- UAlberta Engineering Research Chairs program recognizes and supports researchers running large collaborative research programs.
- Dean's Research Awards program supports undergraduate students involved in research.

- Faculty of Engineering Graduate Research Symposium is a venue for students to present their research contributions.
- Extensive fabrication, characterization, machining facilities at subsidized rates for research.
- Professional development and conference space is available for use for Engineering events (generally at no cost).
- Excellent library facilities are available to support scholarly activities and professional development with online access to journals, technical standards, etc.
- A start-up fund of approximately \$100,000 is provided to new academic staff.
- The Faculty of Engineering's Research Exploration Fund (REF) provides support for faculty who are facing challenges in their current research program or are interested in exploring new research areas. The REF Program is a competitive program with the objective of assisting academic staff members of the Faculty of Engineering's with bridge funding to either overcome challenges in their current research program and/or explore areas of research novel to their current research program by providing up to \$50,000 over two years. The program aims to support the growth and development of faculty members facing challenges in their research program; foster exploration in novel research areas; and increase the quality, capacity, and relevance of the Faculty of Engineering's research outputs to our communities of practice.
- The Lab Safety Associates Program allocates department funding to individuals who are identified by academic staff to take on a safety leadership role in their research groups.
- Graduate support staff (student advisors and applications assistant) are funded by departments to support the graduate students, i.e., highly qualified personnel, who are supervised by academic staff in order to carry out scholarly activities and research
- New academic staff are provided with \$1,800 in computing equipment to support their scholarly activities and professional development.
- The positions of Strategic Support Coordinator and Grant & Technical Communicator are funded by the Departments in order to provide academic staff with technical writing assistance and support in preparing and submitting applications for grants to fund their research activities.
- Teaching Assistant and marker support is provided to academic staff, which enables academic staff to allocate more time to research activities (for example, approximately \$1.35 million budgeted for fiscal year 2023 by the Mechanical Engineering Department).
- Departments actively encourage academic and student visitors to the university with the goal of fostering and supporting collaboration.
- To relieve the administrative burden on academic staff who are engaged in research, additional administrative support is provided for leadership positions and a shared assistant across the department is available on an opt-in basis.
- To support academic staff in seeking awards in recognition of their scholarship activities, the Nomination Committee is available to provide strategic advice and resources/support.
- The UAlberta's Technology Transfer Services (TTS) team, part of the Vice-President (Research and Innovation) portfolio, provides university-wide support to help researchers, postdoctoral fellows, staff, and students explore the commercial potential of their discoveries and innovations and to support intellectual property (IP) protection and strategy.

- The Faculty of Engineering has a support system in place for scholarship that enables academic faculty members to pursue research funding to the tune of:
  - \$62.5 million in 2019-20
  - \$77.8 million in 2020-21
  - \$73.2 million in 2021-22

To highlight the strength of the University of Alberta in scholarship related to mechatronics and robotics, the research projects listed below have recently been awarded total funding of close to \$12 million dollars: (**Industrial partner in bold**)

- Intelligent Sensors and Electromagnetic Surfaces for Resilient Networking and Communications in 5G Wireless Environments (Lead PI: Dr. Ashwin Iyer; Sponsor: Department of National Defence, Canada)
- Multi-material robotic hybrid additive wire arc manufacturing for energy industry (PI: Dr. Ahmed Qureshi; Sponsor: **Syncrude**, NSERC Alliance)
- Artificial Intelligence Industry and Academic Accelerator (PI: Dr. Edmond Lou; Sponsor: Western Economic Diversification)
- Development of Innovative Methods to Assist Treatment of Scoliosis (PI: Dr. Edmond Lou; Sponsor: Alberta Health Services)
- Advanced Solutions for Efficient Alarm Monitoring and Management of Complex Industrial Facilities (PI: Dr. Tongwen Chen; Sponsor: **Suncor**, Multi-sponsor, NSERC CRD)
- Intelligent Alarm Monitoring and Management of Complex Industrial Facilities (PI: Dr. Tongwen Chen; Sponsor: Multi-sponsor, NSERC Alliance)
- A framework for assessment of impact of exoskeletons on safety and performance of construction workers (PI: Dr. Hossein Rouhani; Sponsor: **EWI Works**, AB Innovation, NSERC)
- Computer-Integrated Ultrasound Guidance and Mechatronics Assistance for Breast Brachytherapy (PI: Dr. Mahdi Tavakoli; Sponsor: NSERC, CIHR)

#### 4. Physical and Technical Infrastructure

- a. Describe the facilities, laboratory, and computer equipment (as applicable), and any additional infrastructure available to meet the specialized demands of the program, as well as plans to address any deficiencies in what might be required.

