

6. Research

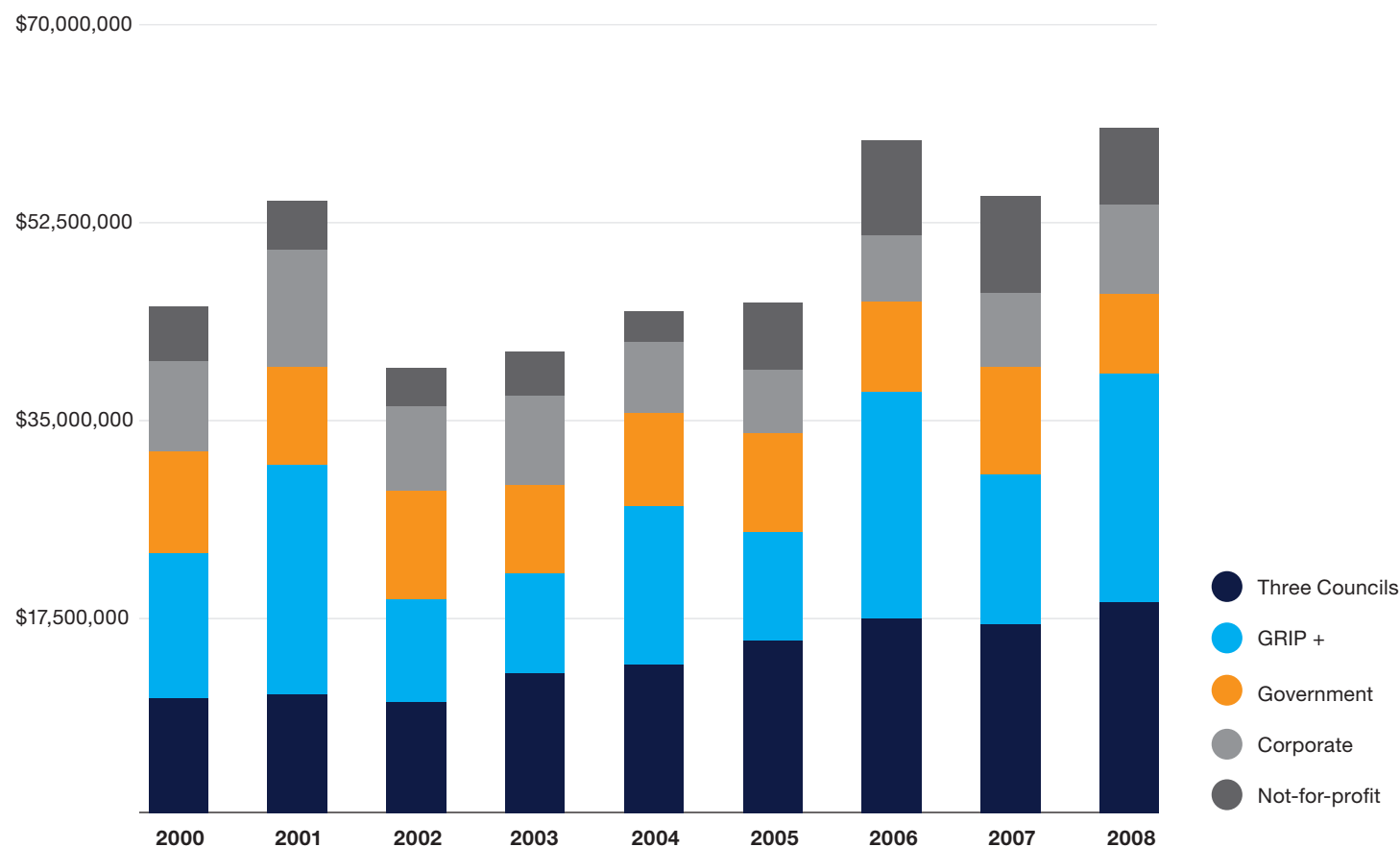
Our Faculty members are leaders in research and technological innovation on both national and international stages. They are recognized not just through the awards and honours they receive, but also through their contributions to knowledge creation, technology transfer, and by the volume of research funding they generate.

In 2008, the Faculty of Applied Science and Engineering received more than \$60.97M in funding – an increase of 35% from 2000 – and we lead all Canadian institutions on this measure. Indeed, over the past five years, we have received the largest share of funding from the Natural Sciences and Engineering Research Council (NSERC) of Canada among our Canadian peers.

