

BROCK UNIVERSITY

Brief for the appraisal of the proposed

Masters in Materials Science

**Submitted to the
Academic Review Committee**

July 2013

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1. INTRODUCTION

1.1. Objectives of the Program

The objective of the new course-based, cost-recovery graduate program, tentatively called the Master of Science In Physics/Materials Science, is to provide intensive, “hands-on” graduate training in advanced experimental, theoretical, and computational techniques of modern materials science. The goal is to prepare highly knowledgeable and skilled graduates, who will be well-trained as materials scientists to fill jobs in industry, government agencies, research institutes and universities worldwide.

Through the mentorship of our faculty, graduates will acquire the skills necessary to work as independent workers as well as in collaboration with others. They will learn to identify important and critical problems and to use appropriate methods and techniques to address them. An essential part of their training will be to communicate their results to a scientific audience as well as to the non-technical management staff, and to evaluate business and societal impact of their work without prejudice. These goals will be achieved through presentations at graduate research seminars and through the production of detailed technical laboratory and term reports conforming to the rigorous standards of scientific and technical publications in the fields of Materials Science and Technology.

International students will receive a thorough training in the use of technical English and in the style of technical and scientific interactions in the workplace. It is an essential element of the program that some of the graduate classes be shared with the Canadian graduate students, to avoid segregating international students into common-language-based groups and to ensure that the working language remains English.

1.2. Motivation for the Program

Materials research provides real, tangible benefits to society, and materials research will provide the key elements for new technologies to address global needs. Spectacular technological achievements of the past decades have been driven by revolutionary advances in basic science of materials, from semiconductors, ceramics and polymers to superconductors and bio-materials. Whole industries have risen on devices made possible by materials with remarkable properties, such as the silicon chip. Today, there are about 300,000 different known materials, but as materials scientists continue to create and combine materials in new ways, the number is almost infinite. Pioneers in materials science are designing unique materials that will bring vital new technologies within reach. Materials have changed our history and continue to shape our future economy.

A graduate with Masters-level practical training in materials science can expect a large and expanding job market. A November, 2012, snapshot of advertised job positions available reveals a healthy North American job market. Indeed.com, the largest aggregate job meta-search engine in North America reveals over 1700 positions incorporating the phrase “materials science”, even excluding professorial, lecturer, postdoctoral, and internship positions. Another job search site, linkup.com, avoids

duplicate listings found on job boards in favour of advertisements direct from employers; it lists over 420 such positions. Finally the open jobs posted at some of the North America's largest materials research professional societies (ASM International, Materials Research Society, The Minerals, Metals & Materials Society, and Canadian Institute for Mining Metallurgy and Petroleum) reveals over 400 current job postings, only some of which are academic in nature.

Excluding job positions which may require PhD level qualifications, job titles that appear on these websites that an MSc in materials science graduate may qualify for include: Manufacturing Engineer, Materials Scientist, Materials Lab Technician, Research Associate, Nuclear Materials & Safeguards Management, Medical Science Liaison, Building Science Engineer, Science Safety Technician, Process Supervisor, Chemical Process Engineer. Industrial giants appearing on these jobs boards include Apple, Intel, General Motors, Xerox, Accelrys, Raytheon, Nike, Alcoa, HP, Dow Corning, Western Digital, Texas Instruments, SC Johnson, Beacon Power, and Merit Medical.

This data reflects only the current North American market. The demand is in fact even more acute in the developing world. Qualifications with a “materials science” designation are seen as essential for differentiating oneself from other participants in the job market, and are highly valued. In fact, the Chinese version of indeed.com adds 168 additional job listings (in English only) that specify “materials science”.

The MSc in materials science aims to provide a jobs-ready, practical education in material science, with a focus on condensed matter materials. Employment for MSc graduates is expected to be in the processing, design, testing, and manufacturing of metals and minerals products for many industries. The job market in materials science world wide is difficult to assess, however, we can comment on the Canadian sector.

In Canada, the jobs in materials science, outside chemical engineering, is closely tied to the larger mining and mineral industries. In 2012 employment in the Canadian mining, support services, and mineral processing industry was up 2.8% from 2011¹, buoyed by strong commodity prices. Although in the nonmetallic mineral product manufacturing industry employment was stable over 2010 to 2012, the primary metal manufacturing and fabricated metal product manufacturing industries saw substantial growth until a cyclic downturn in early 2013.

“If commodity demand and prices remain strong and if advanced projects continue to reach production, employment in Canada's mining and exploration industry should grow or remain stable, provided businesses take steps to ensure operating units remain competitive.”²

In the primary metal manufacturing sector, employment increased 10% from 2010 to 2011, and is experiencing strong recovery from the economic downturn in 2007-2008.³

“Since a cyclical low in 2009, capital investment in the metal ore sector has more than doubled. Despite an expected decline in 2013, anticipated investment would represent the third-highest value on record...Capital investment in the nonmetallic

¹ Natural Resources Canada, Aug 2013

² *ibid*

³ Industry Canada, Canadian Industry Statistics, NAICS 331, 327

mineral mining sector increased in 2012..."⁴

"The mining industry will likely be able to hold on to its share of knowledge workers like engineers and geoscientists in the coming years, says Martha Roberts, director of research, Mining Industry Human Resources Council. Companies, however, cannot sit on their recruiting laurels in the coming decade of baby boomer retirements, as the demand for workers to fill all 66 core mining occupations escalates."⁵

"According to the Mining Industry Human Resources (MiHR) Council, the mining industry is experiencing a 40% retirement rate. New deposits are popping up regularly and thousands of additional workers will be needed each year, creating many new career opportunities in the industry.

Mining isn't all hard hats and dynamite: today, there are engineers, scientists, mechanics, environmentalists, researchers, technicians, skilled workers and executives working on operations around the world – some who may never even step foot in a mine."⁶

Brock University has considerable strength in materials science, as members of the Department of Physics are actively engaged in various aspects of research in this trans-disciplinary field, often in collaboration with their colleagues in Chemistry and Biological Sciences. Brock University's Integrated Strategic Plan⁷ is to improve its position as a modern, comprehensive university, with an emphasis on maintaining excellence in graduate education. The proposed MSc in materials science program aligns well with these strategic priorities, most notably with the strategic objectives to:

- 2C. Develop focused graduate programs appropriate for Brock's regional, national and international roles and strategic directions; and
- 6B. Solidify Brock's position as a Canadian destination for international students.

The current proposal is for a new graduate program that addresses an emerging need for well-trained experts in materials science to fill jobs in industry, government labs and other areas.

The success of this new cost-recovery program will be determined by both a sustained financial stability for the program, based on its enrollments, and the successful job placements of the overwhelming majority of its graduates. At the end of the four-year start-up period outlined in the projected budget (see Table 3.6.1: Projected budgets for the first years of the MSc in materials science program), the viability of the program will be reviewed by both the Department and the Administration.

1.3. Other M.Sc. in Materials Science programs in Ontario

There are several M.Sc. level graduate programs in materials science currently offered by other Ontario Universities: Materials Science at Royal Military College of Canada; Condensed Matter and Material Physics at University of Guelph;

⁴ Natural Resources Canada, Information Bulletin 2013

⁵ CIM Magazine "14 Big Stories in 2014", Dec '13/Jan '14

⁶ <http://www.cim.org/en/Students/Industry.aspx>

⁷ http://www.brocku.ca/webfm_send/18647

Mechanical and Materials Engineering at University of Western Ontario; Materials Chemistry and Materials Science and Engineering at University of Toronto; Materials Science and Engineering at McMaster University; Materials Science jointly at Trent University and University of Ontario Institute of Technology. All of these programs are two years in length and either thesis-based or require completion of a research project. In addition, Material Chemistry and Physics program at the University of Ottawa is currently undergoing a major expansion, advertising six new faculty positions in Physics and Chemistry.⁸

In contrast, our proposed program is entirely course and laboratory-based and expected to be completed in one year. Other unique features of the program are its focus on both the fundamental and applied aspects of material science and its intensive, “hands-on”, mode of delivery in a small-class environment.

1.4. Introduction to the Physics Programs

The Physics Department at Brock University has maintained a strong commitment to both undergraduate and graduate research and to teaching since its formation in 1967, and the approval of its M.Sc. program in 1969 and its Ph.D. program in 2010.

At the undergraduate level, the Department offers six general and specialized Honours major programs, two of which can include a Co-op option; three other B.Sc. options, including a concurrent B.Ed. through the Faculty of Education; and a Minor in Physics option. The new programs in Biophysics (begun in 2006) and Applied Optics and Laser Technology (in 2008) reflect the Department's resolve to provide a breadth of traditional, specialized, and applied physics programs supported by the expertise available at the Department. Every year many of our undergraduates receive Undergraduate Summer Research Awards to enrich their undergraduate experience through research projects in the laboratories alongside our M.Sc. and post-doctoral researchers.

Current undergraduate programs at the Department of Physics are:

- three-year and four-year Pass B.Sc. in Physics;
- four-year B.Sc. Honours and Major in Physics;
- Co-Op Program in Physics (5 years);
- four-year Honours B.Sc. in Computing and Solid-State Device Technology (CAST);
- Co-Op program in CAST (5 years);
- four-year Honours program in Biophysics;
- four-year Honours Physics Program with Concentration in Applied Optics and Laser Technology (a joint program with Niagara College);
- four-year combined Honours programs with Biology, Chemistry, Computer Science, Great Books, and Mathematics;
- concurrent B.Sc./B.Ed. (Physics Stream) Program;
- minor in Physics program.

Further details are available from: www.physics.brocku.ca/Programs/.

⁸See <http://jobs.sciencecareers.org/job/330852/tenure-track-faculty-positions-in-materials-chemistry-and-physics/>

Since its inception in 1969, the M.Sc. Physics program has consistently received a rating of “Good Quality” from OCGS. The last periodic appraisal took place in 2005-6, and the program was approved to continue, once again, with “Good Quality” rating. The M.Sc. program offers fields reflective of our faculty expertise: Theoretical Physics, Experimental Condensed Matter Physics and Materials Science, and Biophysics. Further details on various aspects of our current graduate (M.Sc.) program appear at: www.physics.brocku.ca/Programs/M.Sc/. The majority of our M.Sc. graduates go on to continue their education at Ph.D. level (see Section 5).

Though only a couple of years old, our Ph.D. program is a natural continuation of our proven success in training highly-qualified personnel (HQP) in our M.Sc. program. It has become very popular as a program of choice for our own M.Sc. candidates, and it also attracted additional graduate students from elsewhere. In mounting a Ph.D. program, the Department of Physics has joined other programs in the Faculty of Mathematics and Sciences, such as Biotechnology, Biology, and Chemistry. Our Ph.D. program is a rigorous yet intensely personal and hands-on program of study, attracting students both within Physics and in a variety of interdisciplinary areas.

At present the Department operates with eight core and seven cross-appointed faculty members from the departments of Chemistry, Biology, and Mathematics. In addition, we have several adjunct faculty members who hold permanent positions at institutions outside of Brock:

- Dr. Reinhard Kremer, Head of Group at the Max-Planck-Institute (MPI) for Solid State Research, Stuttgart, Germany;
- Dr. John Katsaras, Senior Scientist Biological Systems / Distinguished R&D Staff, Neutron Sciences Directorate, ORNL, Oak Ridge, TN, USA;
- Dr. Ole Steuernagel, Quantum Physics Group, STRI, School of Physics, Astronomy and Mathematics, University of Hertfordshire, UK.

The appointment of Dr. Kremer is a result of a long-standing association of several Department members with researchers at the MPI. In addition to the frequent visits by MPI researchers, a graduate course on Advanced Magnetism is offered by Dr. Kremer in the Department; and some of our current M.Sc. and Ph.D. students conduct some of their research in Dr. Kremer's laboratory in Stuttgart. Dr. Katsaras has had an on-going collaboration with T. Harroun, and several of the M.Sc. students in the Department have benefited from access to the facilities of the Canada Neutron Beam Centre. The most recent adjunct appointment, that of Dr. Steuernagel, stems from the success of our newest undergraduate program in Applied Optics and Laser Technology, and a new course has been taught by Dr. Steuernagel at Brock for the past several years in an innovative modular format.

Among the core faculty, three are in the field of theoretical condensed matter and statistical physics. The rest are experimentalists in the field of condensed matter and materials physics, soft condensed matter physics and biophysics. Among the cross-appointed faculty, one is in the field of theoretical quantum chemistry and theoretical biophysics, two are in the field of experimental biophysics, and three are in applied mathematics and mathematical physics.

The last retirements in the Physics Department were those of Profs. J.E. Black in

2001 and R.C. Shukla in 2002. Both positions have been filled, D. Crandles for J.E. Black, and K.V. Samokhin for R.C. Shukla. The next expected regular retirement date is 2016.

The Physics Department is known nationally and internationally for its research strength in the field of condensed matter physics. Most members of the Physics Department have research funding from NSERC and some have received recognition in the form of special grants, awards and prizes. Three members of the Department (M. Reedyk, K. Samokhin, and F. Razavi) have received Brock Chancellor's Chair in Research Excellence Awards and several have received CFI awards. Our graduate students have been highly successful in NSERC and OGS competitions. Several graduate students have received the Governor-General's Gold Medal, and the Distinguished Graduating Student Award. This year is the second year in a row that one of our Ph.D. students was awarded the prestigious Vanier Canada Graduate Scholarship.

1.5. Fields in the programs

At the last M.Sc. appraisal in 2005-6, and at the introduction of our Ph.D. in Physics program in 2010, the following fields of specialization were approved by OCGS:

- Theoretical Physics,
- Experimental Condensed Matter Physics and Materials Science, and
- Biophysics.

The new MSc in materials science program will incorporate these existing strengths within the proposed Program, and will enhance some of them further through additional faculty appointments and through targeted collaborations with Niagara College and other nearby institutions that may have specialized equipment not yet available at Brock. Faculty members and topics covered in each field of specialization are listed below.

Theoretical Physics

S.K. Bose, B. Mitrović, K.V. Samokhin, S.M. Rothstein, S. Anco, H. Fuks, A. Odesskii, O. Steuernagel, J. Vrbik, R.C. Shukla, T. Wolf

- study of superconductivity based on *ab initio* electronic structure and electron-phonon coupling calculations;
- non-crystalline materials;
- superconductivity: unconventional pairing (non-centrosymmetric, magnetic, high-T_c superconductors), localization and superconductivity, superconducting glassy state; superconducting fluctuations;
- transport in metals: transport properties of heavy fermion systems;
- quantum Monte Carlo studies of physical properties of isolated atoms and molecules;
- Monte Carlo and molecular dynamics studies of biological molecules.
- dynamical systems; mathematical physics; integrable systems;
- lattice dynamics, thermodynamics of anharmonic crystals;
- wave, quantum and atom optics.

Experimental Condensed Matter Physics and Materials Science

D. Crandles, T. Harroun, F.S. Razavi, M. Reedyk, E. Sternin, J. Katsaras, R. Kremer

- investigation of the optical properties of highly correlated materials and those exhibiting interesting phase transitions (*e.g.*, ferromagnets, superconductors, heavy fermion, spin- and charge-density-wave compounds) via reflectance and transmission spectroscopy from THz to UV frequencies;
- preparation and characterization of ceramic, single crystal and thin-film (using pulsed-laser deposition, sputtering and ultrahigh vacuum deposition) materials including superconductors (*e.g.*, cuprate, pnictide, pyrochlore, CuTiSe_2), colossal magnetoresistivity materials (manganites), and amorphous alloy;
- magnetic, transport and other properties at ambient and high pressure utilizing measurement techniques such as SQUID magnetometry, specific heat, thermopower, DC-resistivity, point contact spectroscopy, X-ray diffraction, magnetoresistivity, and Raman scattering spectroscopy;
- Nuclear Magnetic Resonance spectroscopy and relaxation measurements in soft condensed matter systems; study of collective motions in model membranes, phase transitions in liquid crystals, and surface properties of polyelectrolyte multilayers; exploration of various morphologies and phase behaviour of lipid/solvent systems using scattering techniques (*e.g.*, neutrons, x-ray and light).

Biophysics

T. Harroun, E. Sternin, D. Bruce, A. van der Est, J. Katsaras

- structural and physical characteristics of membranes and membrane proteins, measured by Nuclear Magnetic Resonance spectroscopy and X-ray/neutron diffraction; examining the structural characteristics of membrane-active peptides and the effects of perturbations such as proteins, sterols, substrates, temperature, and pressure have on the structure and phase behavior of lipids;
- biophysics of photosynthetic energy conversion using a combination of specialized optical spectroscopic techniques and theoretical models for excitation energy transfer and electron transport;
- time-resolved Electron Spin Resonance spectroscopy and light-induced spin polarization in photosynthetic membrane proteins and donor/acceptor molecular complexes; investigation of energy and electron transfer and spin dynamics in these systems.