It is important for students to have access to state-of-the-art equipment, technology, and facilities to allow them to gain hands-on experience with the tools and technologies that are currently used in industry, which prepares them to be competitive in the job market, advance the innovation ecosystem, and make an impact in the field.

Teaching facilities that can accommodate each of the cohorts in the Mechatronics and Robotics program include those listed below in Table 13. To facilitate peer learning and collaboration, meeting rooms are available to students for group work, and the 2nd floor of the ECERF building (Electrical and Computer Engineering Research Facility) provides multiple flex rooms as idea generation spaces.

**Table 13. Engineering teaching facilities that can accommodate the 100 students in each year of the mechatronics engineering program**

Building	Room Number	Number of Seats	Furniture Type	Room Type	Characteristics*
Engineering Teaching and Learning Complex (ETLC)	ETLC E1-003	215	Eclectic seating	Lecture theatre	Camera
Engineering Teaching and Learning Complex (ETLC)	ETLC E1-007	215	Eclectic seating	Lecture theatre	Camera
Engineering Teaching and Learning Complex (ETLC)	ETLC E1-013	215	Eclectic seating	Lecture theatre	Camera
Engineering Teaching and Learning Complex (ETLC)	ETLC E1-017	215	Eclectic seating	Lecture theatre	Camera
Mechanical Engineering (MEC)	MEC 2-1	128	Two-person tables	Classroom	Camera
Mechanical Engineering (MEC)	MEC 2-3	126	Eclectic seating	Classroom	Camera
Natural Resources Engineering Facility (NRE)	NRE 1-001	126	Eclectic seating	Lecture theatre	Camera
Natural Resources Engineering Facility (NRE)	NRE 1-003	126	Eclectic seating	Lecture theatre	Camera
Natural Resources Engineering Facility (NRE)	NRE 2-001	126	Eclectic seating	Lecture theatre	Camera
Natural Resources Engineering Facility (NRE)	NRE 2-003	126	Eclectic seating	Lecture theatre	Camera
Engineering Teaching and Learning Complex (ETLC)	ETLC E2-001	100	Eclectic seating	Lecture theatre	Camera
Engineering Teaching and Learning Complex (ETLC)	ETLC E2-002	100	Eclectic seating	Lecture theatre	Camera
Engineering Teaching and Learning Complex (ETLC)	ETLC E1-001	420	Seating with tablet arms - fixed	Lecture theatre	Camera

\*Unless otherwise noted, all classrooms have whiteboards and furniture.

Information Services and Technology (IST) provides technical support for all classroom equipment in the facilities listed above.

### **Existing facilities, student makerspaces, and labs**

There are numerous existing specialized labs for instruction in mechanical, electrical, and computer engineering, as well as makerspaces for student innovation and collaborative activities. The intention is to:

- (i) enable the Mechatronics and Robotics program to benefit from the existing specialized lab facilities (e.g., control systems lab) in such a way as to not have a negative impact on any existing programs, and
- (ii) develop a new specialized lab for instruction in robotics-related courses.

There is an expectation that \$2–3 million in capital equipment expenditures will be required to procure the specialized robotic equipment and infrastructure (both mobile and fixed robots) to meet the instructional needs of the program. This capital expenditure would be covered by the Faculty of Engineering through a combination of allowable ETI allocation, leveraged funds for lab upgrades in MECE and ECE, and endowment funds.

The existing makerspaces and spaces available to facilitate student projects include the ELKO Engineering Garage; the Student Innovation Centre; the Machine Shop; the Electrical Shop; the Innovation, Creativity and Entrepreneurship (ICE) Technology Incubator; nanoFAB; and computer labs.

### **ELKO Engineering Garage**

The ELKO Engineering Garage provides a 6,000 sq. ft. makerspace for student projects and provides tools and equipment for students to engage in 2D fabrication, electronics, plastic fabrication, 3D printing, finishing, textiles, design, metalworking, and woodworking. The ELKO Engineering Garage is a place for hands-on learning, collaboration and physical prototyping and offers training, support and fabrication resources for students to create and build their ideas. It aims to foster learning through exploration and was made possible through the generous financial support of Ernie and Cathie Elko. Table 14 includes a list of the equipment available at the ELKO Engineering Garage.