The Faculty's collaborative multidisciplinary initiatives also received strong support in 2008–2009, securing three NSERC CREATE programs and more than \$15.5M from the Canada Foundation for Innovation. Over the same period, our faculty members held 24 Canada Research Chairs and 28 Endowed Research Chairs, among other prestigious research appointments.

The Faculty excels at turning research into innovations. Engineering faculty have accounted for 43% of all invention disclosures at the University of Toronto over the past eight years and, since the 1950s, U of T engineers have launched more than 100 spin-off companies.

Figure 6.1
Research Funding by Year and Source
2000–2008



	Three Councils (\$)	GRIP + (\$)	Government (\$)	Corporate (\$)	Not-for-profit (\$)	Year Total (\$)
2000	10,211,817	12,900,987	8,953,344	8,004,522	4,800,943	44,871,613
2001	10,621,383	20,288,328	8,624,511	10,346,764	4,402,193	54,283,179
2002	9,936,509	9,084,332	9,528,233	7,494,002	3,395,584	39,438,660
2003	12,459,506	8,793,897	7,815,247	7,862,294	3,978,904	40,909,848
2004	13,220,402	13,995,988	8,237,005	6,294,731	2,705,886	44,454,012
2005	15,379,348	9,535,634	8,740,544	5,637,079	5,912,609	45,205,214
2006	17,324,786	20,025,121	7,966,509	5,804,219	8,405,940	59,544,575
2007	16,799,890	13,279,928	9,477,043	6,561,799	8,628,896	54,747,556
2008	18,742,373	20,309,400	7,067,420	7,983,775	6,871,287	60,974,305

Note: Data is current as of January 2009. GRIP + = Government Research Infrastructure Program; “Three Councils” includes funding from the Canadian Institutes for Health Research (CIHR), the Natural Sciences and Engineering Research Council (NSERC), and the Social Sciences and Humanities Research Council (SSHRC); Engineering research typically receives funding from NSERC and CIHR, with SSHRC typically for social sciences and humanities research.

Figure 6.2a

Canadian Peer Universities vs. University of Toronto Engineering Share of Natural Sciences and Engineering Research Council of Canada Funding, Cumulative 5-Year Share 2003–2004 to 2007–2008