1.6. Trans-disciplinary and external resources

The Department has consistently offered a good selection of graduate courses on an annual basis, and our graduate students' graduations have never been delayed because of a lack of graduate offerings. Cross-appointed and adjunct faculty contribute to graduate teaching in Physics, and have introduced new graduate courses into the Physics curriculum. Prof. A. van der Est from Chemistry has offered a course in Biophysical Techniques (BPHY 5P61), which is now listed in the Physics Graduate Calendar alongside Dr. T. Harroun's new graduate course in Membrane Biophysics (PHYS 5P02) to

complement the undergraduate Biophysics program. A course in advanced magnetism is taught regularly by Dr. Kremer from MPI during his annual visit to Brock in May-June. Two courses developed by Prof. S. Anco at the Department of Mathematics are regularly offered: *General Relativity and Black Holes* (PHYS 4P94) and *Solitons and Nonlinear Wave Equations* (PHYS 4P09). *Modern Wave Optics and its Applications: From Optical Tweezers to Ultracold Atom Clouds* (PHYS 4P62) has been prepared and taught every year for the past four years by Dr. O. Steuernagel. A new course in the *Mathematical Methods in Physics* has been recently developed by Prof. A. Odesskii. Each of these new courses focuses on the core competencies of our faculty, bringing the state-of-the-art in theory and experiment directly to the students.

Niagara College is a pre-eminent technical training institution in Niagara, and it offers some unique opportunities for training students. Niagara College has the largest photonics training labs in Canada, with dedicated testing and microelectronic laboratories, including a class-100 teaching clean-room facility. The Physics Department has a strong working relationship with Niagara College, through our joint B.Sc. in Physics with specialization in Laser Technology, an undergraduate Honours degree program which incorporates a year of mostly laboratory-based study at the Niagara College.

Access to some unique state-of-the-art equipment that is not yet available at Brock will be provided for the MSc in materials science students through Niagara College. A small number of technology-specific modules will be taught there, under contract from Brock. An agreement in principle already exists between the two institutions, and the details are articulated in Section 3.5 below. This will be particularly important in the early years of the program, to supplement areas where Brock currently does not yet have the necessary equipment. A successful growth in the MSc in materials science program will determine the laboratory improvements to make and the specialized equipment to acquire in the future to deliver the entire program at Brock.

1.7. Special matters and innovative features

One of the distinguishing features of the proposed program is going to be its innovative pedagogy, combining a traditional term-long delivery of lecture-based courses of primarily theoretical and computational nature, with short intense teaching of the courses that are of primarily applied/technical nature. Typically, the latter are two-week-long, intense (several hours a day) courses that are taught to the exclusion of everything else. This enables the students to focus on a single subject at a time, and for an instructor to include exercises and laboratories that may take longer than the typical three-hour time slots that the regular schedule allows. We have had considerable success with this style of course delivery in the two courses that are taught by our adjunct faculty, *Modern Wave Optics and its Applications: From Optical Tweezers to Ultracold Atom Clouds* (PHYS 4P62) and *Magnetism and Magnetic Materials* (PHYS 5P74), and we intend to implement the majority of the Summer-term offerings in the MSc in materials science program in this way.

The Physics Department at Brock is known for its strength in Condensed Matter Physics, particularly in the field of superconductivity. Canada's first high-temperature superconductor was synthesized here. Since then the Department has maintained a continued interest in this field and made a significant contribution to both theoretical and experimental aspects of superconductivity.

The Department maintains a collaboration on an ongoing basis with members of the Max-Planck-Institute for Solid-State Research in Stuttgart, Germany, and with the NRC Chalk River Laboratories. Through our adjunct faculty members from these institutions, some of the training modules will be bringing to Brock the very latest technological advances.

Brock's membership in SHARCNET will provide our students with computational resources comparable to leading research institutions around the world. The AccessGrid facility enables our faculty and graduate students to participate in research seminars at other institutions.

A number of programs and initiatives within the Physics Department will contribute to the intellectual experience and sense of scientific community that the MSc in materials science students will enjoy. Our existing graduate programs typically attract a number of international students from countries such as Slovakia, Iran, China, and Nigeria. The Department maintains an active research seminar program with frequent visiting speakers from nearby universities. The external examiners for thesis defences are encouraged to present research talks while on campus. All graduate students are required to attend these seminars, see at www.physics.brocku.ca/Seminars/.

Brock University is in the process of enhancing current graduate programs and fostering new ones, with the goal of becoming a much more comprehensive university over the next decade, as expressed in Brock University's Integrated Strategic Plan (see http://www.brocku.ca/webfm_send/18647). The Faculty of Graduate Studies was established at Brock in 2005, and has been providing consistent support to existing and helping to establish new graduate programs.

1.8. Impact of the new program on existing programs

As will be discussed in section 4.2 which discusses the degree requirements, most of the courses requirements are already existing courses offered either annually or on a two-year rotation for the existing MSc (physics) and PhD programs. We chose to structure the program this way for pedagogical reasons: international students are served best by taking courses alongside native english speakers. Even the new program-specific courses will be of interest to graduate students in both Msc in materials science and our existing graduate programs. Hence, initially, the new program will have only a small impact on the existing programs. Department meetings were held and members agreed to prepare the courses on overload, and teach them for the first several years. As outlined in the program budget (Table 3.6.1), additional funds will be required for teaching assistants and for course preparation and BUFA overloads.

2.FACULTY

2.1. List of faculty by field

Currently, there are eight core faculty members from the Department of Physics who will participate in the proposed MSc in materials science program. In addition, there are seven faculty members from other departments within the Faculty of Mathematics and Science at Brock who are cross-appointed to the Department of Physics with the purpose of supervising graduate students. All cross-appointed faculty have already been active in the delivery of the M.Sc. and Ph.D. Programs in Physics, regularly supervising graduate students and teaching graduate-level courses. Together, these can be considered “Core Faculty” who are expected to be involved in all aspects of the MSc in materials science program: preparing and delivering courses, performing academic advising functions, attending and providing feedback on student presentations, *etc.*

Table 2.1.1 lists the faculty members involved in the graduate program, identifies their field affiliation, and indicates gender. Since the MSc in materials science is a new program, the data is based on the previous participation in the M.Sc. and Ph.D. programs in Physics.

Faculty Name & Rank	M/F	Ret. Date	Home Unit	Supervisory Privileges	Fields		
					1	2	3
Core Faculty, Physics only							
S.K. Bose - Professor	M		Physics	Full	X		
D. Crandles - Professor	M		Physics	Full		X	
T.A. Harroun - Associate	M		Physics	Full		X	X
B. Mitrović - Professor	M		Physics	Full	X		
F.S. Razavi - Professor	M		Physics	Full		X	
M. Reedyk - Professor	F		Physics	Full		X	
K. Samokhin - Professor	M		Physics	Full	X		
E. Sternin - Associate	M		Physics	Full		X	X
Core Faculty, Physics and other Departments							
S. Anco - Professor	M		Math	Full	X		
D. Bruce - Professor	M		Biology	Full			X
H. Fuks - Associate	M		Math	Full	X		
A. Odesskii - Associate	M		Math	Co-Supervision	X		
S. Rothstein - Professor	M	2014	Chemistry	Full	X		X
A. Van der Est - Professor	M		Chemistry	Full			X
J. Vrbik - Professor	M		Math	Full	X		
T. Wolf - Professor	M		Math	Full	X		
Other Faculty							
J. Katsaras	M		CNB ⁹ , Chalk River Lab.	Full		X	X
R. Kremer	M		MPI Stuttgart	Full		X	
O. Steuernagel	M		CAIR ¹⁰ , U.Hertfordshire	Co-Supervision	X		
R.C. Shukla - Emeritus	M		Physics	Co-Supervision	X		

Table 2.1.1: Faculty Members by Field¹¹

⁹Canadian Neutron Beam Centre

¹⁰Centre for Atmospheric and Instrumentation Research

¹¹Faculty members involved in the Physics Graduate Program identified by their field affiliation and their expected retirement dates.

Field 1: Theoretical Physics

Field 2: Experimental Condensed Matter and Materials Science

Field 3: Biophysics

2.2. Research activities/qualifications of the Core Faculty

Core Faculty, Physics only

- S.K. Bose**, M.Sc. *Patna*, M.Sc. *Dalhousie*, Ph.D. *Simon Fraser*

Electronic structure of periodic and aperiodic materials: crystalline and amorphous solids, liquids, quasicrystals, ordered and disordered alloys, amorphous silicon and other semiconductors. Study of stability and cohesive properties, electronic transport, magnetic and superconducting properties of materials. Phase transformation, order-disorder transition and spinodal decomposition of alloys. Monte Carlo studies of phase transitions for spin Hamiltonians in periodic and quasiperiodic lattices.

- D.A. Crandles**, B.Sc. *Western Ontario*, M.Sc. *Ottawa*, Ph.D. *McMaster*

Investigation of the optical, transport and magnetic properties of highly correlated materials including Mott-Hubbard insulators and metallic ferromagnets. Preparation of thin film samples using pulsed-laser deposition technique.

- B. Mitrović**, Dipl. Phys. *Belgrade*, M.Sc., Ph.D. *McMaster*

Superconductivity: strong coupling theory, fluctuations in superconductors, localization and superconductivity, high- T_c materials, the superconducting glassy state. Transport in metals: transport properties of heavy fermion systems. Optical properties of the normal and superconducting states.

- F.S. Razavi**, B.Sc., M.Sc., Ph.D. *McMaster*

Preparation and investigation of magnetic and transport properties of thin films, ceramic and single crystals of superconductors, CMR materials (manganites) and amorphous alloys utilizing measurement techniques such as SQUID magnetometer, high pressure, specific heat and x-ray studies. Pulsed-laser deposition technique to prepare films and various methods to obtain ceramic samples.

- M. Reedyk**, B.Sc. *Trent*, M.Sc., Ph.D. *McMaster*

Investigation of the optical properties of materials with low- T_c phase transitions (e.g., superconductors, heavy-fermion, spin- and charge-density wave compounds) via far-infrared reflectance spectroscopy.

- K. Samokhin**, M.Sc. *Moscow Physical-Technical*, Ph.D. *L.D.Landau Institute*

Unconventional superconductivity: noncentrosymmetric, magnetic superconductors. Strongly-correlated electron systems in one and two dimensions. Mesoscopic physics.

- E. Sternin**, B.Sc., M.Sc., Ph.D. *British Columbia*

Nuclear Magnetic Resonance spectroscopy and relaxation measurements in soft condensed matter systems. Collective motions in model membranes and non-bilayer phases of phospholipids, phase transitions in liquid crystals. Use of inverse-

theory computational methods in the analysis of experimental data.

•**T. Harroun**, B.A. *Berkeley*, Ph.D. *Rice*

Structural and physical characteristics of membranes and membrane proteins, using neutron and X-ray diffraction and other complementary techniques.

Core Faculty, Physics and other programs

•**S. Anco**, B.Sc., *Caltech*, M.Sc., Ph.D., *Chicago*

Mathematical physics, solitons and integrable systems, classical gauge theory, general relativity

•**D. Bruce**, B.Sc., Ph.D. *Simon Fraser*

Biophysics of photo-synthetic light conversion.

•**H. Fuks**, M.Sc., Ph.D. *Illinois*

Spatially-extended discrete dynamical systems, cellular automata, lattice-gas automata.

•**A. Odesskii**, M.Sc., *Moscow Physical-Technical*, Ph.D., *Moscow State*, D.Sc, *L.D. Landau Institute*

Integrable systems, mathematical physics, computer algebra, high-performance computing, representation theory, non-commutative geometry, algebraic geometry.

•**S. Rothstein**, B.Sc. *Illinois*, M.Sc., Ph.D. *Michigan*

Computational chemistry (electronic structure problems for isolated atoms and molecules) and physics (soft condensed matter). Quantum Monte Carlo study of properties of atoms and molecules. Study of protein structure using molecular dynamics and Monte Carlo methods combined with statistical analysis.

•**A. van der Est**, B.Sc., Ph.D. *UBC*, Habil. (Experimental Physics), *FU-Berlin*

Time-resolved Electron Spin Resonance Spectroscopy. Energy and electron transfer, and excited state dynamics in molecular materials.

•**J. Vrbik**, B.Sc., M.Sc. *Charles' University, Prague*, M.Sc., Ph.D. *Calgary*

Celestial Mechanics, Kepler Problem, Dirac Equation, Clifford Algebra.

•**T. Wolf**, B.Sc., M.Sc. *Friedrich Schiller University, Jena*, Ph.D.

Differential equations and integrability, computer algebra, General Relativity and special aspects of optimization and artificial intelligence; Brock site leader of the [SHARCNET](#) consortium.

Other Faculty

•**J. Katsaras**, B.A., B.Sc., *Concordia*, M.Sc., Ph.D., *Guelph*

Atomic resolution neutron and x-ray holographies, structure of biofilms, development of spontaneously forming, functionalised unilamellar vesicles specifically targeted to delivering payloads to the brain.

•**R. Kremer**, Dipl. Physics, *Darmstadt*, Ph.D., *MPI Stuttgart*

Characterization of electrical, thermal and magnetic properties of materials and novel compounds, development of techniques for the measurements of physical properties of solids.

•**O. Steuernagel**, M.Sc., *München*, Ph.D., *Berlin*

Wave optics, Gouy's phase, multi-modal laser beams. Quantum optics, Afshar's paradox, interferometry for quantum imaging, quantum lithography, multi-photon absorption. Atom optics, lenses for atom beams.

•**R.C. Shukla**, M.Sc., Ph.D., *Allahabad*

Lattice dynamics: lattice vibrations in simple metals, thermodynamics of anharmonic crystals, formalism of interacting many-body systems, Monte-Carlo and molecular dynamics simulations.

Additional Faculty and Staff

The first two terms of the MSc in materials science program can be delivered using the current complement of faculty in the Physics Department, with only an occasional part-time teaching or overload teaching contract, as it will utilize mostly the courses that are already being taught within our existing M.Sc. and Ph.D. programs. The teaching of the advanced experimental courses in the final summer term will require an additional full-time faculty position in the Physics Department, as well as an additional technical staff (a lab instructor). A full-time faculty is essential, as the part-time contract instructors would not be able to apply for external research funding, and thus our future ability of bringing new state-of-the-art technologies and expertise on campus will be severely restricted. As the program grows, the program will bring a net financial gain, however in the initial stages of the program it is possible that a small net loss will be realized in the first or second cohorts, as the salary of a new faculty member and some new equipment costs may need to be absorbed. Contract teaching from Niagara College will be helpful in ensuring the breadth of program offerings, but these would not be sufficient for delivering the majority of the curriculum. Thus it is important that a new faculty position be provided by the end of the first academic year of the fully-subscribed MSc in materials science program (beyond the initial ramp-up year), in time for delivering some of the lab-based modules in the summer term.

One of the two lab demonstrators in the Department has been appointed part-time to the Health and Safety as the Radiation Safety Officer, thus reducing our support staff availability. Coupled with the growth in enrollments over the past decade, our lab support staff is stretched to the limit, and no new labs can be added without some additional support staff. It is essential that a lab demonstrator position be added to support the new advanced labs of the MSc in materials science program. This could be a part-time position initially, to become full-time as warranted by the growth of the program.

2.3. Graduate supervision

Member	Completed			Current		
	M.Sc.	Ph.D.	PDF	M.Sc.	Ph.D.	PDF
Core Faculty, Physics only						
S.K. Bose - Professor	3	0	4	1	0	0
D. Crandles - Associate	7	0	0	0	2	0
T.A. Harroun - Associate	1	0	0	0	2	0
B. Mitrović - Professor	3	0	3	1	0	0
F.S. Razavi - Professor	22	2	2	0	4	1
M. Reedyk - Professor	12	0	1	1	1	0
K. Samokhin - Professor	2	0	3	1	0	0
E. Sternin - Associate	8	0	2	0	0	0
Core Faculty, Physics and other Departments						
S. Anco - Professor	0(2)	0(0)	0(2)	0(2)	1(2)	0(1)
D. Bruce - Professor	1(14)	0(2)	0(3)	1(2)	0(2)	1(2)
H. Fuks - Associate	0(4)	0	0	0(1)	0	0
A. Odesskii - Associate	0	0	0	0	1(1)	0
S. Rothstein - Professor	9(14)	0	0(3)	0(0)	0	0
A. Van der Est - Professor	5(7)	1(1)	1(4)	1(1)	0(1)	0(1)
J. Vrbik - Professor	0(9)	0	0	0	0	0
T. Wolf - Professor	0	0	0	0	1(1)	0
Other Faculty - Brock graduate supervisorships only						
J. Katsaras	0(0)	0(0)	0(8)	0(0)	0(0)	0(0)
R. Kremer	0(5)	0(4)	0(8)	0(0)	0(2)	0(0)
O. Steuernagel	0(0)	0(1)	0(0)	0(0)	0(0)	0(0)
R.C. Shukla - Emeritus	16	0	1			

Table 2.3.1: Completed and current supervisorships of master's, doctoral, and post-doctoral students, by faculty member, lifetime summary data¹²

¹²For faculty members who are involved in more than one graduate program the number of students supervised in Physics is listed and, in parentheses, the total number of students supervised in all graduate programs. Prof. Shukla has been experiencing some health difficulties recently and is not currently acting as a

2.4. Instructor Qualifications and Teaching Assignments (within Unit)

Instructor Name	Year						Courses		Supervisions						Comment	
	Academic Year	M/F	Terminal Degree	Rank*	Tenure or Tenure Stream	Start Date (Year)	Undergraduate	Graduate	Core or Participating	Undergraduate Thesis	Major Research Paper	Graduate Thesis - Master's	Graduate Thesis - Doctoral	Grad Committee Member		Post-doctoral Fellows
Bose, S	08/09	M	PhD	F	T	1988	0.0	0.0	C	0		0	NA	2		Jul 2008 - Jun 2009 Sabbatical
Crandles, D	08/09	M	PhD	AC		2001	2.0	0.0	C	1		2	NA	3		
Harroun, T	08/09	M	PhD	AT		2006	2.0	0.0	C	0		1	NA	3		
Mitrovic, B	08/09	M	PhD	F	T	1983	1.75	0.0	C	0		0	NA	3		
Razavi, F	08/09	M	PhD	F	T	1984	2.0	0.0	C	1		4	NA	1		
Reedyk, M	08/09	F	PhD	F	T	1994	1.5	0.5	C	1		1	NA	4		
Samokhin, K	08/09	M	PhD	F	T	2002	2.0	0.0	C	0		0	NA	3		Physics Grad Program Director
Sternin, E	08/09	M	PhD	AC		1991	1.0	0.0	C	0		2	NA	1		Physics Chair 1.0 Release
Knigavko, A	08/09	M	PhD	LC		2005	1.0	1.0	P							PT Instructor past PDF

Table 2.4.1: Instructor Qualifications and Teaching Assignments (within Unit), 2008-2009

graduate supervisor.