**Table 14. Equipment available for student use at the ELKO Engineering Garage**

<b>2D Fabrication:</b> CO2 Laser Cutter Fiber Laser Cutter Waterjet Cutter	<b>Design:</b> 3D Scanner AV Equipment Microscope	<b>Woodworking Equipment:</b> Bandsaw Drill Press Jig Saw Power Planer Thickness Planer CNC Router Dust Collector Miter Saw Table Router Domino Joiner Hand Router Nail & Staple Gun Table Saw	<b>3D Printing Equipment:</b> Dremel Digilab 3D45 Desktop FDM Printer Stratasys F120 Industrial FDM Prusa MK3S+ Stratasys Fortus 450mc Industrial FDM Formlabs Form 3 Desktop SLA Stratasys J750 Industrial Polyjet
<b>Finishing Equipment:</b> Power Sanders Vented Booth	<b>Electronics Equipment:</b> Electronics Testing Devices PCB Mill Soldering Iron		
<b>Metalworking Equipment:</b> CNC Mills Drilling-Milling Machine Cold Cut Saw	<b>Textiles:</b> CNC Fabric Cutter Sergers Vinyl Cutter Embroidery Machine Sewing Machines		
<b>Plastic Fabrication Equipment:</b> Injection Molder Vacuum Former			

### **Student Innovation Centre (SIC)**

Designed to accommodate an active interdisciplinary community of student innovators, the Student Innovation Centre (SIC) is a space designed for extracurricular competitions, maker projects, and student-led ventures at every stage, from design planning to



entrepreneurship. The SIC is a 5,000+ sq. ft workspace that is modern, flexible, and inspiring, designed to facilitate collaboration between students as they explore their ideas. The SIC offers bookable project rooms, open seating areas, conferencing capabilities, a growing network of equipment, and free student programming and workshops.

### **Machine Shop**

The Machine Shop located in the Mechanical Engineering building provides equipment for use in student design and capstone projects for activities including welding, sheet metal, grinding, sanding & blasting, drilling, sawing, milling, and more. The equipment and their quantities are listed below.

- CNC milling (quantity: 6)
- CNC turning (4)
- Manual drilling (21)
- Manual milling (12)
- Manual turning (16)
- Milling accessories (4)
- 3D printing (7)
- Material testing (13)
- Non-conventional tools such as EDM, water jet, laser cutter (9)
- Metal saws (15)
- Metrology (32)
- Sheet metal & rods (33)
- Surfacing (51)
- Welding (28)
- Woodworking (18)
- Electronic testing/troubleshooting (1)
- Hand tools

### **Electrical Shop**

The Electrical Shop in the Mechanical Engineering Building provides consultation, design, modification, troubleshooting and repair of scientific apparatus. Electronic circuit design and fabrication services are also available. The Electrical Shop provides an environment for students and researchers to ask questions and learn the safe application and integration of high and low voltage systems into both research and undergraduate labs. Available services include:

- Equipment Repair
- Equipment / experimental setup troubleshooting
- Circuit Design and fabrication involving:
  - Analog circuits: Signal conditioners, amplifiers, and filters
  - Digital circuits: Arduino, Teensy, ESP32, Raspberry Pi
  - Transducer interfaces including: temperature, humidity, pressure, strain, and flow
  - RS232, RS422, RS485, I2C, SPI etc.
  - Schematic capture and printed circuit board design
  - PCB assembly: SMT and Thru-hole
- Programming in Arduino, C / C++, LabVIEW / Real-time FPGA, Python / MicroPython Data Acquisition, Machine and Process Control: LabVIEW/Compact DAQ/RIO, OPTO 22/PAC Control, OPC, Modbus (ASCII/RTU/TCP)

- Custom cabling
- Instrumentation design and fabrication: Heater PID controllers for example
- Equipment purchasing / consultation
- Electronics theory consultation
- Safety consultation

### **Innovation, Creativity and Entrepreneurship (ICE) Technology Incubator**

The Innovation, Creativity and Entrepreneurship (ICE) Technology Incubator is part of the Faculty's experiential learning offerings and integrates with campus makerspaces to provide a dedicated space for students and recent alumni interested in commercializing technology and launching new start-ups and social ventures.

### **nanoFAB**

The nanoFAB is a national, open-access training, service, and collaboration centre, focused on academic and industrial applications in micro- and nanoscale fabrication and characterization. Some technical electives or capstone projects may benefit from access to the nanoFAB facility.