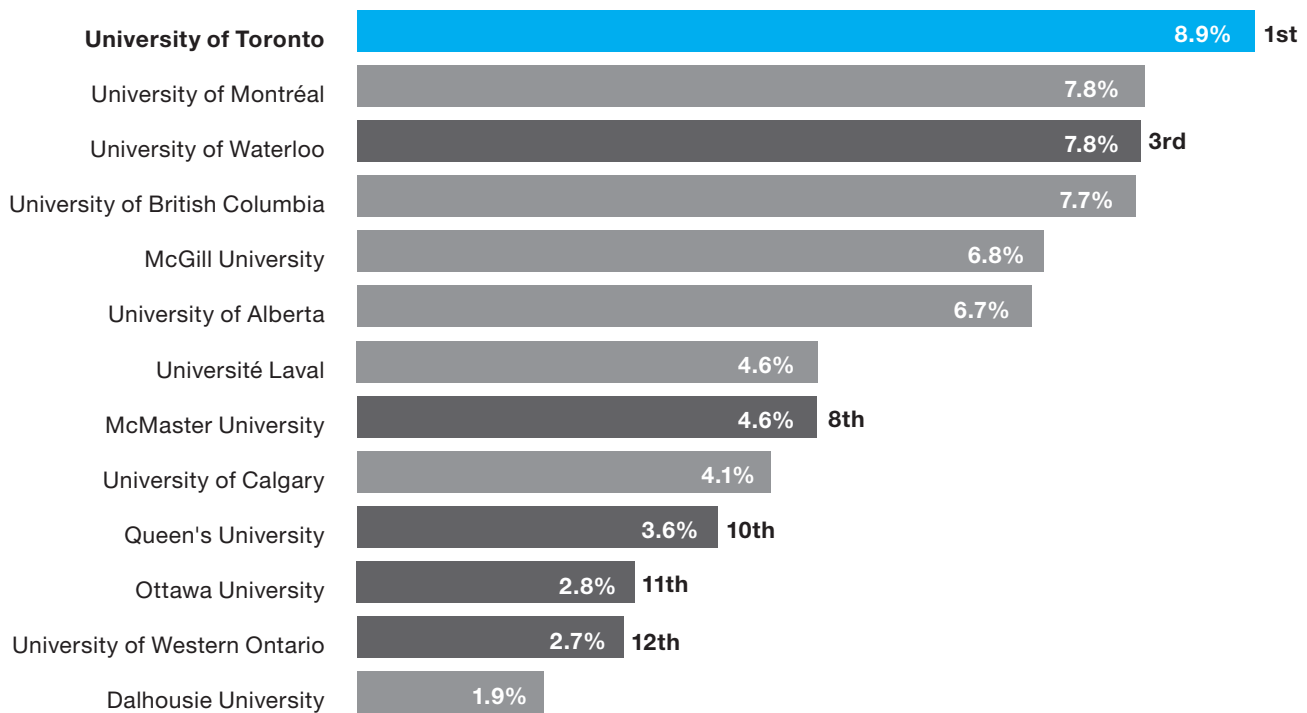


Figure 6.2b

University of Toronto Share of NSERC Funding in Engineering 2003–2004 to 2007–2008

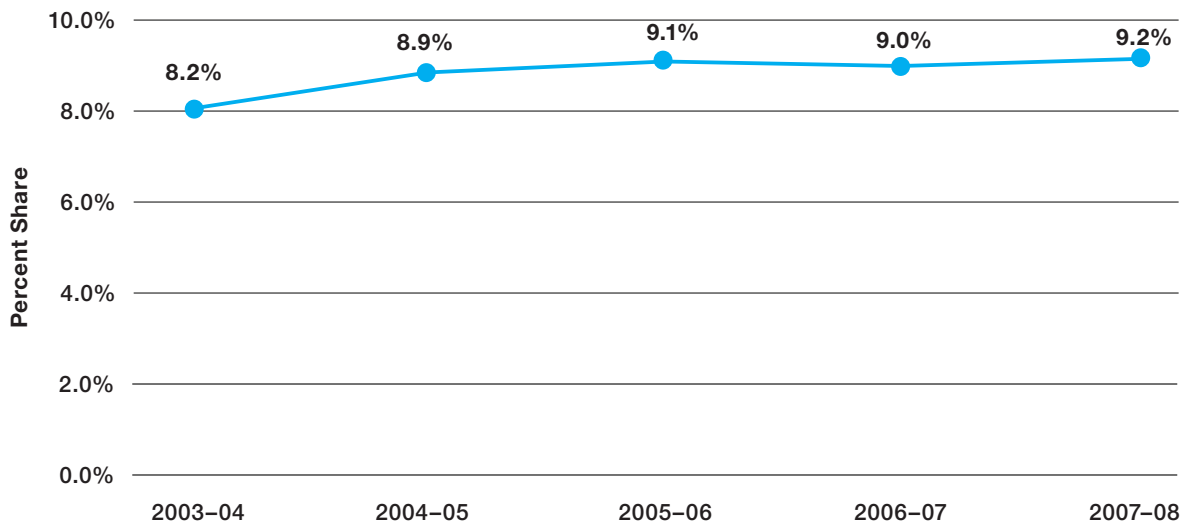
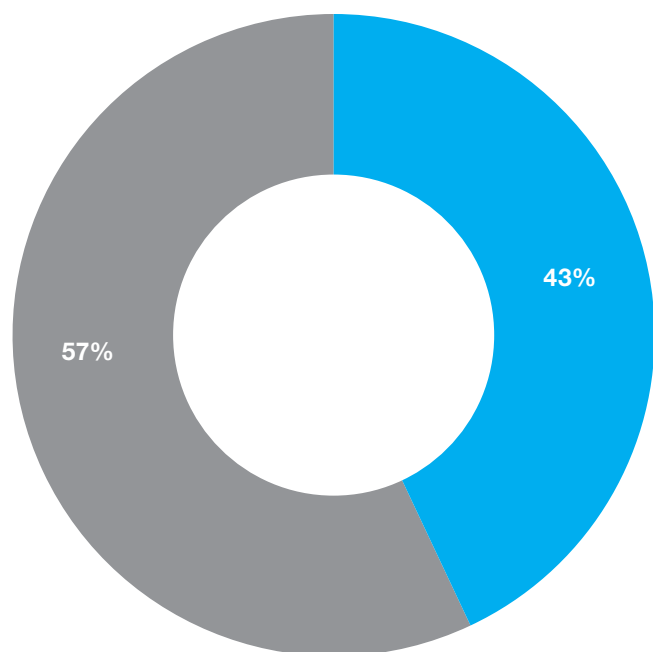


Figure 6.3a
Total University of Toronto Invention Disclosures
2000–2008



- Faculty of Applied Science and Engineering
- Other Faculties at the University of Toronto

The high number of inventions in Engineering indicates our potential for commercialization and knowledge transfer, and is also an important indicator of the social and economic benefit of Engineering innovation.