Instructor Name	Year						Courses		Supervisions						Comment	
	Academic Year	M/F	Terminal Degree	Rank*	Tenure or Tenure Stream	Start Date (Year)	Undergraduate	Graduate	Core or Participating	Undergraduate Thesis	Major Research Paper	Graduate Thesis - Master's	Graduate Thesis - Doctoral	Grad Committee Member		Post-doctoral Fellows
Bose, S	09/10	M	PhD	F	T	1988	0.5	0.5	C					4	1	1.0 medical course release
Crandles, D	09/10	M	PhD	AC		2001	1.5	0.5	C	1		3		2		
Harroun, T	09/10	M	PhD	AT		2006	2.0	0.0	C	1		1		5		
Mitrovic, B	09/10	M	PhD	F	T	1983	2.0	0.0	C	1				6		
Razavi, F	09/10	M	PhD	F	T	1984	2.0	0.0	C			4		1	2	
Reedyk, M	09/10	F	PhD	F	T	1994	1.5	0.5	C			4		3		
Samokhin, K	09/10	M	PhD	F	T	2002	1.5	0.5	C					4		Physics Grad Program Director
Sternin, E	09/10	M	PhD	AC		1991	1.0	0.0	C			3		4		Physics Chair 1.0 Release
Kremer, R	09/10	M	PhD	AD		2008	0.0	0.5	P							Visiting Instructor Max Plank, Stuttgart
Knigavko, A	09/10	M	PhD	LC		2005	1.0	0.0	P							PT instructor - past PDF
Steuernagel, O	09/10	M	PhD	AD		2009	0.5	0.0	P							Visiting Instructor University of Hertfordshire, UK

Table 2.4.2: Instructor Qualifications and Teaching Assignments (within Unit), 2009-2010

Instructor Name	Year						Courses		Supervisions						Comment	
	Academic Year	M/F	Terminal Degree	Rank*	Tenure or Tenure Stream	Start Date (Year)	Undergraduate	Graduate	Core or Participating	Undergraduate Thesis	Major Research Paper	Graduate Thesis - Master's	Graduate Thesis - Doctoral	Grad Committee Member		Post-doctoral Fellows
Bose, S	10/11	M	PhD	F	T	1988	1.5	.5	C			1		5	1	
Crandles, D	10/11	M	PhD	AC		2001	2.0		C	1		3		3		
Harroun, T	10/11	M	PhD	AC		2006	1.5	0.5	C	1		1		4		
Mitrovic, B	10/11	M	PhD	F	T	1983	1.5	0.5	C	2		1		4		
Razavi, F	10/11	M	PhD	F	T	1984	1.5	0.5	C			1	2		1	
Reedyk, M	10/11	F	PhD	F	T	1994	2.0		C			4		3		
Samokhin, K	10/11	M	PhD	F	T	2002	1.5	0.5	C						1	Physics Grad Program Director
Sternin, E	10/11	M	PhD	AC		1991	1.5		C	1		2		4		Physics Chair
Kremer, R	10/11	M	PhD	AD		2008		0.5	P							Visiting Instructor - Max Plank Institute Stuttgart
Knigavko, A	10/11	M	PhD	LC		2005	1.0		P							PT Instructor - past PDF
Steuernagel, O	10/11	M	PhD	AD		2009	0.5		P							Visiting Instructor - University of Hertfordshire, UK

Table 2.4.3: Instructor Qualifications and Teaching Assignments (within Unit), 2010-2011

Instructor Name	Year						Courses		Supervisions						Comment
	Academic Year	M/F	Terminal Degree	Rank*	Tenure or Tenure Stream	Start Date (Year)	Undergraduate	Graduate	Core or Participating	Undergraduate Thesis	Major Research Paper	Graduate Thesis - Master's	Graduate Thesis - Doctoral	Grad Committee Member	
Bose, S	11/12	M	PhD	F	T	1988	1.0	1.0	C					5	
Crandles, D	11/12	M	PhD	AC		2001	2.0	0.5	C	3		2	2	4	
Harroun, T	11/12	M	PhD	AC		2006	2.0		C	1		1	1	5	
Mitrovic, B	11/12	M	PhD	F	T	1983	1.5	0.5	C			1		4	
Razavi, F	11/12	M	PhD	F	T	1984	1.5	0.5	C			2	3		1
Reedyk, M	11/12	F	PhD	F	T	1994	1.0		C	1		3		3	Jan-Jun 2012 Sabbatical
Samokhin, K	11/12	M	PhD	F	T	2002	1.0	1.0	C	1		1		4	Physics Grad Program Director
Sternin, E	11/12	M	PhD	AC		1991	1.5		C	1				5	Physics Chair; PEP Program Director (*)
Kremer, R	11/12	M	PhD	AD		2008		0.5	P						Visiting Instructor Max Plank Institute, Stuttgart
Knigavko, A	11/12	M	PhD	LC		2005	1.0		P						PT Instructor - past PDF
Singh, M	11/12	M	PhD	LC		2010	0.5		P						PT Instructor - PDF
Steuernagel, O	11/12	M	PhD	AD		2009	0.5		P						Visiting Instructor University of Hertfordshire, UK

Table 2.4.4: Instructor Qualifications and Teaching Assignments (within Unit), 2011-2012

*

* PEP = Physics Enrichment program, a for-credit high school program, see www.physics.brocku.ca/Programs/Enrichment

Instructor Name	Year						Courses		Supervisions						Comment	
	Academic Year	M/F	Terminal Degree	Rank*	Tenure or Tenure Stream	Start Date (Year)	Undergraduate	Graduate	Core or Participating	Undergraduate Thesis	Major Research Paper	Graduate Thesis - Master's	Graduate Thesis - Doctoral	Grad Committee Member		Post-doctoral Fellows
Bose, S	12/13	M	PhD	F	T	1988		1.0	C			1		3		Jan - June 2013 Sabbatical
Crandles, D	12/13	M	PhD	AC		2001	2.0		C	4			2	4		
Harroun, T	12/13	M	PhD	AC		2006	1.5	0.5	C				2	5		
Mitrovic, B	12/13	M	PhD	F	T	1983	2.5	0.5	C			1		4		
Razavi, F	12/13	M	PhD	F	T	1984	1.0		C				4	1		Jan - Aug 2013 Sabbatical
Reedyk, M	12/13	F	PhD	F	T	1994	2.0		C	3		2	1	4		
Samokhin, K	12/13	M	PhD	F	T	2002	2.0	0.5	C	1		1		4		Physics Grad Program Director
Sternin, E	12/13	M	PhD	AC		1991	1.0		C	1				6		Physics Chair; PEP Program Director (*)
Kremer, R	12/13	M	PhD	AD		2008		0.5	P							Visiting Instructor Max Plank Institute, Stuttgart
Knigavko, A	12/13	M	PhD	LC		2005	1.0		P							PT Instructor - Past PDF
Steuernagel, O	12/13	M	PhD	AD		2009	0.5		P							Visiting Instructor University of Hertfordshire, UK

Table 2.4.5: Instructor Qualifications and Teaching Assignments (within Unit), 2012-2013

*

* PEP = Physics Enrichment program, a for-credit high school program, see www.physics.brocku.ca/Programs/Enrichment

2.5. Contributions by Instructors to Other Units

Instructor Name	Year	Other Unit	Courses		Supervisions						Comment	
	Academic Year	Other Unit	Undergraduate	Graduate	Core or Participating	Undergraduate Thesis	Major Research Paper	Graduate Thesis - Master's	Graduate Thesis - Doctoral	Grad Committee Member		Post-doctoral Fellows
Bose, S	09-13											NONE
Crandles, D	09-13											NONE
Harroun, T	09-13											NONE
Mitrovic, B	09-13											NONE
Razavi, F	09-13											NONE
Reedyk, M	09-13											NONE
Samokhin, K	09-13											NONE
Sternin, E	09-13											NONE

Table 2.5.1: Contributions by Instructors to Other Units, 2009-2013

2.6. Contributions by Instructors from Other Units

Instructor Name	Year	Other Unit	Courses		Supervisions						Comment	
	Academic Year	Other Unit	Undergraduate	Graduate	Core or Participating	Undergraduate Thesis	Major Research Paper	Graduate Thesis - Master's	Graduate Thesis - Doctoral	Grad Committee Member		Post-doctoral Fellows
Bruce, D	08/09	Biology						1		0		Adjunct Faculty
VAN DER EST, A	08/09	Chemistry	0.5							2		Adjunct Faculty/cross-listed course
FUETEN, F	08/09	Earth Sciences	0.25									portion of Astronomy course

Table 2.6.1: Contributions by Instructors from Other Units, 2009-2010

Instructor Name	Year	Other Unit	Courses		Supervisions						Comment	
	Academic Year	Other Unit	Undergraduate	Graduate	Core or Participating	Undergraduate Thesis	Major Research Paper	Graduate Thesis - Master's	Graduate Thesis - Doctoral	Grad Committee Member		Post-doctoral Fellows
Anco, S	10/11	Mathematics	0.5		C				1			Adjunct Faculty/cross-listed course
Odesski, A	10/11	Mathematics			C				1			Adjunct Faculty
Wolf, T	10/11	Mathematics			C				1			Adjunct Faculty
Rothstein, S	10/11	Chemistry		0.5	C			1				Adjunct Faculty/cross-listed course
D'Agostino, S	10/11	Mathematics	0.5		P							

Table 2.6.2: Contributions by Instructors from Other Units, 2010-2011

Instructor Name	Year	Other Unit	Courses		Supervisions						Comment	
	Academic Year	Other Unit	Undergraduate	Graduate	Core or Participating	Undergraduate Thesis	Major Research Paper	Graduate Thesis - Master's	Graduate Thesis - Doctoral	Grad Committee Member		Post-doctoral Fellows
Rothstein, S	11/12	Chemistry			C			1				Adjunct Faculty
van der Est, A	11/12	Chemistry			C					1		Adjunct Faculty
Odesski, A	11/12	Mathematics	0.5		C				1			Adjunct Faculty/cross-listed course
Wolf, T	11/12	Mathematics			C				1			Adjunct Faculty
Anco, S	11/12	Mathematics	0.5		C				1			Adjunct Faculty/cross-listed course
STUDENT DEVELOPMENT CT	11/12			0.5	P							Graduate writing course

Table 2.6.3: Contributions by Instructors from Other Units, 2011-2012

Instructor Name	Year	Other Unit	Courses		Supervisions						Comment	
	Academic Year	Other Unit	Undergraduate	Graduate	Core or Participating	Undergraduate Thesis	Major Research Paper	Graduate Thesis - Master's	Graduate Thesis - Doctoral	Grad Committee Member		Post-doctoral Fellows
Anco, S	12/13	Mathematics	0.5		P	2			1			Adjunct Faculty/cross-listed course
Odesski, A	12/13	Mathematics			P				1			Adjunct Faculty
Wolf, T	12/13	Mathematics			P				1			Adjunct Faculty
Rothstein, S	12/13	Chemistry			P				1			Adjunct Faculty
Van der Est, A	12/13	Chemistry		0.5	P			1		1		Adjunct Faculty/cross-listed course
Bruce, D	12/13	Biology			P			1				Adjunct Faculty

Table 2.6.4: Contributions by Instructors from Other Units, 2012-2013

2.7. Intellectual Contributions

Faculty Name	A. Publication of books and monographs	B. Contributions to edited books	C. Papers in peer refereed Journals	D. Peer reviewed abstracts	E. Papers delivered at conferences and professional meetings	F. Contributions to panels, workshops, and clinics	G. Invited Presentations	H. Consulting (government, related professionals and agencies)	I. Preparation of instructional, clinical, curriculum or policy materials for such agencies	J. Editorial and refereeing duties	K. Creation, performance, direction, programming, design and staging of creative works for the public	L. Curation of juried exhibitions	M. Festivals and competitions adjudicated, master classes offered	N. Professional residencies	O. Development of software, hardware or equipment	P. Scholarly contributions to pedagogy	Q. Other scholarly contributions to agencies, communities, governments or organizations	R. Other publications (non-refereed) with significant public impact
BOSE, S	12	1			6					6						1	4	
CRANDLES, D			6		3	1	3			3								
HARROUN, T		1			1		2	2		3							1	
MITROVIC, B			2							7								1
RAZAVI, F			18							1								
REEDYK, M			3		1		2			5								
SAMOKHIN, K		1	29		5	1	10			3						1		
STERNIN, E	1		7		8	1	6			2					2			6

Table 2.7.1: Summary of Intellectual Contributions for Academic Years 2005-2013

2.8. Research Grants and Contracts - External

Name	Year	CFI		CIHR		NSERC		SSHRC		Other Major Granting Agencies		Other Grants & Contracts		Year Total	Individual Total
		#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount		
Bose, S	05/06					1	\$17,000							\$17,000	
Bose, S	06/07					1	\$17,000							\$17,000	
Bose, S	07/08					1	\$17,000							\$17,000	
Bose, S	07/08					1	\$4,000							\$4,000	
Bose, S	08/09					1	\$17,000							\$17,000	
Bose, S	09/10					1	\$17,000							\$17,000	\$89,000
Crandles, D	05/06					1	\$24,000							\$24,000	
Crandles, D	06/07					1	\$19,000							\$19,000	
Crandles, D	07/08					1	\$19,000							\$19,000	
Crandles, D	08/09					1	\$18,000							\$18,000	
Crandles, D	09/10					1	\$18,000							\$18,000	
Crandles, D	10/11					1	\$3,175							\$3,175	
Crandles, D	11/12					1	\$20,000							\$20,000	
Crandles, D	12/13					1	\$20,000							\$20,000	\$141,175
Harroun, T	06/07					1	\$1,300,000							\$1,300,000	
Harroun, T	07/08					1	\$32,000							\$32,000	
Harroun, T	08/09					1	\$26,666							\$26,666	
Harroun, T	09/10					1	\$26,666							\$26,666	
Harroun, T	10/11					1	\$26,666							\$26,666	
Harroun, T	11/12					1	\$26,666							\$26,666	
Harroun, T	12/13					1	\$26,666							\$26,666	\$1,465,330
Mitrovic, B	05/06					1	\$12,000							\$12,000	
Mitrovic, B	06/07					1	\$12,000							\$12,000	
Mitrovic, B	07/08					1	\$12,000							\$12,000	
Mitrovic, B	08/09					1	\$12,000							\$12,000	
Mitrovic, B	09/10					1	\$12,000							\$12,000	
Mitrovic, B	10/11					1	\$12,000							\$12,000	
Mitrovic, B	11/12					1	\$12,000							\$12,000	\$84,000