- \$84M in specialized equipment and infrastructure, over 200 pieces of equipment in a 25,000 sq ft communal laboratory space
- Complete capabilities for microscopy, spectroscopy, material analysis, lithography, thin-film deposition, and etching
- Advanced materials, microscopy, and spectroscopy analysis suite

### **Computing resources**

There are computer labs available for students (ETLC 2-005, 2-009, MEC 3-3, MEC 3-28, MEC 4-19, ECE labs), plus secure and encrypted high-speed wifi and LAN access, and remote software capabilities (cloud computing resources).

## **5. Information Services**

- a. Provide an inventory and analysis of information resources to support the program (using standard library reference guides), plans to deal with any deficiencies, and a description of student access to other information services.

Please refer to Appendix E for the **Library Impact Statement**.

### **Existing collection strengths**

University of Alberta Libraries holds one of the most extensive academic library collections in Canada, with print and electronic collections exceeding 5.8 million titles and over 8.4 million volumes. This includes:

- more than 210,000 scholarly ejournals across disciplines from a wide range of publishers
- over 2.2 million ebooks accessible via a variety of platforms
- over 500 online databases
- over 60,000 items in ERA: Education & Research Archive, UAlberta's institutional repository
- over 60 hosted open access journals
- over 3,800 research data files available in Dataverse
- more than 160,000 digitized books, 67,000 newspaper issues, and 20,000 images and maps related to the Canadian prairies and beyond.

The \$20 million collection budget is no longer allocated by department, but is instead administered by a central team. This allows greater flexibility in adding resources to meet changing program needs. The library maintains an e-preferred policy, providing online access to resources for the greatest number of students and faculty at the University of Alberta.

### **Subject-specific resources**

Access is already available for many relevant databases of interest to students and researchers in mechatronics engineering including the following:

- AccessEngineering
- ASME Journals, Conference Proceedings, and Standards
- Compendex
- Derwent Innovations Index
- IEEE Xplore
- IET Digital Library
- Knovel
- O'Reilly Books
- SAE Mobilus
- Science Direct
- Scopus
- SPIE Digital Library
- Synthesis Digital Library of Engineering and Computer Science
- Taylor & Francis eBooks
- Web of Science
- Wiley Online Library

The library provides access to a number of print books and ebooks on topics related to the proposed program, including, but not limited to:

- Numerical methods, probability, statistics, calculus, ODEs, PDEs, complex variables and analysis;
- Statics, mechanics, dynamics;

- Chemistry, material science;
- Circuits, control systems, signals and systems;
- Thermodynamics, fluid dynamics, strength of materials, mechanical engineering design, computer-assisted drafting;
- Engineering design;
- Robotics, modelling, sensors and actuators;
- Computer science and programming

### **Indigenous resources**

Respectful relations with First Nations, Métis, and Inuit peoples are supported through learning opportunities for students and staff including:

- Indigenous Canada - a Massive Open Online Course that explores indigenous histories and contemporary issues.
- 4 Seasons of Reconciliation - a multi-media teaching unit developed for use in postsecondary education that fosters renewed relationships between Indigenous peoples and Canadians.

In addition to these training resources, the library provides access to books, journals, and databases of material related to Indigenous Peoples, worldviews, and knowledge. The library also offers guidance on how to search for information related to Indigenous topics, and a dedicated Subject Librarian to help students and researchers. Some examples of our holdings in this area include:

- Bibliography of Indigenous Peoples in North America,
- Canadian Geographic Indigenous Peoples Atlas of Canada,
- Elements of Indigenous Style, A Guide for Writing By and About Indigenous Peoples,
- Decolonizing Methodologies,
- Gale Primary Sources Indigenous Peoples of North America,
- Informit Indigenous Collection,
- iPortal,
- Sources and Methods in Indigenous Studies.

### **Student access**

Because the majority of our collection is acquired in electronic format, students have access to many library materials online, from the convenience of their classrooms, laboratory spaces, study rooms and homes. We prioritize licenses that allow for multiple concurrent users (often unlimited in number), which ensures the broadest possible access to material for students. Students also have ample access to the print collection and library study spaces as detailed below.

### **Deficiencies and means to address**

Benchmarking against the collections of other institutions with accredited mechatronics programs revealed no deficiencies in our collection. As the University of Alberta Library already supports programs in Computer Science, Computer Engineering, Electrical

Engineering, and Mechanical Engineering, the collection is robust in the areas of interest to this newly-proposed program. Should the program be approved, UAL would consult with the program directors to ensure that any additional resources most relevant to the program are licensed or acquired. As noted above the University of Alberta Libraries does not allocate budgets at the program level, but works to ensure program needs across the university are met.