All inventions at U of T are required, by the University’s Inventions Policy, to fully and completely disclose the invention to the University. All rights to the invention are then jointly owned by the University and the inventor, in most cases. The inventor can commercialize the invention, which results in the high number of spin-off companies in Engineering, also outlined in this Chapter.

The following table shows the inventions of U of T Engineering faculty that have been disclosed to U of T. Where all inventors for an invention are from one Department, that Department is credited with one disclosure; when inventors are from multiple Departments, each Department is credited with an equal portion of the invention.

Figure 6.3b
Engineering Invention Disclosures by Academic Area
2000–2008

	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
UTIAS	1.0	0.0	0.0	1.0	3.5	3.0	0.0	0.0	1.0	9.5
IBBME	1.5	16.2	6.5	4.9	4.5	10.7	8.6	11.3	9.2	73.4
ChemE	7.8	12.2	2.0	4.7	6.5	6.0	2.5	4.8	4.8	51.3
CivE	1.0	1.7	1.0	2.0	0.0	9.0	0.0	1.0	3.5	19.2
ECE	16.8	18.3	17.5	23.8	17.2	24.9	44.2	40.0	39.7	242.4
EngSci	0.0	0.0	0.0	0.0	1.0	0.2	0.0	0.0	0.3	1.5
MSE	7.7	2.0	3.0	9.3	11.4	6.0	4.3	0.8	6.7	51.2
MIE	7.0	11.3	4.0	3.8	16.2	15.7	9.0	15.9	19.3	102.2
Total	42.8	61.7	34.0	49.5	60.3	75.5	68.6	73.8	84.5	550.7

Figure 6.4 Engineering Spin-off Companies 1951–2009

Commercialization occurs through the licensing of an invention to an existing company, or through the creation of a spin-off company to launch the new invention. The number of new licenses created indicates our level of engagement with private sector firms, in addition to the direct contribution to the social and economic development of our research community.