Name	Year	CFI		CIHR		NSERC		SSHRC		Other Major Granting Agencies		Other Grants & Contracts		Year Total	Individual Total
		#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount		
Razavi, F	05/06					1	\$26,900							\$26,900	
Razavi, F	06/07					1	\$26,900							\$26,900	
Razavi, F	07/08					1	\$38,070							\$38,070	
Razavi, F	07/08					1	\$109,180							\$109,180	
Razavi, F	08/09					1	\$38,070							\$38,070	
Razavi, F	09/10					1	\$38,070							\$38,070	
Razavi, F	09/10	1	\$245,850											\$245,850	
Razavi, F	10/11					1	\$38,070							\$38,070	
Razavi, F	11/12					1	\$25,000							\$25,000	
Razavi, F	11/12											1	\$50,000	\$50,000	
Razavi, F	12/13											1	\$50,000	\$50,000	
Razavi, F	12/13					1	\$21,000							\$21,000	\$707,110
Reedyk, M	06/07					1	\$38,000							\$38,000	
Reedyk, M	08/09					1	\$38,000							\$38,000	
Reedyk, M	09/10					1	\$27,000							\$27,000	
Reedyk, M	10/11					1	\$27,000							\$27,000	
Reedyk, M	11/12					1	\$27,000							\$27,000	
Reedyk, M	12/13					1	\$27,000							\$27,000	\$184,000
Samokhin, K	05/06					1	\$30,000							\$30,000	
Samokhin, K	06/07					1	\$30,000							\$30,000	
Samokhin, K	07/08						\$30,000							\$30,000	
Samokhin, K	08/09					1	\$30,529							\$30,529	
Samokhin, K	09/10					1	\$30,529							\$30,529	
Samokhin, K	10/11					1	\$30,529							\$30,529	
Samokhin, K	11/12					1	\$30,529							\$30,529	
Samokhin, K	12/13					1	\$30,529							\$30,529	\$242,645
Sternin, E	05/06					1	\$14,000							\$14,000	
Sternin, E	06/07					1	\$14,000							\$14,000	
Sternin, E	07/08					1	\$14,000							\$14,000	
Sternin, E	08/09					1	\$14,000							\$14,000	
Sternin, E	08/09											1	1,000	\$1,000	
Sternin, E	09/10					1	\$14,000					1	5,000	\$19,000	
Sternin, E	11/12											1	1,000	\$1,000	
Sternin, E	12/13											1	500	\$500	\$77,500

Table 2.8.1: Summary of External Research Grants for Academic Years 2005-2013

2.9. Research Grants and Contracts - Internal

Instructor Name	Year	BUAF		CIHR Internal		SSRC Internal		Dean		Department		Other		Year Total	Individual Total
		#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount		
Harroun, T	05/06	1	\$80,000											\$80,000	
Harroun, T	07/08											1	\$4,500	\$4,500	
Harroun, T	07/08											1	\$3,250	\$3,250	\$87,750
Razavi, F	08/09											1	\$15,000	\$15,000	
Razavi, F	09/10											1	\$15,000	\$15,000	
Razavi, F	10/11											1	\$15,000	\$15,000	\$45,000
Reedyk, M	05/06											1	\$5,463	\$5,463	
Reedyk, M	08/09											1	\$7,840	\$7,840	
Reedyk, M	09/10											1	\$500	\$500	
Reedyk, M	10/11											1	\$8,411	\$8,411	
Reedyk, M	12/13											1	\$5,747	\$5,747	\$27,961
Samokhin, K	05/06											1	\$15,000	\$15,000	
Samokhin, K	06/07											1	\$15,000	\$15,000	
Samokhin, K	07/08											1	\$15,000	\$15,000	\$45,000
Stemin, E	07/08							1	\$8,000					\$8,000	
Stemin, E	08/09							1	\$8,000					\$8,000	
Stemin, E	09/10							1	\$16,000					\$16,000	
Stemin, E	10/11							1	\$8,000			1	\$4,800	\$12,800	
Stemin, E	11/12											1	\$4,800	\$4,800	
Stemin, E	12/13											1	\$4,800	\$4,800	\$54,400

Table 2.9.1: Summary of Internal Research Grants for Academic Years 2005-2013

3. PHYSICAL RESOURCES

3.1. Library resources

The James A. Gibson Library occupies seven floors of the Arthur Schmon Tower, the focal point of Brock University, and also encompasses a Map Library in a separate physical location. The Library has extensive and growing collections of digital resources that include e-journals, e-books, statistical and geospatial data, and multimedia resources. Its print collections of monographs, serials, government documents, maps and microforms number over one million items. The Library staff comprises 65 full-time equivalent positions, including 20 librarians.

In addition, the Instructional Resource Centre (IRC), a curriculum library, is located in and maintained by the Faculty of Education, at both the St. Catharines and Hamilton campuses. Designed to meet the specialized needs of education students, the materials and facilities are available to all students registered at the University.

The collections and services provided by the University Library support a wide range of undergraduate and graduate programs.

COLLECTIONS SUPPORT

Books

The library holdings which support the teaching programs of the Department of Physics have been selected jointly by the faculty and the liaison librarian for Physics, based on the Collection Development Policy (updated 2008). Books including e-books and other one-time purchases are made against the departmental library allocation, which is determined by a formula based on enrolment and the number of unique courses offered. The Physics library allocations for the past several years are:

Academic year	Library allocation for Physics
2012/2013	\$7,863
2011/2012	\$7,863
2010/2011	\$7,575
2009/2010	\$7,258
2008/2009	\$8,284
2007/2008	\$7,661
2006/2007	\$7,880
2005/2006	\$7,880

Table 3.1.1: Physics Library Budget, 2005-2013

The Library also has a growing collection of scholarly e-books from a variety of

publishers (e.g. Oxford, Cambridge, Springer), many of which are available through a single interface: the *Scholars Portal Book Platform*. *Scholars Portal* is an innovative repository of digital scholarly materials being developed by the Ontario Council of University Libraries (OCUL). *Scholars Portal* provides consolidated retrieval and storage capabilities for e-books. With more than 50,000 commercial and 200,000 open access titles, it is one of the largest e-book collections in the world.

Journals

The Library provides access to more than 30,000 full-text electronic journals containing hundreds of thousands of articles in a broad range of disciplines, with extensive digital archival holdings. It also has a collection of print journals, but many print subscriptions have been replaced by online access. The costs of journals are not formally allocated by department or discipline, but are covered by a central library fund. The *Scholars Portal E-Journals* collection provides access to the full-text of thousands of scholarly journals from a variety of publishers.

The Library maintains subscriptions journals which directly support the programs in the Department of Physics, plus a broad range of titles in related disciplines.

Individual journal titles are accessible from the Brock Library Catalogue, <http://catalogue.library.brocku.ca/>. Access to the contents of relevant journals is provided by subscriptions to the databases, *SciFinder*, *Reaxys*, *ACS Web Editions*, and interdisciplinary databases *Web of Knowledge/Science*, *Google Scholar* and *Academic Search Complete*. The *Science Citation Index*, available through *Web of Science*, allows citation searching.

Reference Collection

The print Reference Collection contains handbooks, encyclopaedias and dictionaries important to Physics. Increasingly, the Library is purchasing electronic reference resources rather than print. Examples of recent online acquisitions are the *Springer Handbook of Atomic, Molecular and Optical Physics Handbook (2006)*, *CRC Handbook of Chemistry and Physics, Materials Handbook: A Concise Desktop Reference (2008)*, *Handbook of Theoretical Atomic Physics (2012)*, and *Encyclopedia of Mathematical Physics (2006)*.

The Physics Research LibGuide is an invaluable resource that provides citations and links to Library reference materials @ <http://researchguides.library.brocku.ca/PHYS>.

Digital Repository

The Library retains a Digital Repository that retains a unique collection of items created by the wider Brock University community including Brock Physics M.Sc. theses and Ph. D. doctoral dissertations.

External Resources: Interlibrary Loan/Document Delivery (via RACER)

Students may request research materials which are not available at Brock through RACER, the interlibrary loan system. The Library currently subsidizes the cost of articles obtained on interlibrary loan within Canada, so there is no cost to students.

External Resources: Canadian Reciprocal Borrowing Agreement

As a result of an agreement among the four Canadian regional library consortia, Brock students may take advantage of in-person borrowing privileges (subject to the regulations of the lending library) at many university libraries across Canada. Some exceptions apply.

SERVICES

Library Hours

During Fall/Winter terms the library is open 95.5 hours per week, and during the examination period library hours are extended until 2 a.m.

Access 24/7 www.brocku.ca/library

The Library's digital resources are accessible to Brock University faculty, staff and registered students, both on and off-campus, twenty-four hours a day, seven days a week. Students can email the library any time with a question, or chat online with a staff person during limited hours via LIVEHelp!

Teaching and Learning

Managing information effectively is a key competency in the Ontario Undergraduate Degree Level Expectations. The information literate student is one who is able to access information efficiently, critically assess it, assimilate and synthesize it effectively.

The Physics Liaison Librarian is available to work collaboratively with faculty to address students' information competencies through a number of methods, including:

- hand-on workshops
- guest lectures
- tutorials
- online learning modules (in the university learning management system, for example)
- research guides
- individual research consultations

Matheson Learning Commons (aimed primarily at undergraduates)

In collaboration with other campus partners, the Library opened the Matheson Learning Commons in 2008. Designed to help students succeed in their research, writing, and learning, the commons staff provide an array of services within a dynamic and vibrant learning environment. Features include:

- 11 bookable group study rooms
- 2 classrooms

- Help Desk for library research support and reference assistance (throughout the week and evenings/weekends during the Fall/Winter terms)
- Learning Centre: for help with essay writing and study skills
- Career Resource Centre: for assistance with resumes, interview skills, and job searches
- 113 public computers (PCs & Macs)
- Laptop computers available for short term loan

Graduate Student Space

In the summer 2011 the Library opened new space for graduate students on the 6th floor of the Library, featuring:

- 22 large study carrels
- two computer workstations
- 38 bookable lockers nearby for storage
- two lounge chairs
- bookable meeting/presentation/group space for up to 10 students

Summary

The Library endeavours to contribute to a positive learning experience for students in Physics by:

- acquiring and maintaining collections to meet their curriculum needs
- providing excellent teaching, learning and research services
- continuously assessing needs that inform the development of our collections and services

3.2. Research laboratory facilities

The Department is well-equipped to support the needs of the MSc in materials science program. The experimental needs of a Materials Science program are similar to those of the Experimental Condensed-Matter Physics, a combination of sample preparation and materials characterization and investigation, and the requirements for both are well-served by the existing complement of equipment. Thus the initial fit is excellent, and the future growth of the MSc in materials science program will enable additional equipment purchases that will support both fields, for example an STM/AFM facility. Quite frequently, our equipment is unique and is developed in-house, a task much assisted by the central technical services of the Faculty of Mathematics and Sciences that are excellent, competent and well-equipped. The labour costs associated with the shops are borne by the University, the researchers being charged only for the materials and supplies. As a result, innovative state-of-the-art equipment is continuously being developed and built. In the past, we have been commended by various NSERC site visit committees for our ability to maintain such an excellent research infrastructure in a small- to medium-sized University. We maintain a list of the equipment available at the Department at www.physics.brocku.ca/Equipment/.

Major equipment - sample preparation

- thin-film pulsed-laser deposition facility, UHV growth chamber
- RF sputtering facility
- Czochralski crystal growth apparatus
- (new) KrF excimer laser for the pulsed-laser deposition facility
- XeCl excimer laser for a (new) UHV growth chamber
- (new) a hydrostatic 20-ton press for preparing pellets for pulsed-laser deposition.

Major equipment - materials' characterization

- a SQUID Magnetometer
- an X-ray diffractometer
- an EDS elemental analysis system
- an electron microscope
- a Bomem Michelson Interferometer ($200\text{-}5000\text{ cm}^{-1}$)
- various continuous flow and closed-cycle cryostats
- a custom IR labs ^3He cryostat (DC resistivity/AC susceptibility)
- specific heat, susceptibility- and resistivity-measuring instruments for a wide temperature range and under pressure
- a magnetic properties measurement system with a ^3He low-temperature module
- a high-pressure measurement system with cryostat and various high-pressure cells (quasihydrostatic, hydrostatic, small and large)
- a Microcal differential scanning calorimeter
- a Microcal isothermal titration calorimeter
- SpectraMate 18 Raman spectrometer with a CCD camera detector

Major equipment - optical, NMR, and ESR spectroscopy

- a Bruker IFS66V/S Interferometer (20-40000 cm^{-1})
- a Sciencetech Martin-Puplett type interferometer (5-200 cm^{-1})
- a Jarell-Ash double grating spectrometer for Raman spectroscopy
- a custom IR labs Helium-3 cryostat (reflectance)
- a solid-state multi-channel NMR spectrometer with a 7T superconducting wide-bore magnet
- a Bruker Elexsys E580 pulsed and CW X-band spectrometer, liquid-He cryostat (5-300K)
- time-resolved 9GHz and 35GHz EPR setup, with a pulsed Nd-YAG pumped OPO laser, tunable in 450-680 nm and 710-1200 nm ranges

Miscellaneous

- an arc-melting facility
- an RF furnace
- a drybox with a (new) gas purification system
- various 2-zone and 3-zone tube furnaces for crystal growth
- a (new) biological-sample preparation drybox with a microgram balance
- rotary shakers, evaporators, vacuum furnace
- high precision micropipettes, with SolventSafe tips

Original equipment developed recently at Brock

- temperature- and hydration-controlled thin-film sample cells for neutron and X-ray diffraction
- variable time-base pulse programmer for NMR
- low-thermal-expansion sample holder for reflectance spectroscopy

Common University facilities (shared by all Science departments)

Experimental research facilities are supported by the University Technical Services, including an electronics shop (four full-time technicians), a glass-blowing shop (one full-time glass-blower), and a machine shop (four full-time technicians). All shops are fully-equipped including digital milling machines, CAD/CAM facilities, etc. Some custom microelectronics can be produced through cooperation with the silicon foundry facilities at the nearby Niagara College. The Faculty of Mathematics and Sciences does not have user charges for labour or regular shop supplies. The University also maintains a central Nitrogen liquification facility, with liquid Nitrogen available without charge. This is important in freeing operating grant money for other research costs; this advantage has been favourably noted by NSERC during site visits.

Equipment in other Departments used by physicists

Many analytical instruments and other equipment is accessible through shared access with other Departments such as Chemistry, Biology, and Earth Sciences. It is the University policy that equipment housed in other Departments is available to all. This includes two high-resolution multi-nuclear NMR spectrometers (Bruker Avance 600 and Avance 300), a high-resolution E/B mass-spectrometer (Kratos Concept 1S), various FT-IR and chromatography

instruments, freezers, centrifuges, *etc.*

3.3. Computer facilities

The University provides extensive computing facilities, including access to high-performance computing clusters, and a comprehensive networking infrastructure. The facilities are maintained and supported by the Information Technology Services as a central service, at no cost to the users.

Central servers and high-performance computing

Ample central file servers, web and email servers, with automatic daily backups, firewall maintenance, and account maintenance is taken for granted at Brock. Every faculty member receives a desktop computer, updated and renewed every three years, and is entitled to access central servers as needed. In the past, several high-performance multi-processor central servers were dedicated to the computationally-intensive jobs such as molecular modeling. Some are still available, primarily to support some special-use software (SAS, SPSS, Gaussian) but are being phased out. In their place, a 42-node Beowulf cluster (beowulf.brocku.ca) is on-line and available for large-scale computations. Brock University is also a member of the Canadian High Performance Computer Consortium (C3.ca) providing researchers access to various high-performance computers throughout Canada.

Brock is also a member of SHARCNET (www.sharcnet.ca), a consortium of colleges and universities maintaining a variety of distributed high-performance computing clusters. A dedicated GridAccess facility provides a convenient and transparent access to all of SHARCNET and enables easy collaborations with researchers from other member institutions. Several members of the Department are members of the Brock Institute for Scientific Computing, established to foster inter-Departmental connections among researchers involved in computationally-intensive work.

Departmental facilities

The Department has more than 60 Linux-based computer workstations, provided by the University and distributed in all faculty, PDF, and graduate student offices, as well as in several general-purpose student labs. The workstations are supported by a centrally-maintained files server, and provide a transparent access to any user at any location. This has proven to be an extremely successful model of operation, requiring very little maintenance and providing high functionality and security. The students in the Department first use the workstations in a limited way in their first-year labs, and as they gain full access in second and subsequent years, the variety of tools that they learn to use increases (Maple, SciLab, LaTeX, programming IDEs, *etc.*). When they graduate, they are universally competent in the use of computers in Physics. This translates into a computer-savvy pool of potential graduate students, as well as potential candidates for undergraduate summer research projects. Identical workstations are installed in every faculty office, making the computational environment identical between the students and the faculty, and therefore ensuring ease of communications and code sharing, as well as continuity of projects as graduate students complete their studies and leave.

Network infrastructure

High-speed (1GBps) optical backbone, wired and wireless (802.11g) concentrators, ubiquitous access to the network through labs, offices, and common areas on campus, a central firewall. Little needs to be said about Brock's network infrastructure, except: it works, it's well-maintained, and is fully capable to support the existing and future computing needs of the proposed MSc in materials science program.

3.4. Space

The Department's research laboratories are entirely situated in H block of the Mackenzie-Chown complex (built in 1983). A total of 755 m² (8122 sq. ft.) is assigned to research and research support activities, faculty and graduate offices. All faculty members and senior demonstrators have access to private offices with telephone and Ethernet lines through Information Technology Services. Graduate students have access to shared office space, telephone and Ethernet connections.