### **Additional library services**

#### *ILL/document delivery*

Through the Interlibrary Loan system students and staff may borrow material that is not available at the University of Alberta Libraries from other libraries worldwide. Request forms may be submitted online. Many of our article databases and World Cat, a global network of library content, are integrated with our Interlibrary Loan request forms allowing for easy submission of requests.

Requested items can be conveniently picked up at a preferred library pick-up location. Items on loan must be signed out when picked up, and due date information can be viewed online through the My Account service. The usual loan period for material requested on interlibrary loan is two weeks. Renewal information is displayed on the Interlibrary Loan green band on the item. Interlibrary Loan items can be returned at any of the University of Alberta Libraries during open hours, and at 24/7 book drops at the Cameron, J. W. Scott and Rutherford Libraries.

There is no charge to the users for these services.

#### *Library hours (including 24-hour spaces)*

The Cameron Science and Technology Library service desk is open 76 hours per week during term: Monday to Thursday 0800-2100; Friday 0800-1800; and Saturday and Sunday 1000-1700. The basement and main floor study areas are accessible 24hr a day, with the exception of certain holidays. Cameron Library seats 1650, with 400+ computers. It has 18 group study rooms, two treadmill desks, and a mix of comfortable seating. Cameron is zoned for three levels of noise: silent/no food, quiet, and collaborative. Cameron Library is the home of the Digital Scholarship Centre.

#### *Staffed information services (chat, in-person reference)*

Information services in the Science and Technology Library are provided during all hours the service desk is open, 76 hours per week. In addition to in-person and telephone service, staff are available to answer questions via chat or text.

Additionally, subject librarians are available during normal working hours via phone, in-person consultation, and e-mail. The engineering librarian also provides six hours a week of information service during fall and winter terms on site in the Donadeo Innovation Centre for Engineering in order to be more accessible to engineering faculty and students. This service, known as “Librarian in Residence,” is available in a consultation room in ICE, and has been running since September 2003.

### *Professional Librarians*

The library provides subject liaisons, professional librarians who specialize in the literature and scholarly communications needs of their subject areas and who provide coordination between academic departments and the Library system. They work with faculty to understand the needs of their assigned departments and to ensure that the Libraries fulfill the information and instruction needs of both the faculty and students in the program. Librarians at the University of Alberta are strongly encouraged to contribute to the profession beyond the University's boundaries. Subject librarians are active in professional associations related to both librarianship and their specific areas of expertise.

### *Information Literacy Instruction*

Instruction in library and research skills is offered to undergraduate students in a number of existing courses. Typically, this instruction addresses broad Information Literacy concepts through the use of subject-specific examples targeted to the course and year of study.

Graduate students and faculty are offered higher level instruction, including in-depth search strategy development and introduction to a larger number of subject-specific databases. Sessions are offered at the departmental level, and are also provided on request to individual research groups, with instruction tailored for the interests of those groups. The library organizes a series of workshops on topics such as Scholarly Communication, Advanced Search Techniques, and Introduction to Metrics designed for graduate students and faculty.

## **SECTION C: CONSULTATION AND ASSESSMENT**

### **1. Program Evaluation**

- a. Describe the criteria and methods which will be used to ensure the ongoing quality of the program. Include mechanisms for periodic review using external evaluation. Describe the mechanisms to be used for critically assessing the extent to which the program learning outcomes have been met, and any key performance indicators that the institution wishes to include.

Mechanisms for periodic external evaluation are presently in development. Terms of reference for the following three program advisory committees are in development at this time, and stakeholders have indicated their interest to serve on these committees.

- Mechatronics Industry Advisory Committee (MIAC)

- Indigenous Program Advisory Council
- Equity, Diversity and Inclusion Program Advisory Committee

As this will be an accredited program through the Canadian Engineering Accreditation Board (CEAB), there will be an accreditation requirement for continual evaluation and certification of the program every 6 years. Part of this requirement is a continuous evaluation and improvement strategy that needs to be justified to and approved by CEAB.

## 2. Consultation / Accreditation or Regulatory Approval

- a. If not already included in Part A of the proposal, outline the consultation that has occurred with other institutions, organizations or agencies, including advisory bodies formed by the applicant institution, to assist in program design, implementation, and evaluation. This should include, where appropriate, professional associations, regulatory agencies and/or accrediting bodies, and prospective employers.

Please refer to Appendix C.

- b. If the program is subject to accreditation or approval of a regulatory body, provide a description of the review process, requirements of the body, and timing of the review (if in process). If possible, a chart or table may be useful to outline accreditation or regulatory approval requirements.