Est.	Company Name	Engineering Affiliation	Department
2009	Chip Care Corp.	J. Stewart Aitchison	ECE
2009	Peraso Technologies Inc.	Co-founded by Sorin Voinigescu	ECE
2008	Incise Photonics Inc.	Peter Herman	ECE
2008	Arch Power Inc.	Reza Iravani	ECE
2008	Quantum Dental Technologies	Andreas Mandelis	MIE
2008	Ablazeon Inc.	Javad Mostaghimi	MIE
2008	AXAL Inc.	Milos Popovic and Egor Sanin	IBBME
2008	Simple Systems Inc.	Milos Popovic, Aleksandar Prodić and Armen Baronijan	ECE, IBBME
2007	Viewgenie Inc.	Parham Aarabi	ECE
2007	Modiface Inc.	Parham Aarabi	ECE
2007	Neurochip Inc.	Berj Bardakjian	IBBME
2007	Inometrix Inc.	Michael Galle	ECE
2007	Cast Connex Corp.	Jeffrey Packer and Constantin Christopoulos	CivE
2007	002122461 Ontario Inc.	Harry Ruda	MSE
2007	Elastin Specialties	Kimberly Woodhouse	ChemE
2006	Anviv Mechatronics Inc. (AMI)	Andrew Goldenburg	MIE
2006	Hydratek and Associates Inc.	Bryan Karney and Fabian Papa	CivE
2006	Vennsa Technologies Inc.	Andreas Veneris and Sean Safarpour	ECE
2006	Metabacus Inc.	Jianwen Zhu	ECE
2005	Greencore Composites	Mohini Sain	Forestry, ChemE
2004	Tissue Regeneration Therapeutics Inc. (TRT)	J.E. Davies	IBBME
2004	Field Metrica Inc. (FMI)	Tim DeMonte and Richard Yoon	IBBME
2003	Vocalage Inc.	Mark Chignell	MIE
2003	ArchES Computing Systems Corp.	Paul Chow	ECE
2003	Norel Optronics Inc.	Zhenghong Lu	MSE
2003	1484667 Ontario Inc.	Brad Saville	ChemE
2002	OMDEC Inc.	Andrew K.S. Jardine	MIE
2002	MatRegen Corp.	Molly Shoichet	IBBME, ChemE
2002	Information Intelligence Corp. (IIC)	Burhan Turksen	MIE
2001	Interface Biologics Inc.	Paul Santerre	IBBME
2001	Fox-Tek	Rod Tennyson	UTIAS
2001	Insception Biosciences	Peter Zandstra	IBBME
2000	Biox Corp.	David Boocock	ChemE
2000	Virtek Engineering Science Inc.	Andrew Goldenberg	MIE
2000	Photo-Thermal Diagnostics Inc.	Andreas Mandelis	MIE
2000	Simulent Inc.	Javad Mostaghimi	MIE
1999	em2 Inc.	J.E. Davies	IBBME
1999	Accelight Networks Inc.	Alberto Leon-Garcia and Paul Chow	ECE
1999	Soma Networks	Michael Stumm and Martin Snelgrove	ECE
1999	Vivosonic Inc.	Yuri Sokolov and Hans Kunov	IBBME
1998	BoneTec Corp. (Now a wholly owned subsidiary of TRT)	J.E. Davies and Molly Shoichet	IBBME
1998	BANAK Inc.	Andrew K.S. Jardine	MIE
1998	Snowbush Microelectronics	Kenneth Martin and David Johns	ECE
1998	1208211 Ontario Ltd. / Regen STARR	Robert Pilliar, Rita Kandel and Marc Grynpas	IBBME
1998	Right Track CAD Corp.	Jonathan Rose	ECE
1998	SMT HydraSil	Rod Tennyson	UTIAS
1997	Rimon Therapeutics	Michael Sefton	IBBME, ChemE
1996	Rocscience Inc.	John Curran	CivE
1996	OANDA Corp.	Michael Stumm	ECE
1995	Electrobiologics	Paul Madsen	IBBME

1995	Tribokinetics Inc.	Raymond Woodhams	ChemE
1995	Hydrogenics Corp.		MIE
1995	Amilog Systems		MIE
1994	Key Lime Co.	Honghi Tran	ChemE
1994	Trantek Power		ECE
1993	Electro Photonics	Raymond Measures	UTIAS
1993	SmartSpeaker Corp.	Anees Munshi	ECE
1993	SAFE Nozzle Group	Honghi Tran	ChemE
1993	Liquid Metal Sonics Ltd.		MSE
1992	Novator Systems Ltd.	Mark Fox	MIE
1992	Gao Research & Consulting Ltd.	Frank Gao	ECE
1992	Paul Madsen Medical Devices	Hans Kunov	IBBME
1992	Polyphalt Inc.	Raymond Woodhams	ChemE
1992	Condata Technologies Ltd.		ECE
1991	Redrock Solvers Inc.	Michael Carter	MIE
1991	Minnovex	Glenn Dobby	MSE
1991	LinShin Canada Inc.		IBBME
1991	Advent Process Engineering Inc.		MSE
1990	Fibre Metrics	Dale Hogg	UTIAS
1989	Apollo Environmental Systems Corp.	John Harbinson	ChemE
1989	Translucent Technologies Inc.	Paul Milgram	MIE
1989	Xiris Automation Inc.	Cameron Serles	MIE
1989	Integrity Testing Laboratory Inc. (ITL)		UTIAS
1988	Food BioTek Corp.	Leon Rubin	ChemE
1988	Advanced Materials Technologies	Steven Thorpe	MSE
1986	EHM Rehabilitation Technologies	Pomeranz Salansky	UTIAS
1986	LACEC Energy Systems Inc.	Charles Ward	MIE
1985	Electrocaps Inc.	J. Smith	ChemE
1985	Katosizer Industries Ltd.	W. Snelgrove	ECE
1985	El-Mar Inc.		IBBME
1985	Tibur-Howden		MSE
1984	Ergotechnics	P. Foley	MIE
1984	MERP Enhanced Composites Inc.	Michael Piggott	ChemE
1984	ABIT Systems Inc.	Burhan Turksen	MIE
1983	Human Factors North	N. Moray	MIE
1982	Engineering Services Inc. (ESI)	Andrew Goldenberg	MIE
1982	DMER	D. Mackay	ChemE
1982	Owl Instruments	J.W. Smith	IBBME
1980	SatCon Power Systems Canada Ltd.	Shashi Dewan	ECE
1980	Dynacon Inc.	Peter Hughes	UTIAS
1980	Almax Ltd.	G. Sinclair	ECE
1978	Hummel Energy Systems Ltd.	R.L. Hummel	ChemE
1978	Aurora Scientific Inc.	David James	MIE
1976	Kings Engineering Associates Ltd.	Iain Currie	MIE
1976	Hooper & Angus Consulting Engineers	Frank Hooper	MIE
1975	General Comminution Inc.	Olev Trass	ChemE
1974	MDS Scienc – Division of MDS Inc.	Barry French	UTIAS
1974	Envirogetics	Frank Hooper	MIE
1974	Tibur Metals Inc.		MSE
1973	Hooper & Hix, Engineers and Architects	Frank Hooper	MIE
1970	Eco-Tec Ltd.	R. Hunter	ChemE
1968	Vibron	D. Allen	MIE
1968	Electrical Engineering Consolidated Ltd.	K.C. Smith	ECE
1966	Aercol		UTIAS
1964	Chemical Engineering Research Consultants	W. Graydon	ChemE
1960	Integral Apparatus Ltd.	Frank Hooper	MIE
1951	Sinclair Technologies Inc.	G. Sinclair	ECE