Office space totalling 68 m² (735 sq. ft.) is allocated exclusively to the graduate students and post doctoral fellows. As well, an additional 10 m² (104 sq. ft.) is dedicated to 2 emeritus faculty members. Faculty office and research space totals 650 m² (6991 sq. ft.), of which 383 m² (4119 sq. ft.) is dedicated to individual faculty research labs; 183 m² (1970 sq. ft.) is in shared support facilities; and individual faculty office space totals 84 m² (902 sq. ft.) for the eight members of the Department.

Description	Area, m ²
Research space	383
Research support facilities (e.g. X-ray lab, general prep lab)	184
Faculty office space	84
Graduate student office space	59
Administrative office space	39
Emeritus Faculty office space	10
Post-doctoral fellows' office space	10
TOTAL	** Expressio n is faulty **

Table 3.4.1: Summary of the space used by the Department of Physics

The new Cairns Family Health and Bioscience Research Complex has just opened in 2012. It contains a 307-m² Photophysical Sciences Lab, where the majority of the graduate students are from the field of Biophysics.

To accomodate the additional students in the MSc in materials science program, the

Department will be seeking additional space, configured as a shared research/study space (similar to the current setup in MC E201, used by the Humanities' Ph.D. students), with individual desks/carrels assigned to each student for the duration of the program*. Clusters of computer workstations are going to be made available in each room. Since a large number of Biology and Chemistry labs has moved to the new Cairns building, it is hoped that space can be found within the McKenzie-Chown complex. The primary teaching labs for the programs are MC H303a and H308, with additional equipment housed elsewhere within the research labs of the Department of Physics. MC H300 must also be recovered from the Conference Services during the Spring/Summer term when they use it as one of the Science Camp spaces.

3.5. Resources at Niagara College

Advanced equipment for materials characterization that is currently only available at Niagara College include:

- a suite of teaching lasers (solid state, semiconductor, and gas) including, double pulsed ruby, CO₂, excimer, YAG and Ar-ion;
- a suite of spectral analysis tools, including: a McPherson monochromator, several solid state spectrometers, 20" and 6' temperature controlled integrating spheres, optical time domain reflectometer, and communications grade optical spectrum analyzers;
- a fully equipped microelectronics labs for digital circuit fabrication and microcontroller programming, including a digital communications analyzer;
- rigs for vacuum system technology instruction, with incorporated mass spectrometer;
- stations for electron beam physical vapor deposition and organic film deposition;
- surface profilometers with 1 nm resolution;
- a scanning electron microscope.

3.6. Summary of additional resources required by the program

Human resources

The MSc in materials science program is a complementary, non-thesis graduate program that is going to utilize the existing physical and human resources and competencies at the Department of Physics. The core courses required within the program is the same as for our existing M.Sc. in Physics, and the expected additional load is minimal (possibly, several courses may require some additional TA stipends). Several additional courses will be developed by the faculty at the Department, and in the first year of the program, only some minor additional costs in the form of course development teaching releases/overload stipends will be required. However, maintaining and growing the program to the ultimate anticipated capacity of 15 students per cohort will only be possible if an additional full-time faculty member with a significant Materials Science

* This could be MC E201 if Humanities' students could be provided with space within the Faculty of Humanities, or E203 if Prof. S.Rothstein's research space can be allocated within the Cairns Complex.

background is hired in time to support the second cohort of students, in July, 2017. This must be considered an essential program cost, on an ongoing basis. To accommodate further growth, if the program is successful and develops beyond this capacity of 15, additional human and physical resources will be required, including an additional lab space in the MC H Block.

Increased equipment service and maintenance needs can be anticipated (see below). Combined with a projected ongoing increases in the undergraduate enrolments, one additional lab demonstrator/technician will be required no later than May, 2017, to address an inevitable increase in the maintenance and support of the new and existing equipment. Much of it is going to be state-of-the-art research-grade equipment, and it would require training and assistance to the student provided on an ongoing basis.

Equipment and maintenance

The equipment currently available at the Department is sufficient to mount the program, and no major initial cost is required to launch it. However, a significant increase in the maintenance costs of the equipment due to increased use must be anticipated. These costs will be phased in gradually over roughly the first five years of the program and should remain constant beyond that.

Making use of the equipment/facilities at the Niagara College is expected to be a fixed cost for a few years initially. However, it will be highly desirable to bring to Brock all of the equipment necessary to deliver the labs locally. Acquisition of a clean-room facility must be postponed until a significant additional space becomes available, but several medium-cost facilities should be budgeted for once the program enrolments stabilize, by the end of the initial five-year period. These include a new X-ray diffractometer, STM/AFM, vacuum equipment, etc. Some of this equipment may be acquired as a part of the start-up cost of the additional faculty member.

Student support

Initially, the student support will be provided through several existing offices. Administrative Assistant at the Physics Department will coordinate most of the program-specific issues, including course scheduling, enrolments and communications with the IELP office and the Niagara College. This is adequate, but as the program grows, it may require a focused and dedicated administrative assistant. In order to concentrate all of the student support for the program in one location, and additional one-half administrative staff will be required, possibly to take up the Neuroscience responsibilities and allowing the existing Physics Administrative Assistant to focus only on the programs within the Department. This should be considered a priority in years 3-4 of the program.

The Academic Adviser of the Faculty of Mathematics and Sciences will be providing ongoing support for those students who may come as undergraduates for a qualifying year prior to the beginning of the MSc in materials science program.

IELP services will provide a tailored program of English instruction. IELP does not provide support post-IELP completion, however because of the highly technical nature of the program, a significant IELP involvement is probably not required. In the past, the main difficulties experienced by international graduate students in Physics have been in the area of thesis preparation. This is not required for the MSc in materials science program. Emerging needs of the MSc in materials science students will be monitored and this

should be re-assessed by the end of the second year of the program.

Additional support will be available from the Faculty of Mathematics and Sciences. The Faculty is committed to establishing an additional support position of an ISP Program Coordinator, to assist students in entering the program and to monitor their progress and post-graduation career trajectories. The current Proposal is one of several cost-recovery programs being planned by the Faculty; part of the costs (25%) of this additional Administrative position is budgeted for within our business plan (see below). Additional support, such as follow-up ESL support, could also be arranged through this office.

Finally, social support is available through Brock International Student Services and, possibly, through the Confucius Institute (for students from China).

Student space should be considered an essential element of the required student support. Study carrels/common area must be found to create and foster a sense of a community of learners among the students in the program. In our experience, availability of such a "home" for the program is essential for its success, since the reputation of the program must be excellent right from the beginning in order to attract subsequent cohorts of students. This is not a luxury but a necessity, and must be found before the second cohort arrives in July, 2017. A space in close proximity to the Department of Physics or to the labs in MC H block is essential.

The following is a business plan for the start-up phase of the new program; all included monetary estimates conform to the existing pay scales and standards of various collective agreements valid at the time of the writing.

Externally determined values
 Faculty salary (Asst. Prof. incl benefits) \$90,090
 BUFA stipend (incl benefits) \$8,190
 OSSTF salary (incl benefits) \$63,000
 Non-BUFA stipend (incl benefits) \$7,371

		\$90,090		\$91,892		\$93,730		\$95,604
		\$8,190		\$8,190		\$8,190		\$8,190
		\$63,000		\$63,000		\$63,000		\$63,000
		\$7,371		\$7,371		\$7,371		\$7,371

[IMS] ² projected budgets 2015-2019	May 2015 - August 2016				May 2016 - August 2017				May 2017 - August 2018				May 2018 - August 2019			
	One-time	Ongoing	Unit cost	Net	One-time	Ongoing	Unit cost	Net	One-time	Ongoing	Unit cost	Net	One-time	Ongoing	Unit cost	Net
<i>Revenue</i>																
Projected qualifying year intake		2	\$28,000	\$56,000		2	\$28,000	\$56,000		2	\$28,000	\$56,000		2	\$28,000	\$56,000
Projected M.Sc. intake		8	\$28,000	\$224,000		12	\$28,000	\$336,000		15	\$28,000	\$420,000		15	\$28,000	\$420,000
Total revenue:				\$280,000				\$392,000				\$476,000				\$476,000

New equipment	May 2015 - August 2016				May 2016 - August 2017				May 2017 - August 2018				May 2018 - August 2019			
	One-time	Ongoing	Unit cost	Net	One-time	Ongoing	Unit cost	Net	One-time	Ongoing	Unit cost	Net	One-time	Ongoing	Unit cost	Net
X-ray *	0.33		\$120,000	\$40,000	0.33		\$120,000	\$40,000	0.33		\$120,000	\$40,000				
AFM/STM	0.13		\$65,000	\$8,125	0.13		\$65,000	\$8,125	0.13		\$65,000	\$8,125	0.13		\$65,000	\$8,125
Vacuum station	0.2		\$25,000	\$5,000	0.2		\$25,000	\$5,000	0.2		\$25,000	\$5,000	0.2		\$25,000	\$5,000
Cryogenic equipment	0.2		\$10,000	\$2,000	0.2		\$10,000	\$2,000	0.2		\$10,000	\$2,000	0.2		\$10,000	\$2,000
<i>Course expenditures</i>																
PHYS 4P61 (no impact)																
PHYS 4P62 (no impact)																
PHYS 5P10 (new)																
Materials (MATLAB licenses)	5		\$5,000	\$25,000	5		\$5,000	\$25,000	10		\$500	\$5,000	10		\$500	\$5,000
Course preparation/overload **	0.5	1	\$8,190	\$12,285	0.5	1	\$8,190	\$12,285	1	1	\$8,190	\$8,190	1	1	\$8,190	\$8,190
TA (60hrs, incl. benefits)		0	\$2,072	\$0		1	\$2,072	\$2,072		1	\$2,072	\$2,072		1	\$2,072	\$2,072
PHYS 5P30 (no impact)																
PHYS 5P41 (enrolment)																
TA (60hrs, incl. benefits)		0	\$2,072	\$0		1	\$2,072	\$2,072		1	\$2,072	\$2,072		1	\$2,072	\$2,072
PHYS 5P50 (no impact)																
PHYS 5P70 (enrolment)																
TA (60hrs, incl. benefits)		0	\$2,072	\$0		1	\$2,072	\$2,072		1	\$2,072	\$2,072		1	\$2,072	\$2,072
PHYS 5P74 (no impact)																
PHYS 5P75 (no impact)																
PHYS 5P76 (no impact)																
PHYS 5P79 (Exp. Methods I, enrolment)																
Materials	8		\$250	\$2,000	12		\$250	\$3,000	15		\$250	\$3,750	15		\$250	\$3,750
Repairs & maintenance	8		\$250	\$2,000	12		\$250	\$3,000	15		\$250	\$3,750	15		\$250	\$3,750
Course preparation/overload **	0.5	1	\$8,190	\$12,285	0.5	1	\$8,190	\$12,285	1	1	\$8,190	\$8,190	1	1	\$8,190	\$8,190
TA (60hrs, incl. benefits)		0	\$2,072	\$0		1	\$2,072	\$2,072		1	\$2,072	\$2,072		1	\$2,072	\$2,072
PHYS 5P80 (Exp Methods II, new)																
Materials	8		\$250	\$2,000	12		\$250	\$3,000	15		\$250	\$3,750	15		\$250	\$3,750
Repairs & maintenance	8		\$250	\$2,000	12		\$250	\$3,000	15		\$250	\$3,750	15		\$250	\$3,750
Course preparation/overload **	0.5	1	\$8,190	\$12,285	0.5	1	\$8,190	\$12,285	1	1	\$8,190	\$8,190	1	1	\$8,190	\$8,190
Niagara College fees	2		\$6,300	\$12,600	2		\$6,300	\$12,600	2		\$6,300	\$12,600	2		\$6,300	\$12,600
TA (60hrs, incl. benefits)		0	\$2,072	\$0		1	\$2,072	\$2,072		1	\$2,072	\$2,072		1	\$2,072	\$2,072
Transportation to Niagara College	1		\$4,000	\$4,000	1		\$4,000	\$4,000	1		\$4,000	\$4,000	1		\$4,000	\$4,000
PHYS 5P81 (Sample prep., new)																
Materials	8		\$250	\$2,000	12		\$250	\$3,000	15		\$250	\$3,750	15		\$250	\$3,750
Repairs & maintenance	8		\$250	\$2,000	12		\$250	\$3,000	15		\$250	\$3,750	15		\$250	\$3,750
Course preparation/overload **	0.5	1	\$8,190	\$12,285	0.5	1	\$8,190	\$12,285	1	1	\$8,190	\$8,190	1	1	\$8,190	\$8,190
Niagara College fees	1		\$6,300	\$6,300	2		\$6,300	\$12,600	2		\$6,300	\$12,600	2		\$6,300	\$12,600
TA (60hrs, incl. benefits)		0	\$2,072	\$0		1	\$2,072	\$2,072		1	\$2,072	\$2,072		1	\$2,072	\$2,072
ESL (new)	0.5	1	\$7,371	\$11,057	0.5	1	\$7,371	\$11,057	1	1	\$7,371	\$7,371	1	1	\$7,371	\$7,371
<i>Personnel expenditures</i>																
Technician (incl. benefits)					1		\$61,000	\$61,000	1		\$61,000	\$61,000	1		\$61,000	\$61,000
Admin support																
Salary (OSSTF incl. benefits)					0.25		\$63,000	\$15,750	0.25		\$63,000	\$15,750	0.25		\$63,000	\$15,750
Supplies					12		\$50	\$600	15		\$50	\$750	15		\$50	\$750
Additional Faculty (Materials Science)																
Salary (incl. benefits)									0.5		\$93,730	\$93,730	0.5		\$93,730	\$93,730
Start-up/equipment											\$100,000	\$50,000			\$100,000	\$50,000
<i>Other expenditures</i>																
Recruitment	1		\$5,000	\$5,000	1		\$5,000	\$5,000	1		\$5,000	\$5,000	1		\$5,000	\$5,000
Total expenditures:				\$180,222				\$262,238				\$390,618				\$352,492
Net profit:				\$99,779				\$129,762				\$85,382				\$123,508

* - second-hand X-ray may shorten the timeline to 2 years, at the same level of expenditure, adding \$40,000 to profit in Y3
 ** - depending on enrolments in and cycling of Physics MSc/PhD courses, overload stipends may not be required

Table 3.6.1: Projected budgets for the first years of the MSc in materials science program

4. PROGRAM REGULATIONS AND COURSES

4.1. Program regulations

The new program regulations are in full conformity with the policies and procedures of the Faculty of Graduate Studies, as described in the *Brock University Graduate Calendar* (www.brocku.ca/webcal/current/graduate/). The substantive elements of the MSc in materials science program-specific academic regulations are given below. They are to be included in a future version of the Graduate Handbook of the Department of Physics, once the program is approved by the Senate.

Admissions

Applications will be reviewed by the Department of Physics and the Faculty of Graduate Studies according to the standard admissions procedure used in all graduate programs. Admission requirements will be a BSc in Physics or a closely related discipline, with a minimum 75% overall average, from an accredited institution, and fulfillment of English language requirements as specified by the Faculty of Graduate Studies (<http://brocku.ca/nextstep/international-students/english-language-proficiency/>). The Graduate Record Examination (GRE) is recommended for international students but not required.

The Program Committee will review all applications and recommend admission for a limited number of suitable candidates. Applicants holding a degree without sufficient background in Physics, may be required to complete additional qualifying undergraduate courses prior to an admission decision.

At the beginning of the program, the biggest recruiter of prospective students will likely be Can-Zhong International Education (www.CanZhong.com) which is already employed by the Faculty of Business for their successful MBA International Students Program. The students apply directly through CanZhong through whom they undergo three preliminary screenings for suitability for the program. A fourth interview to ensure adequate preparation will be with a Brock physics faculty member. Only then will a prospective student make the normal application to graduate school at Brock.

Language requirements

In order to be admitted, applicants will be required to provide proof of English language proficiency through one of the accepted program/examinations listed below in order to be accepted into the program:

- A minimum TOEFL PBT (Paper Based Test) score of 550 plus 4.0 minimum for the TWE (Test of Written English), or TOEFL iBT (Internet based) minimum overall score of 80 with not sub-test score under 19; or

- A minimum score of 6.5 on the International English Language Testing System - Academic (IELTS), with no section under 5.5; or
- A minimum overall score range of 520-545 (Range 2), with a minimum writing score of 225-235 on the Brock University International Test of English Language Proficiency (ITELP); or
- Achievement of an overall Band Score of 60, with 60 in writing, and no other under 50 on the Canadian Academic English Language Assessment (CAEL); or
- An average of at least 4.5 with no band score lower than 4.0 on the Can Test (Canadian Test of English for Scholars and Trainees).
- Test scores must have been taken within the last two years to be considered.

4.2. Degree requirements

- ESL component

All students accepted into the program will be required to complete an ESL program, starting at the beginning of July immediately prior to the MSc in materials science program. The ESL program will train students in Graduate Level English and is expected to last approximately eight weeks. This will also give new students a period of acclimatization in Canada, and on campus.

- Orientation

Immediately following the ESL program, all students will participate in an orientation session to familiarize them with the program structure, expectations of graduate students, library training, and academic integrity policy.

- Program structure

The MSc in materials science program will begin in September and will require all students to complete **10 half-credit courses** (4 theoretical courses, 3 experimental/laboratory courses, 1 computational course, and 2 research seminar courses).