### **Accreditation through the Canadian Engineering Accreditation Board (CEAB):**

- The process by which a new engineering program can seek accreditation through the Canadian Engineering Accreditation Board (CEAB) is laid out in Section 4 of the Criteria and Procedures Report (2022 version). As per Section 4.1, “Accreditation of a program is granted only after students have graduated from the program. For new programs, an accreditation visit may be undertaken in the final year of the first graduating class.” Generally, new programs receive their accreditation visit in the winter semester so the first cohort is sufficiently along in the final year for the program visitors to appreciate how the program will roll out. The timing means that cohort of students will be mid-flight on capstone projects, but new programs generally provide an update after the semester ended and before the June CEAB meeting (when decisions are made) on how the cohort finished the year. The details on what to submit for this update will be coordinated with the visiting team chair.
- In advance of this, there is a program development advisory procedure offered by the CEAB. The Faculty intends to invite the CEAB to conduct a curriculum assessment of the proposed curriculum to provide us with information about how the developed program meets the criteria for accreditation units (AU).

### **Accreditation through Co-operative Education and Work-Integrated Learning Canada (CEWIL Canada):**

- A minimum of one employee of the Engineering Co-op Office will be a current member of CEWIL as this is a requirement for accreditation. The current Director of the Co-op Office is a member of the Accreditation Council and is therefore very familiar with the

accreditation process and how to meet all the criteria. There has been appropriate consultation with the Co-op Office throughout the program development process.

- Before submitting an application for accreditation, a program must have graduates in order to be eligible for accreditation so the submission of the application will occur after the first cohort has graduated (after Winter term 2029).
- For an application to be recommended for accreditation, the review committee must be satisfied that all required criteria are met. A successful review will result in a program being accredited for a period of six years.

- c. If not already covered above, indicate how graduates will meet professional or regulatory expectations.

Graduates of an engineering program accredited by CEAB in Alberta may apply for Engineer-in-Training status through APEGA (the Association of Professional Engineers and Geoscientists of Alberta), which regulates the practices of engineering and geoscience in Alberta on behalf of the Government of Alberta through the Engineering and Geoscience Professions Act.

### 3. Reports of Independent Academic Experts

- a. CAQC views external peer review as fundamental to ensuring the quality of academic programs. In order to strengthen the proposal, before the proposal is finalized, the institution must solicit comprehensive reviews of the proposal from two or more independent academic experts it selects from outside the institution. Terms of reference must be provided to the reviewers (see Appendix G of the CAQC Handbook for sample terms of reference), as well as up-to-date drafts of Part A and Part B of the proposal, and appendices. Please append the full reports of the independent academic experts, the institution's response to the reports, and CVs from the independent academic experts (see Appendix G of the CAQC Handbook for guidelines on the selection and use of Independent Academic Experts).

## SECTION D: OTHER

### 1. Adverse Claims or Allegations

- a. Disclose any adverse claims or allegations (and, if possible, identify their provenance) that might affect this application or be of concern to CAQC.



None to disclose.

## 2. Other Documentation

- a. Provide any other supporting documents such as the Graduate Program Handbook, Faculty Handbook, current calendar, or cyclical review of programs policy that would add support to the applicant's case and would help reviewers (provide website links, if available).

The Associate Chair of the Mechanical Engineering Department, David Nobes, has created an online program **Visualizer**. The Visualizer presents the curriculum term-by-term (as shown in Appendix A) and enables the viewer to interact with a visual representation of the courses, their sequence, their prerequisites, and various categories of courses (e.g., math, coding, engineering profession, CAD, etc.). The Visualizer for the proposed Mechatronics and Robotics program is available at the link below:

[https://sites.ualberta.ca/~dnobes/Eng\\_Programs/MecTronE\\_Visualizer4/index.html](https://sites.ualberta.ca/~dnobes/Eng_Programs/MecTronE_Visualizer4/index.html)

### **How to use the Visualizer:**

- Hover over a course to see its Calendar description pop-up.
- Left-click on a course to draw arrows between that course and its prerequisites and corequisites, as well as the courses it is a prerequisite and corequisite for.
- Right-click on a course to have its Calendar description stay in place.
- Highlight all courses in a category by left-clicking on one of the colored boxes to the right.
- To clear all selections, refresh the page.

***Note the Statement of Institutional Integrity  
which appears on the separate page below***

## 3. Statement of Institutional Integrity

Please sign the Statement of Institutional Integrity below.