Note: This includes all spin-off companies on file with the U of T Innovations Group, and as added by faculty.

Figure 6.5
Research Chairs
2008–2009

Chair Title	Chairholder	Sponsor	Tier	Department
Alumni Chair in Bioengineering	Cristina Amon	Endowed		MIE
Bahen/Tanenbaum Chair in Civil Engineering	Michael Collins	Endowed		CivE
Bahen/Tanenbaum Chair in Civil Engineering	Jeffrey Packer	Endowed		CivE
Bell Chair in Multimedia	Dimitrios Hatzinakos	Endowed		ECE
Bell University Labs Chair in Computer Engineering	Baochun Li	Endowed		ECE
Bell University Labs Chair in Software Engineering	Hans-Arno Jacobsen	Endowed		ECE
Canada Research Chair in Autonomic Service Architecture	Alberto Leon-Garcia	NSERC	Tier 1	ECE
Canada Research Chair in Diffusion-Wave Sciences and Technologies	Andreas Mandelis	NSERC	Tier 1	MIE
Canada Research Chair in Intelligent Transportation Systems	Baher Abdulhai	NSERC	Tier 2	CivE
Canada Research Chair in Information Processing and Machine Learning	Brendan Frey	NSERC	Tier 2	ECE
Canada Research Chair in Molecular Imaging	Christopher Yip	CIHR	Tier 2	ChemE
Canada Research Chair in Mircocellular Plastics	Chul Park	NSERC	Tier 1	MIE
Canada Research Chair in Computational Aerodynamics and Environmentally Friendly Aircraft Design	David Zingg	NSERC	Tier 1	UTIAS
Canada Research Chair in Nanotechnology	Ted Sargent	NSERC	Tier 2	ECE
Canada Research Chair in Communication Algorithms	Frank Kschischang	NSERC	Tier 1	ECE
Canada Research Chair in Nano- and Micro-Structured Electromagnetic Materials and Applications	George Eleftheriades	NSERC	Tier 1	ECE
Canada Research Chair in Signal Processing Systems	Glenn Gulak	NSERC	Tier 1	ECE
Canada Research Chair in Smart and Functional Polymers	Hani Naguib	NSERC	Tier 2	MIE
Canada Research Chair in Quantum Information	Hoi-Kwong Lo	NSERC	Tier 2	ECE
Canada Research Chair in Multi-disciplinary Optimization	Joaquim Martins	NSERC	Tier 2	UTIAS
Canada Research Chair in Photonic Technologies and Applications	Li Qian	NSERC	Tier 2	ECE
Canada Research Chair in Tissue Engineering	Molly Shoichet	NSERC	Tier 1	ChemE
Canada Research Chair in Fuel Cell Materials and Manufacturing	Olivera Kesler	NSERC	Tier 2	MIE
Canada Research Chair in Internet Video, Audio, and Image Search	Parham Aarabi	NSERC	Tier 2	ECE
Canada Research Chair in Stem Cell Bioengineering	Peter Zandstra	NSERC	Tier 2	IBBME
Canada Research Chair in Autonomous Space Robotics	Tim Barfoot	NSERC	Tier 2	UTIAS
Canada Research Chair of Biotechnology	Warren Chan	NSERC	Tier 2	IBBME
Canada Research Chair in Digital Communications	Wei Yu	NSERC	Tier 2	ECE
Canada Research Chair in Stem Cell Bioengineering and Functional Genomics	William Stanford	CIHR	Tier 2	IBBME
Canada Research Chair in Micro and Nano Engineering Systems	Yu Sun	NSERC	Tier 2	MIE
Celestica Chair in Materials for Microelectronics	Doug Perovic	Endowed		MSE
Chair in Computer Networks and Enterprise Innovation	Elvino Sousa	Endowed		ECE