Theoretical courses:

- one of PHYS 5P30 (Advanced Electromagnetism), PHYS 5P41 (Advanced Statistical Physics), PHYS 5P50 (Advanced Quantum Mechanics I)
- PHYS 5P70 (Advanced Condensed Matter Physics)
- one of PHYS 4P61 (Nuclear Physics), PHYS 4P62 (Modern Wave Optics)
- one of PHYS 5P74 (Magnetism & Magnetic Materials), PHYS 5P75 (Optical Properties of Solids), PHYS 5P76 (Nuclear Magnetic Resonance)

Experimental/laboratory courses:

- **PHYS 5P81** (Sample Preparation and Characterization Techniques for Materials Science)
- PHYS 5P79 (Advanced Experimental Methods in Condensed Matter Physics I)
- **PHYS 5P80** (Advanced Experimental Methods in Condensed Matter Physics II)

Computational courses:

- **PHYS 5P10** (Computational Methods for Materials Science)

Research seminar courses:

- PHYS 5P91 (Graduate Seminar I)
- **PHYS 5P92** (Graduate Seminar II)

Most of the courses in the program are already present in the Physics Department course bank. Four new courses (**highlighted** in the above list) are being proposed, see APPENDIX 1: LIST OF COURSES. In the seminar courses students will be required to present, after a consultation with the faculty instructor, a research paper or a mock research proposal.

Students will choose their courses in consultation with the program committee. Depending on their background and progress in the program, students may be required by the program committee to take additional courses.

Students in this program will attend some lectures, laboratories and seminars with students in the other streams of the Physics graduate program. The Department of Physics has extensive experience with international graduate students. The “head count” for November 2012, for example, indicated that 6 of 15 in our Ph.D. and M.Sc. programs were international students. The experience indicates that international students in Physics generally perform as well as domestic students in this subject.

- Course scheduling

Fall Term	Winter Term	Spring Term
PHYS 5P50 or 5P41 or 5P30	PHYS 5P70	PHYS 5P74 or 5P75 or 5P76
PHYS 5P10	PHYS 4P61 or 4P62	PHYS 5P81
PHYS 5P91	PHYS 5P79	PHYS 5P80
	PHYS 5P92	

- Evaluating student's performance

According to the University regulations, graduate credit is not given in courses

where the final grade is less than 70%. If the student fails a course, the program committee will decide on the remediation plan. Normally, the student will be required to repeat this course. Obtaining a failing grade in any two courses is sufficient grounds for dismissal from the program.

If a student is dismissed from the program due to a poor academic performance, the program committee may recommend that the student takes a remedial undergraduate year at Brock as a non-degree student and then re-applies for admission into the MSc in materials science program. If the student is re-admitted, the credits obtained in the MSc in materials science program prior to dismissal will be counted towards the degree requirements.

4.3. Program governance and administration

The program will be governed by a committee, consisting of three Physics graduate faculty members. The Physics Graduate Program Director will serve as Chair of the program committee. The committee will

- make admission decisions;
- advise students on their course selection;
- monitor student progress and plan and implement remediation, should it be necessary;
- make termination decisions.

The Faculty of Mathematics & Science will hire a coordinator to provide administrative support for its ISP programs. The coordinator's duties will include

- communicating with the program committee, the recruiters and their agents to facilitate and monitor the recruitment process;
- arranging transportation of students from the airport to Brock University;
- arranging temporary housing for students upon arrival;
- preparing and running an orientation session with incoming students.

The program will be open to international students worldwide. All prospective students can apply directly to the program using the electronic application system provided by Graduate Studies (as is the practice for ISP programs in the Goodman School of Business). In many Asian countries, the most effective way to attract students is by employing recruiters. Furthermore, recruiters can be very helpful in facilitating the acquisition of Visas and other documents that are required for the students to come to Canada to study. As a result, recruiters are expected to bring in the majority of the candidate students into the MSc in materials science program, at least initially. A preliminary agreement already exists with one such recruiter, also used by other international programs at Brock (*e.g.*, in the Goodman School of Business). As the program expands and become better-known, expansion into other emerging markets is anticipated (South America, Eastern Europe). At all times, the candidates will be evaluated and accepted into the program only by the program committee.

4.4. Degree-Level Expectations and Learning Outcomes

Learning outcomes within Internal Quality Assurance Process

Historically, Ontario had no government-defined “standards” in University education. Universities autonomously developed programs and implemented means of maintaining quality. Transfers of students and comparison of programs between Universities could be difficult as a result. Motivated by the desire to increase accountability, in 2009 Ontario unilaterally mandated the introduction of Internal Quality Assurance Programs (IQAP) at each institution. This mirrored similar development of Education Tuning (ET) framework within the European Union, under way since mid-1990's. While the ET processes followed a bottom-up approach of starting the process through an extensive series of workshops and discipline-specific panels that consulted multiple constituencies affected by the process (students, educators, employers, etc.), the Ontario process was essentially top-down, with a significant autonomy retained by the Universities in defining their IQAP rules and procedures. At the provincial level, only a handful of broadly defined categories were specified by the Ontario Council of Academic Vice-presidents (OCAV):

1. depth and breadth of knowledge;
2. knowledge of methodologies;
3. application of knowledge;
4. communication skills;
5. awareness of the limits of knowledge; and
6. autonomy and professional capacity.

It was left to the Universities to define more specific Degree Level Expectations, for both Undergraduate (UDLE) and Graduate (GDLE) level programs. Further refinement was to be performed at the individual Faculty and Program levels.

Graduate Degree-Level Expectations (GDLEs)

The following table contains Brock University and the Faculty of Mathematics and Science (FMS) GDLEs for a Master's degree. Similar definitions exist for undergraduate and Ph.D. degrees.

OCAV category	Brock GDLEs for a Master's degree	FMS GDLEs for a Master's degree
	This degree is awarded to students who have demonstrated the following:	This degree is awarded to students who have demonstrated the following:
1. Depth and breadth of knowledge	A systematic understanding of knowledge, including, where appropriate, relevant knowledge outside the field and/or discipline, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of their academic discipline, field of study, or area of professional practice.	A systematic understanding of knowledge in science, technology, or mathematics , including, where appropriate, relevant knowledge outside the field and/or discipline, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of their academic discipline, field of study, or area of professional practice.
2. Research and scholarship	A conceptual understanding and methodological competence that a) enables a working comprehension how established techniques of research	A conceptual understanding and methodological competence that a) enables a working comprehension of how established techniques of

OCAV category	Brock GDLEs for a Master's degree	FMS GDLEs for a Master's degree
	<p>This degree is awarded to students who have demonstrated the following:</p> <p>and inquiry are used to create and interpret knowledge in the discipline;</p> <p>b) enables a critical evaluation of current research and advanced research and scholarship in the discipline or area of professional competence; and</p> <p>c) enables a treatment of complex issues and judgements based on established principles and techniques; and,</p> <p>On the basis of that competence, has shown at least one of the following:</p> <p>d) the development and support of a sustained argument in written form; or</p> <p>e) originality in the application of knowledge.</p>	<p>This degree is awarded to students who have demonstrated the following:</p> <p>research and inquiry are used to create and interpret knowledge in science, technology, or mathematics;</p> <p>b) enables a critical evaluation of current research and advanced research and scholarship in science, technology, or mathematics or in a related area of professional competence; and</p> <p>c) enables a treatment of complex issues and judgements based on established principles and techniques; and,</p> <p>On the basis of that competence, has shown at least one of the following:</p> <p>d) the development and support of a sustained argument in written form; or</p> <p>e) originality in the application of knowledge.</p>
3. Level of application of knowledge	Competence in the research process by applying an existing body of knowledge in the critical analysis of a new question or of a specific problem or issue in a new setting.	Competence in the research process by applying an existing body of knowledge in science, technology or mathematics in the critical analysis of a new question or of a specific problem or issue in a new setting.
4. Professional capacity/autonomy	<p>a) The qualities and transferable skills necessary for employment requiring:</p> <p>i) the exercise of initiative and of personal responsibility and accountability; and</p> <p>ii) decision-making in complex situations; and</p> <p>b) The intellectual independence required for continuing professional development;</p> <p>c) The ethical behaviour consistent with academic integrity and the use of appropriate guidelines and procedures for responsible conduct of research; and</p> <p>d) The ability to appreciate the broader implications of applying knowledge to particular contexts.</p>	<p>a) The qualities and transferable skills necessary for employment requiring:</p> <p>i) the exercise of initiative and of personal responsibility and accountability; and</p> <p>ii) decision-making in complex situations; and</p> <p>b) The intellectual independence required for continuing professional development;</p> <p>c) The ethical behaviour consistent with academic integrity and the use of appropriate guidelines and procedures for responsible conduct of research; and</p> <p>d) The ability to appreciate the broader implications of applying knowledge to particular contexts.</p>
5. Level of communications	The ability to communicate ideas,	The ability to communicate ideas,

OCAV category	Brock GDLEs for a Master's degree	FMS GDLEs for a Master's degree
	This degree is awarded to students who have demonstrated the following:	This degree is awarded to students who have demonstrated the following:
skills	issues and conclusions clearly.	issues and conclusions clearly.
6. Awareness of limits of knowledge	Cognisance of the complexity of knowledge and of the potential contributions of other interpretations, methods, and disciplines.	Cognisance of the complexity of knowledge in science, technology or mathematics and of the potential contributions of other interpretations, methods, and disciplines.

As the table demonstrates, there is only a minimal refinement of the GDLE specifications from the University to the Faculty level (highlighted **in red**). In what follows the two will be used interchangeably. The task of generating program-specific GDLEs is left to the individual Departments.

The weakness of this top-down approach is that the fit of the broadly-defined category at a more general level may be poor to the specific needs of programs and disciplines: the purpose at a more general level is to introduce criteria and categories that work for multiple disciplines, and while the generality of the resulting GDLEs makes them easy to accept in general terms, their operational usefulness at the discipline level is diminished. This is the case in Physics.

A comparison with the European ET process

The European ET process followed a bottom-up approach and a considerable number of discipline-specific competencies were identified first, accompanied by a great number of examples and scenarios, by working groups and panels that included members of all affected constituencies. They were then grouped in a way still meaningful to the discipline, with more general categories identified through a comparison of the results from several disciplines. It is instructive to list here the broadest categories – called “dimensions” in the ET process – that emerged as the result:

- A. knowledge and understanding;
- B. applying knowledge and understanding;
- C. making judgements;
- D. communications skills;
- E. learning skills.

These are the so-called “Dublin descriptors”¹³, they are similar to the OCAV categories, and similarly impossible not to agree with. However, one crucial difference is the recognition that for each discipline-specific competency multiple Dublin descriptors may apply. This removes the difficulty most physicists experience in assigning a discipline-specific competency to a single OCAV category. As a result, for Physics-related skills and competencies at the “second cycle”, *i.e.* at the M.Sc. level, the ET process results in the following prioritized list¹⁴:

¹³ Tuning Educational Structures in Europe, Final Report, Pilot Project – Phase 1, J.Gonzalez and R.Wagenaar, eds. University of Deusto and University of Groningen, 2003.

¹⁴ Reproduced from *Reference Points for the Design and Delivery of Degree Programmes in PHYSICS*, Publicaciones de la Universidad de Deusto, Bilbao, 2008

Importance rank	Cognitive abilities and competencies	Practical skills	Generic competencies	Related Dublin descriptors
1	Modelling skills			B
2	Estimation skills			A
3			Literature search skills	E
4			Learning ability	E
5	Deep knowledge and understanding			A-D
6	Familiarity with basic and applied research			A-B-C
7		Mathematical skills		A-B
8	Frontier research			A
9		Problem solving		B
10		Experimental skills		B
11			Specific communications skills	D
12			Managing skills	C
13			Human/professional skills	A-B-C
14	Physics culture			A-D
15			Updating skills	E
16			Foreign language skills (relevant to Physics)	E
17			Ethical awareness (relevant to Physics)	C
18			Absolute standards awareness	A-C

Only the short-form names of the specific skills and competencies are used¹⁵. It should be noted that the same skills and competencies have a different priority order, and a different mapping onto the relevant Dublin descriptors in similar tables developed for the first (B.Sc.) and third (Ph.D.) cycles. This is appropriate, and reflects that, for example, at the undergraduate level the focus must be on the knowledge acquisition, while by the time the student has reached graduate school, skills like literature search may shift to higher relevance ranking. This is a flexible and useful scheme for which an equivalent does not exist in the IQAP process.

Learning outcomes in Physics at Brock

Physics is a mature discipline, and both the knowledge base and the set of skills associated with the practice of Physics are well established and widely agreed upon by physicists. In this way, the degree-level expectations are straightforward: students graduating with a B.Sc. in Physics must be ready to continue on to graduate studies in Physics, anywhere in the world, and those graduating with M.Sc. or Ph.D. must be able to enter research environments as professional Physicists, both in the academic and in the

¹⁵ For detailed descriptions and examples of each, see *Reference Points for the Design and Delivery of Degree Programmes in PHYSICS*, Publicaciones de la Universidad de Deusto, Bilbao, 2008

industrial research contexts. Because of the nature of the discipline, this can only happen if the graduates possess a broad knowledge of the phenomena of the physical world, and the skills to translate real-world problem into their abstract (often, mathematical) representation, analyze and model them, critically evaluate the results, and then make real-world predictions based on the results of such analysis. In brief, the graduates must be able to fully practice the scientific method. The sequence of courses and modules that implement such a training program are well understood and are not subject to significant revision. Minor adjustments reflective of the new tools and techniques that become available to the practice of the profession are continuously made: such flexibility is, in fact, a part of the professional training itself. However, the foundational touchstones of Physics will always remain (Newtonian mechanics, electromagnetism, statistical physics, quantum mechanics) and must be included, at the appropriate level of mathematical complexity, in any Physics program.

The Department of Physics offers this high-quality training, and this is reflected in the success of our graduates, at both undergraduate and graduate level, for which plenty of evidence exists. It is, however, only one aspect of a successful Physics program, and the one that typically is represented by only a small number of graduates in the Physics and Physics-related programs.

Physics is also of foundational importance to other science disciplines (Chemistry, Biology, Earth Science) and to various professional preparation programs (Engineering, Kinesiology and other Applied Health Sciences, pre-medical, etc.). For many such students, Physics courses provide an opportunity to master rigorous logical thinking, mathematical and computational fluency, unflinching self-evaluation and critical estimation, error analysis, problem-solving skills in the context of both familiar and completely new challenges. In essence, the purpose is to encourage other disciplines to be “more like Physics”, to the state of deep and profound certainty of understanding of the relationships and connections between the phenomena. This task of transmitting the attitudes inherent in the practice of Physics, if not the details of its skill set, is also important and, in fact, typically affects many more students who complete courses offered by the Department, though not necessarily graduate with a Physics or related degree. It is being pursued vigorously by the Department, and much thought and effort goes into the preparation of courses taken by non-majors.

All of the above constitutes a preamble for the following section, where the GDLEs for the MSc in materials science program are defined.

GDLEs for the program

The intent of the MSc in materials science program is to provide a solid theoretical background in the physical principles that underpin the technological developments in the material science of semiconductor devices, molecular films, exotic magnetic systems, biologically-inspired materials, *etc.*, yet at the same time to provide an extensive opportunity to develop and validate practical skills used in the field of materials science, both in R&D and technological/applied contexts. The resulting degree-level expectations are somewhat different from those appropriate to pure Physics M.Sc. programs, whether

under OCAV or ET classification. They are presented below, with an approximate mapping to the OCAV categories and Brock/FMS GDLEs; related Dublin descriptors are also included.

Rank	GDLEs for MSc in materials science (short-form) Upon completing the program, students should have:	Brock/FMS GDLEs	Dublin descriptors
1-2	Deep knowledge and understanding of the core of Physics	1,2a	A
1-2	Experimental and applied skills	2a,2c,2e,4a-b,4d	B,C,E
3	Numerical, mathematical, and modelling skills	1,2c,2e	A,B,C
4	Estimation and error evaluation skills	1,2b,2c,3,6	A,B,C
5	Familiarity with a variety of communications skills	2c,2d,5	C,D,E
6	Ability to relate and differentiate basic and applied research	1,2a-c,3,6	A,B,C
7	Ability to follow and use the results of frontier research	1,2a-c,3,4b-c,6	A,C,D,E
8	Integrity, ethical norms, and professional development	2c,4a-c,5,6	C,D,E

Each of the short-form GDLEs is discussed in more detail in a separate section below.

Assessment of GDLEs within the program

Integral to these specifications is the discussion of how each is evaluated to ensure that the desired learning outcomes are realized. In the MSc in materials science program such evaluations are achieved through a variety of academic measurement techniques. Problem-solving ability associated with each of the GDLEs is evaluated through a combination of homework, in-class and take-home written tests, and extended term projects. Experimental skills are assessed through observation in the laboratory environment and through written lab reports and term projects. Communications skills are developed and evaluated through group work, seminar participation and presentations, and oral exams – throughout the curriculum. The marking schemes vary among the courses in the MSc in materials science program as appropriate to the course material, and are designed so that the final grades are reflective of the level of achievement. *The cumulative grade average in the program is therefore a valid measure of whether the desired GDLEs have been achieved.* It is not possible to make an exact numerical mapping of which GDLEs are addressed by a certain percentage of each of the courses in the program, but a satisfactory average grade should be considered a valid measure of achievement in all of the specified GDLEs together.

Long form of the GDLEs

- Deep knowledge and understanding of the core of Physics

Have a good understanding of the most important physical theories (logical and mathematical structure, experimental support, described physical phenomena),

including a deep knowledge of the foundations of modern physics, including quantum theory, statistical physics, and solid-state physics.

Courses contributing to this competency: PHYS 4P61, 4P62, 5P30, 5P41, 5P50, 5P70, 5P74, 5P75, 5P76

- Experimental and laboratory skills

Be able to perform experiments independently, as well as to describe, analyze and critically evaluate experimental data; have become familiar with most important experimental methods in solid-state physics and materials science.

Courses contributing to this competency: PHYS 5P74, 5P75, 5P76, 5P79, 5P80, 5P81

- Numerical, mathematical, and modelling skills

Be able to identify the essentials of a process/situation and to set up a working model of the same; be able to perform the required approximations, *i.e.* critical thinking to construct physical models; be able to adapt available models to new experimental data; be able to generate computational frameworks using numerical and symbolic computational systems to support the models and to analyze experimental data.

Courses contributing to this competency: PHYS 4P62, 5P10, 5P74, 5P75, 5P76

- Estimation and error evaluation skills

Be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems; be able to appreciate the significance of the results ; be able to critically analyze the errors of measurement and the consequences of limited precision of the results of measurements.

Courses contributing to this competency: PHYS 5P74, 5P75, 5P76, 5P79, 5P80

- Familiarity with a variety of communications skills

Be able to present one's own research or literature search results to professional as well as to lay audiences (orally and in written form to describe complex phenomena/problems in everyday language, as appropriate to the audience); be able to work in an interdisciplinary team. Good knowledge of technical English and on-line computer searching skills are also required.

Courses contributing to this competency: ESL, PHYS 5P79, 5P80, 5P91, 5P92

- Ability to relate and differentiate basic and applied research

Have acquired an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics and, in particular, to materials science; be able to design experimental and/or theoretical procedures for solving current problems in academic or industrial research.

Courses contributing to this competency: PHYS 5P74, 5P79, 5P80, 5P81, 5P91, 5P92

- Ability to follow and use the results of frontier research

Be familiar with the most important areas of physics and with those approaches that span many areas in physics; be able to search for and use physical and other technical literature, as well as any other sources of information relevant to research work and technical project development.

Courses contributing to this competency: PHYS 5P91, 5P92

- Integrity, ethical norms, and professional development

Be able to develop a personal sense of responsibility, given the free choice of elective/optional courses; be able to gain professional flexibility through the wide spectrum of scientific techniques offered in the curriculum; be able to remain informed of new developments and methods and to provide professional advice on their possible range of applications. Be prepared to work with a high degree of autonomy, even accepting responsibilities in project planning.

Courses contributing to this competency: PHYS 5P79, 5P80, 5P91, 5P92

5. OUTCOMES

The MSc in materials science program being proposed is a new program, so the data on the outcomes are not yet available. However, the M.Sc. program in Physics has been in place since 1969, and its current outcomes can help form an impression of the expected outcomes of the proposed program. It should be noted that significant numbers of our M.Sc. graduates continue their studies in a Ph.D. program; it is expected that at least some of them would remain at Brock if a Ph.D. program were available as an option.

5.1. Enrollment and graduations

New Enrolments, Withdrawals and Graduations in the M.Sc. in Physics Program				
Academic Year	Graduate Students			Average # of terms to completion ¹
	New	Withdrew	Completed	
2002-03	7		1	6.0
2003-04	5		2	6.5
2004-05	6		8	6.0
2005-06	2		3	6.7
2006-07	4		4	5.8
2007-08	3	1	4	7.3
2008-09	4		4	5.5
2009-10	9		3	6.0
2010-11 ²	6		3	6.3
2011-12	4	2	4	6.5
2012-13 ³	4		1	-

¹ Each academic year counts as three terms: Fall, Winter and Spring/Summer

² First year of the Physics Ph.D. program

³ As of September 1, 2012, **sixteen** graduate students are pursuing a graduate degree in the Department

5.2. Employment

Supervisor	Current Employment/Status of Graduates
S.K. Bose	G. Fekete – Physics and Technology instructor, Niagara College Q. B.* (co. R. Shukla) – Ph.D. student, Materials Engineering, McMaster U.
D. Bruce	S. K. – Ph.D. student at U. Western Ontario
D. Crandles	J. Manson – Ph.D. student, Physics, Brock U. L. Obied – Ph.D. student, Brock U. B. DeRoches – Tornado Medical Services, Toronto A. Madubuonu – Teachers' College, UWO F. Eftekhari – Ph.D. student, Electrical Engineering, U. Victoria R. Klassen – firefighter/EMS, Markham M. Yazdanian – M.Sc. in Materials Engineering, Windsor U.
T. Harroun	D. Marquardt – Ph.D. student, Physics, Brock U.
B. Mitrović	M.C. – PhD in Physics (McMaster U)
F.S. Razavi	M. Taheri – Ph.D. student, Physics, Brock U. B. Indovski – Ph.D. student, Physics, Brock U. M. Potalivo – a teacher P. Reuvecamp – Ph.D. student, MPI Stutgart M. Hajjalamdari – Ph.D student in Optics, U. Waterloo S. Jamali Gharetape – Ph.D. student, Medical Physics, U. Toronto T. Hezareh – Ph.D. student, Astrophysics, UWO H. Jalili (co. R Shukla) – PDF, Physics, MIT R. T. – Ph.D. student, Physics, U. Alberta H. P. – business owner, Slovakia
M. Reedyk	Y. Pan – Ph.D. student, Physics, Brock U. B. Dempsie – underground pipe testing, Niagara Falls B. Liu – PhD student, McMaster U. N. H. – Ph.D. student, Medical Physics, U. Toronto S. Ocadlik – working in high-tech industry, Bratislava G. Wardlaw – Ph.D. student, Medical Physics, McMaster U. A. Brown – senior software analyst, WinWin Solutions, Florida
S. Rothstein	E. Ospadov – Ph.D. student, Physics, Brock U. I. Bosa – Ph.D. student, U. Cork Y. Li – Ph.D. student, McMaster U.
K. Samokhin	W. R. – Ph.D. student, McMaster U. A. F. – Ph.D. student, Queens U.
E. Sternin	I. Komljenovic – Ph.D. student, Biophysics, Guelph U. S. Ghamari – Ph.D. student, Physics, McMaster U. S. S. – Ph.D. student, Biophysics, Simon Fraser U. A. Keyvanloo – Ph.D. student, Physics, Simon Fraser U. Z. Trskova – support engineer, Hewlett-Packard Europe, Bratislava

* Only the initials are shown for those students without a release form on file.

5.3. Projected graduate intake and enrollments

MSc in materials science program is expected to take in 15 international students per year. During the Spring/Summer term, the total number of students may therefore be about twice that, with one cohort completing their final term of laboratory-work-oriented modules and the second cohort starting their ESL training.

6. APPENDICES

APPENDIX 1: LIST OF COURSES

New course codes are highlighted using boldface. Descriptions marked with an asterisk () indicate existing courses that require modifications. Up-to-date course outlines for the existing courses are available on the Departmental web server, under this link: www.physics.brocku.ca/Courses/ (hardcopy outlines have not been used in the Department since mid-1990's).*

PHYS 4P61

Nuclear Physics

Intrinsic properties of nuclei, nuclear binding energy; qualitative treatment of shell model; alpha, beta and gamma radioactivities, nuclear fission, characteristics of nuclear reactions. *Lectures, problem sessions, 3 hours per week.*

PHYS 4P62

Modern Wave Optics: Optical Tweezers to Atom Clouds

Optical lattices, spatial light modulators, evanescent waves and their applications from biology to ultracold atoms. Laser cooling and optical trapping. Manipulation of crystal properties by light. Optical patterns: tweezers, mirrors, funnels, bottles. Maple-based coursework. *Lectures, tutorial, 4 hours per week.*

PHYS 5P10

Introduction to Scientific Computing

Survey of computational methods and techniques commonly used in condensed matter physics research; use of common subroutine libraries; symbolic computing systems; case studies from various areas of computational science; an independent-study term project. Use of graphing and visualization software. Numerical differentiation and integration. Use of special functions. Monte Carlo and molecular dynamics simulation of structure, energetics and thermodynamic properties of metallic, semiconducting and ionic solids and nanoparticles. *Lectures, computer labs, 4 hours per week.*

PHYS 5P30

Advanced Electromagnetism

Electromagnetic wave propagation in vacuum, dielectrics, conductors, and ionized gases; wave guide and transmission line propagation; dipole and quadrupole radiation fields; relativistic transformation of the electromagnetic fields; radiation by moving charges. *Lectures, problem sessions, 3 hours per week.*

PHYS 5P41

Advanced Statistical Physics

Statistical ensembles; mean field and Landau theory, critical phenomena, and the renormalization group; quantum fluids; superfluidity; selected topics on disordered

systems. *Lectures, problem sessions, 3 hours per week.*

PHYS 5P50

Advanced Quantum Mechanics I

Angular momentum, rotations, and scalar and vector operators, selection rules; Pauli principle and periodic table; nuclear shell model; degenerate perturbation theory; electron in magnetic field, Landau levels; time evolution in quantum mechanics, time-dependent perturbation theory; elastic scattering. *Lectures, problem sessions, 3 hours per week.*

PHYS 5P70

Advanced Condensed Matter Physics

Energy bands in metals, semiconductors, and insulators; lattice dynamics; electrical, magnetic, thermal, optical, and transport properties of solids. *Lectures, problem sessions, 3 hours per week.*

PHYS 5P74

Magnetism and Magnetic Materials

Fundamental and device applications of magnetism will be explored. Magnetic materials and magnetic measurements; domains, domain walls, domain processes, magnetization curves, and hysteresis; soft and hard magnetic materials and applications; magnetic recording; new developments and recent progress: magnetic multilayer structures, granular magnetic thin films, and giant magnetoresistance. *Lectures, problem sessions, 3 hours per week.*

PHYS 5P75

Optical Properties of Solids

Measurement techniques; reflectivity, the dielectric function and the optical conductivity; Lorentz-Drude oscillator model; Kramers-Kronig transformations and sum rules; properties of metals, insulators, and superconductors. *Lectures, problem sessions, 3 hours per week.*

PHYS 5P76

Nuclear Magnetic Resonance

Density matrix formulation of NMR theory; spectroscopy of simple spin systems and spin-dependent interactions; relaxation theory; spin temperature; dipolar broadening in solids; NMR of soft condensed matter systems; practical aspects of high-fidelity solid-state NMR; NMR spectrometer design; NMR imaging and microscopy. *Lectures, problem sessions, 3 hours per week.*

Prerequisite: PHYS 5P50

PHYS 5P79*

Advanced Experimental Methods in Condensed Matter Physics I

Survey of experimental methods commonly used in condensed matter physics: optical and NMR spectroscopy, SQUID magnetometry, neutron and X-ray scattering, low-temperature and high-pressure technology. The techniques presented will vary. Designing

experiments with advanced equipment and critical analysis of the results on both statistical and methodological grounds. Introductory classroom-centered section will be followed by several individualized hands-on modules of short duration focusing on each of the specific techniques. *Lectures, laboratories, 4 hours per week.*

PHYS 5P80

Advanced Experimental Methods in Condensed Matter Physics II

Continuation of class-room instruction and modules from PHYS 5P79 and/or new ones chosen from laser alignment, thin film deposition, vacuum technology, laser processing of materials, operation of class 100 clean rooms. *Lectures, laboratories, 4 hours per week*

PHYS 5P81

Sample Preparation and Characterization Techniques for Materials Science

An experimental course that focuses on the synthesis of ceramic materials and fabrication of thin films of these material. Nano particles of ceramic material will be prepared by methods such as sol-gel and solid-state reactions. The structure and composition of the materials will be characterized by X-ray, scanning electron microscope and energy dispersive X-ray spectroscopy. The magnetic and electronic properties of the prepared materials will be characterized by various techniques learned in PHYS 5P79. *Laboratories, 4 hours per week.*

Pre-requisites: PHYS 5P79 or permission of the instructor.

PHYS 5P91

Graduate Seminar I

Independent study and presentation of major research papers in the area of specialization. Each student is required to attend and participate in all seminars given by students registered in the course. Students are also required to attend at least 80% of the Departmental seminars. *Lectures, presentations.*

PHYS 5P92

Graduate Seminar II

Independent study and presentation of major research papers in the area of specialization. Each student is required to attend and participate in all seminars given by students registered in the course. Students are also required to attend at least 80% of the Departmental seminars. *Lectures, presentations.*

APPENDIX 2: GRADUATE CALENDAR - ACADEMIC REGULATIONS†

Academic Regulations and University Policies

I. Confidentiality and Release of Student Records

A. Protection of Privacy

Brock University collects and retains student and alumni personal information under the authority of The Brock University Act, 1964. This information is related directly to and needed by the University for the purposes of admission, registration, graduation and other activities related to its programs, being a member of the Brock University community and attending a public post secondary institution in the Province of Ontario.

The information will be used to admit, register and graduate students, record management achievement, issue student identification cards, and administer and operate academic, athletic, recreational, residences and other University programs.

Information on admission, registration and academic achievement may also be disclosed and used for statistical and research purposes by the University, other post-secondary educational institutions and the provincial government.

Personal information provided for admission and registration and any other information placed into the student record will be collected, protected, used, disclosed and retained in compliance with Ontario's Freedom of Information and Protection of Privacy Act (R.S.O. 1990, c.F.31).

B. Student Access

Students have the right to inspect all documents contained in their own record, with the exception of evaluations and letters of reference supplied to the University with the understanding that they be kept confidential.

Students have the right to request that erroneous information contained in their records be corrected and those recipients, of any information found to be in error, be advised of the correction.

Students wishing to inspect their record must make an appointment with the Director or Associate Director of Graduate Studies.

All official transcripts will be complete and unabridged. Partial transcripts cannot be issued. Transcripts issued directly to students bear the notation "Issued to Student".

Documents pertaining to a student's achievement at another institution, which may have been received by the University, will not normally be released or redirected to another institution.

† Current graduate calendar is available at www.brocku.ca/webcal/current/graduate/; only the section on Academic Regulations is included here.

C. Employee and Student Organization Access

Employees of the University are permitted access to information contained in student records, if they need to know the information in order to perform their official duties. As a general rule, only employees involved in some aspect of academic administration or student affairs are given access to the contents of student records.

In addition to collecting personal information for its own purposes the University collects specific and limited personal information on behalf of the Graduate Students' Association (GSA), as well as constituent organizations authorized by them GSA. The GSA uses this information for the purposes of membership administration, elections, annual general meetings, transit passes, and health plan and for other authorized purposes. Information provided is released by the Faculty of Graduate Studies to GSA upon entering into a written confidentiality and privacy agreement outlining the terms, conditions and purpose for the release.

D. Third Party Access

It is University policy to make a minimum of information freely available to all inquirers. The University will disclose information about students who have graduated, which is considered to be public information as follows:

1. degree(s) obtained and the dates conferred by the University, and in most circumstances,
2. scholarships and the dates awarded.
3. Except as specified below other information contained in the record (including current registration status and program of study) will be disclosed only with the student's written consent. This restriction applies to requests from parents, spouses, credit bureaus, police, CSIS and immigration and other government agencies. Specified records or portions thereof may be provided to persons or agencies pursuant to a court order, summons or subpoena directing the University to release information; to Statistics Canada and the Ministry of Education in connection with enrolment audits; or in accordance with the requirements of duly constituted professional licensing and certification bodies.

In emergency situations involving the health and safety of an individual, or in compassionate situations, the Director of Graduate Studies or designate may, if it is considered to be in the best interest of the student, authorize the release of information needed to contact the student.

E. Notification of Disclosure of Personal Information

I. Statistics Canada

Statistics Canada is the national statistical agency. As such, Statistics Canada carries out hundreds of surveys each year on a wide range of matters, including education.

It is essential to be able to follow students across time and institutions to understand, for example, the factors affecting enrolment demand at post-secondary institutions. The increased emphasis on accountability for public investment means that it is also

important to understand 'outcomes'. In order to carry out such studies, Statistics Canada asks all colleges and universities to provide data on students and graduates. Institutions collect and provide to Statistics Canada student identification information (student's name, student ID number, Social Insurance Number), student contact information (address and telephone number), student demographic characteristics, enrolment information, previous education, and labour force activity.

The Federal Statistics Act provides the legal authority for Statistics Canada to obtain access to personal information held by educational institutions. The information may be used only for statistical purposes, and the confidentiality provisions of the Statistics Act prevent the information from being released in any way that would identify a student.