Chair in Information Engineering	Joseph Paradi	Endowed	ChemE
Chair in Software Engineering	Tarek Abdelrahman	Endowed	ECE
Clarice Chalmers Chair of Engineering Design	William Cleghorn	Endowed	MIE
Dusan and Anne Miklas Chair in Engineering Design	Paul Chow	Endowed	ECE
Edward S. Rogers Sr. Chair in Engineering	Glenn Gulak	Endowed	ECE
Eugene V. Polistuk Chair in Electromagnetic Design	Doug Lavers	Endowed	ECE
Frank Dottori Chair in Pulp and Paper Engineering	Honghi Tran	Endowed	ChemE
Heffernan Chair in Materials Processing	Torstein Utigard	Endowed	MSE
Industrial Research Chair in Design Engineering for the Urban Environment	Paul Gauvreau	NSERC	CivE
Industrial Research Chair in Drinking Water Research	Robert Andrews	NSERC	CivE
Industrial Research Chair in Durable and Sustainable Concrete	Doug Hooton	NSERC	CivE
Industrial Research Chair in Nano-engineering of Alloys for Nuclear Power Systems	Roger Newman	NSERC/ UNENE	ChemE
J. Armand Bombardier Chair in Aerospace Flight	David Zingg	Endowed	UTIAS
L. Lau Chair in Electrical and Computer Engineering	Reza Iravani	Endowed	ECE
Michael E. Charles Chair in Chemical Engineering	Michael Sefton	Endowed	ChemE
Nortel Institute Chair in Emerging Technology	J. Stewart Aitchison	Endowed	ECE
Nortel Institute Chair in Network Architecture and Services	Jörg Liebeherr	Endowed	ECE
Pierre Lassonde Chair in Mining Engineering	William Bawden	Endowed	CivE
Robert M. Smith Chair in Geotechnical Mine Design and Analysis	John Curran	Endowed	CivE
Stanley Ho Professorship	Sorin Voinigescu	Endowed	ECE
The Stanley L. Meek Chair in Advanced Nanotechnology	Harry Ruda	Endowed	MSE
University of Toronto Distinguished Professor in Plasma Engineering	Javad Mostaghimi	U of T	MIE
Velma M. Rogers Graham Chair in Engineering	George Eleftheriades	Endowed	ECE
Wallace G. Chalmers Chair of Engineering Design	Li Shu	Endowed	MIE
W. M. Keck Chair of Seismology and Rock Mechanics	Paul Young	Endowed	CivE

Note:

Canada Research Chair

Established by the Government of Canada to attract and retain some of the world's most outstanding researchers in Canadian degree-granting institutions. The program invests a total of \$300 million per year across the country. There are two types of CRCs: Tier 1, which is renewable and held for seven years. The University receives \$200,000 annually per Tier 1 Chair; Tier 2 is a junior chair, held for five years and is eligible for renewal only once, unlike the Tier 1 level. The University receives \$100,000 annually for Tier 2 CRCs.

Endowed Research Chair

Created with the generous support of donations and indicates a broad and continuing commitment to the position and discipline of research. Each Faculty member who holds a Chair position is considered to be of great distinction and typically at the rank of Professor with tenure. Each Chair position is held for a fixed term.

Industrial Research Chair

Jointly funded by NSERC and industry to help universities build on existing strengths or develop major research capacity in areas of interest to industry.

U of T Distinguished Professor

Designed to advance and recognize faculty with highly distinguished accomplishments who display promise. This Chair is limited to no more than 3% of tenured faculty in a Faculty.