Students who do not wish to have their information used are able to ask Statistics Canada to remove their identification and contact information from the national database. On request by a student, Statistics Canada will delete an individual's contact information (name, address, or other personal identifiers) from the PSIS database. To make such a request, please contact:

By email: PSIS-SIEP_contact@statcan.gc.ca

By telephone: 1-800-307-3382 or 1-613-951-7608

By mail: Institutional Surveys Section, Centre for Education Statistics, Statistics Canada, Main Building, SC 2100-K, Tunney's Pasture, Ottawa, ON K1A 0T6

II. Ministry of Training, Colleges and Universities

The University is required to report student-level enrolment-related data to the Ministry of Training, Colleges and Universities (MTCU) as a condition of receipt of its operating grant funding. The Ministry collects this enrolment data, which includes limited personal information such as the Ontario Education numbers, student characteristics and educational outcomes, in order to administer government postsecondary funding, policies and programs, including planning, evaluation and monitoring activities.

Further information on the collection and use of student-level enrolment-related data can be obtained from the MTCU website: <http://www.tcu.gov.on.ca/> or by writing to the Director, Postsecondary Finance Branch, Postsecondary Education Division, 7th Floor, Mowat Block, 900 Bay Street, Toronto, ON M7A 1L2.

F. Name Changes

As Brock is committed to the integrity of its student records, each student is required to provide, either on application for admission or in personal data required for registration, his/her legal name. Any requests to change a name, by means of alteration or deletion, substitution or addition, must be accompanied by appropriate supporting documentation. Upon making application for graduation a student may be asked to provide proof of his/her name.

G. Transcripts

Copies of student transcripts will be issued at the student's request, subject to reasonable notice. Requests should be submitted in person or by writing to the Office of the

Registrar. In accordance with the University's Policy on Access to Student Records, the student's signature is required for the release of records. Transcripts issued directly to the student are stamped "Issued to Student". Partial transcripts cannot be issued. The Office of the Registrar cannot be responsible for transcripts lost or delayed in the mail.

H. Withholding of Degree or Grades

Only the Faculty of Graduate Studies may release final grades. No student owing the University fees or fines will receive a diploma, certificate, transcript or a statement of final grades or have any such statements communicated to parties outside the University, until such time as the debts have been cleared to the satisfaction of the University.

II. Student Status

Graduate students must be identified as completing their graduate program on either a full-time or part-time basis and must be registered on a continuous basis from the point of admission to completion of the graduate program unless they have applied for and received approval for inactive status or a leave of absence.

Each graduate program determines whether a particular graduate program may be taken at Brock on a full-time or part-time basis.

Students are defined as having either full-time or part-time status at the time of admission and are expected to complete their degree under the admission status. Requests for changes to status will be reviewed, and only approved in extenuating circumstances by the Faculty of Graduate Studies.

Students admitted to graduate studies at Brock may not pursue two degrees concurrently (at Brock or elsewhere).

Definitions

Full-time Students

Full-time graduate students are defined as students whose main purpose is graduate study for the purpose of obtaining a graduate degree. Graduate study differs from undergraduate study in that it is for most students an activity that is highly concentrated, demanding and all-consuming.

Full-time graduate students are defined according to regulations as follows:

1. they must be pursuing their studies as a full-time occupation and identify themselves as full-time graduate students in all documentation;
2. they must be considered by the University to be in full-time study;
3. they must maintain regular contact with their graduate program director and supervisor;
4. they must be geographically available and visit the campus regularly. Without forfeiting full-time status, a graduate student, while under supervision, may be absent from the university (e.g. visiting libraries, doing field work, attending a graduate course at another institution, etc.) provided that, if any such absence

exceeds four weeks in any one term, written approval of the student's absence by the Graduate Program Director is forwarded to the Faculty of Graduate Studies and approved by the Dean of Graduate Studies (or designate); (see <http://www.brocku.ca/gradstudies/forms>)

5. it is advisable for full-time graduate students to notify their Graduate Program Director and supervisor of any employment undertaken outside the University; they must limit University employment to an average of no more than ten hours a week of University paid work in a given term. This ten hour a week rule applies to paid employment on campus and includes Graduate Teaching Assistantships and Research Assistantships. Approval to work on campus for more than an average of ten hours per week requires the approval of the graduate supervisor, the Graduate Program Director, and the Dean of Graduate Studies.

Part-time Students

Students who are admitted to part-time studies are restricted to a less than full-time program of study. There is no restriction with respect to time spent on paid employment. Part-time students may register in a maximum of 1.0 credit per term, excluding thesis registration. (A part-time MEd student may register in a maximum of 1.0 credit in each of the Spring and Summer MEd terms.) Not all programs offer the option to study part-time.

Part-time students should consult with their Graduate Program Director regarding course selection and course load per term.

Inactive Students

If, for some acceptable reason, a student is unable to take courses in a specific term, inactive status may be approved by the Graduate Program Director. Permission must be obtained before the start of the academic term for which the student is seeking inactive status (via the Request for Inactive Term Form found at: <http://www.brocku.ca/gradstudies/forms>). During an inactive term, the student pays the inactive fee and retains library privileges. Inactive terms do not extend the final completion date by which degree requirements must be completed. Normally, inactive terms may not be consecutive and no more than two inactive terms may be taken during any graduate degree program.

Leave of Absence Students

A leave of absence from a graduate program will be granted only in exceptional circumstances which will include parental and maternity leave, medical leave, work leave which requires the student to leave the geographic area or compassionate grounds. Cases will be considered on an individual basis and must have the approval of the Graduate Supervisor (if applicable) and the Graduate Program Director before they are submitted to the Faculty of Graduate Studies for approval. A graduate student granted a leave of absence will not be registered and will not be required to pay fees for the duration of the leave. Students on leave will not be eligible to receive University fellowship support or other financial support from the University. In the case of funding by an external agency, the regulations of the granting agency will apply. The length of time for completion of the degree will be extended by the duration of the leave. While on leave students will not normally be entitled to use University facilities and resources or receive

supervision. Leaves of absence are for a minimum of two consecutive terms and a maximum of three consecutive terms. Normally, a student will not be granted more than one leave of absence during a graduate degree program. A leave of absence cannot be followed by an inactive term.

Request for Leave of Absence Forms are available from the Faculty of Graduate Studies or the Graduate Studies website at <http://www.brocku.ca/graduate-studies/current-students/student-forms>

Personal Time Off

Students may take up to two weeks per year (14 calendar days) in personal time off, plus statutory and non-statutory holidays during which the University is closed. This personal time off must be negotiated between student and supervisor and/or Graduate Program Director. Time off should not compromise the progress of a student's studies, including the fulfillment of course requirements. Students must ensure that laboratory activities and experimentation are either completed or arrangements made for others to continue ongoing work. Time sensitive deadlines must be taken into consideration. Time off cannot be carried forward from year to year. Time off should be requested as far in advance as possible.

III. Residency Requirements

The residency requirements of a graduate degree program is the minimum number of terms in which the student must be registered prior to degree completion. For MA, MSc, MBE, MADS, MEd degrees it is 3 terms (one year) of full-time registration. For part-time students 6 terms (two years) of study is required to fulfil the residency requirements. The minimum requirements for MAcc students is 2 terms of full-time registration. The requirements for MBA students is 2 terms of full-time registration or 4 terms of part-time registration. A Doctoral degree requires at least 9 terms (three years) of full-time study after a BA/BSc or 6 terms (two years) after a Master's degree.

IV. Degree Requirements

Each graduate program specifies and outlines the graduate program degree requirements in their graduate program entries within the Graduate Calendar. Links to the graduate program calendar entries are found at: <http://www.brocku.ca/webcal/current/graduate/>

Course Substitutions

A Graduate Program Director may approve degree requirement course substitutions up to a maximum of 25% of program requirements (excluding the thesis or major research paper). Such course substitutions must be reported to the Faculty of Graduate Studies preferably at the time of course registration.

Questions regarding program/degree requirements should be addressed to the graduate program.

V. Applicable Calendar

Students who have maintained enrolment in each calendar year (May to April) may complete the degree program using the "Academic Regulations" section of the Calendar published in the year in which that program was entered, or any subsequent Calendar

published while enrolled. Students who interrupt their studies for one or more years by not enrolling become subject to the Calendar regulations in effect at the time of their re-registration.

VI. Degree Completion Time Limits

Each graduate program has a defined time to completion, for its degree program, which is the number of graduate terms normally required to complete the program. Graduate funding periods are typically tied to the program's defined time to completion and are specified in the graduate program calendar entry. Additionally, there are maximum time limits for the completion of graduate degree programs.

Maximum Time Limits

Master's Degrees

Full-time students

Full-time candidates must complete all degree requirements within three years from the date of first registration.

Part-time students

Part-time MA, MEd, MSc, MBE and MADS students must complete all degree requirements within five years from the date of first registration.

Part-time MBA students must complete all degree requirements within six years from the date of first registration.

Doctoral Degrees

Full-time students

Full-time candidates must complete the thesis and course requirements within six years from the date of first registration.

Part-time students

Part-time candidates must complete all degree requirements within eight years from the date of first registration.

Where a student is permitted to change status from full-time to part-time or vice versa, the fraction of time remaining under the previous status will apply to the new status. Permission to change status must be approved by the graduate program and forwarded to the Faculty of Graduate Studies.

Extension of Degree Time Limits

In exceptional circumstances, an extension of time permitting further registration may be granted. Extension requests, detailing the exceptional circumstances, must be received by the Faculty of Graduate Studies within the first month of the term in which the completion date expires, and all requests must have the approval of the Dean of Graduate Studies. An extension will only be granted if approved by the graduate program

concerned. A Request for Extension of Degree Time Limits Form can be found at:
<http://www.brocku.ca/graduate-studies/current-student-forms>

VII.Registration Policies and Procedures

All graduate students must maintain continuous registration in each successive term from the time of initial admission until degree requirements are complete. Students are responsible for ensuring that they register at the appropriate time for each term, as indicated in the Schedule of Important Dates.

<http://www.brocku.ca/webcal/current/graduate/sche.html>

tudents must remain continuously registered to the end of the term in which they complete the degree requirements. Completion means that all corrections have been made to the thesis, project or major essay and the final approved copy has been submitted to the graduate program. Copies of the thesis and the Graduate Record Form must also be received in the Faculty of Graduate Studies. Should the Graduate Record Form not be received by the last day for late registration in a given term, the student will be required to register for that term. If registration is allowed to lapse, the student will be withdrawn from the program.

Final Stage Status

Students approved for Final Stage Status by their graduate program must have a complete draft of their Major Research Paper or Thesis, that requires no further research or additional chapters/sections, and must be deemed by their graduate program committee to be able to complete their exit requirement within the subsequent term. Final Stage Status may only be awarded once and only for one term. The Final Stage Status Form is found at: brocku.ca/graduate-studies/current-students/student-forms

Credit will be given only for those courses for which the candidate is formally registered. A student will receive no credit for any work completed during a term in which the student was not properly registered.

It is the responsibility of students to ensure that they are registered by the appropriate deadline date. Students who fail to register by the deadline date will be charged a \$50.00 late registration fee. Students will not be allowed to register after the official registration count dates of November 1, February 1 and June 30.

Part-time students may register in a maximum of 1.0 credit per term, excluding thesis registration. (A part-time MEd student may register in a maximum of 1.0 credit in each of the Spring and Summer MEd terms.) Part-time students should consult with their Graduate Program Director regarding course selection and course load per term.

Students must check their student account via Student Self Serve for fees owing. To access and check a student financial account, sign into the University portal, my.brocku.ca, click on Student Self Serve, then from the list of options click on Financial History. It is important for students to check their Brock email regularly, for messages from the Student Accounts Finance Office regarding their financial account. Graduate funding information is available through the my.brocku.ca Student Self Serve, click on

GradStuFunding. Via this screen, students have the capability to see all graduate student funding items processed by the Faculty of Graduate Studies, that have been paid, per term, as well as funding committed for the current academic year.

Students who fail to register for any term, and who have not applied for inactive status or been granted a leave of absence, are considered to have withdrawn from their program of study. The student will be required to apply for reinstatement into the program. The request for reinstatement must be approved by the graduate program and the Faculty of Graduate Studies. The program may also make recommendations regarding the retention of previous course credits. A reinstatement application fee is charged. If enrolment is allowed to lapse a second time, the student will not be readmitted. The Request for Re-Instatement Form can be found at: <http://www.brocku.ca/graduate-studies/current-students/student-forms/>

Master of Accountancy

All students are required to register for both the Winter (January - April) and Fall (September - December) terms, unless they have received approval from the graduate program and the Faculty of Graduate Studies for interruption of their program.

Master of Business Administration

All students are required to register for both the Fall (September-December) and Winter (January-April) terms, unless they have received approval from the graduate program and the Faculty of Graduate Studies for interruption of their program.

Master of Arts, Master of Business Economics, Master of Science and Doctoral programs

All MA, MBE, MSc and PhD students are required to register for each of the three academic terms (Fall, Winter, Spring) unless they have received approval from the graduate program and the Faculty of Graduate Studies for interruption of their program.

Master of Applied Disability Studies (MADS)

All MADS students are required to register for each of the three academic terms (Fall, Winter, Spring) unless they have received approval from the graduate program and the Faculty of Graduate Studies for interruption of their program.

Master of Education

MEd students are required to register in three academic terms per year: Spring (May-June) or Summer (July-August), Fall (September-December) and Winter (January-April) unless they have received approval from the graduate program and the Faculty of Graduate Studies for interruption of their program.

Extra Courses

A full-time graduate student, with the permission of his/her Graduate Program Director, may take up to one extra graduate or undergraduate credit course (including audit status courses) that are not directly related to their graduate degree program. Students must declare a course to be Extra prior to the last day of withdrawal; however the declaration is typically made at the point of registration. No additional fee above that charged for the graduate program degree requirements will be levied for these courses. Extra courses are

subject to the same regulations as courses required for the degree but cannot be used for credit toward the degree.

Audit Courses

Graduate students wishing to attend courses without completing assignments and writing examinations must register as auditing the course. Students must have approval from the instructor of the course and their Graduate Program Director. No credit or assessment of performance will be awarded. Changes from audit to degree status or vice versa, are accepted by the Faculty of Graduate Studies no later than the last day to add a course (of that term). All audit courses are coded as extra courses.

Repeating a Course for which a Passing Grade has been Awarded

Students may repeat a course in which they have received a passing grade. The grade awarded for a repeated course will supersede the grade from the first attempt at the course regardless of whether it is higher or lower. Both grades will remain on the student's transcript but the second grade, whether higher or lower, will be used in the computation of the student's average. No course may be repeated more than once.

Repeating a Failed Course

Students may repeat a failed course, but no course may be repeated more than once. Both grades will remain on the student's transcript but the second grade will be used in the computation of the student's average.

Ontario Visiting Graduate Student Plan (OVGS)

The Ontario Visiting Graduate Student Plan allows graduate students of an Ontario university to take graduate courses at another Ontario university while remaining registered at their own university. The plan allows students to bypass the usual application for admission procedures. Admission is not complete until prior approval has been received from both the host and the home universities.

A student who is classified as an Ontario Visiting Graduate Student will register and pay fees to the home university but will pay no fees to the host university. A description of the course must be attached to the form (course outline if available). No more than one credit (two half credit courses) will be allowed as OVGS credit. The course(s) selected must be at the graduate level and required for the student's degree program and not available at the home (Brock) university. Such courses may not be "extra" or "audit" courses for the student. Ontario Visiting Graduate Student forms are available from the Faculty of Graduate Studies or the Graduate Studies website <http://www.brocku.ca/graduate-studies/current-students/student-forms>

Letters of Permission

A student may request a Letter of Permission from the Faculty of Graduate Studies in order to take a course or courses at another university (outside of Ontario) as a visiting student.

The student must be in good standing that is, having successfully completed a minimum of two graduate credits with a minimum overall B average. Brock credit will not be granted to students who Challenge for Credit, on a Letter of Permission, at the host

institution. The student must indicate the specific course(s) he/she wishes to take and provide the Faculty of Graduate Studies with the course description(s) from the calendar of the host university. Course(s) requested should be relevant to a student's degree program and must be approved by both the student's academic department/program and the Dean of Graduate Studies. Approval shall be at the discretion of the department/program and Dean, who shall base the decision on the applicant's overall academic record, the appropriateness of the particular course to the applicant's program and on any other factors deemed relevant.

If a letter of permission is granted to a currently registered student, it will be provisional pending successful completion of the progression requirements for that session.

On return to the Faculty of Graduate Studies of the approved application, the Faculty of Graduate Studies will forward a Letter of Permission to the host university. Students should contact the host university to determine any course access limitations imposed on visiting students.

Students must formally request that the host university forward an official transcript to Brock. The transcript must be received within eight weeks of the course end date as specified on the application for the Letter of Permission. Failure to provide an official transcript will result in the automatic assignment of a failing (F) grade in each course attempted on the Letter of Permission.

Not more than one credit (two half credit courses) may be taken at other universities on a Letter of Permission to fulfil graduation requirements for any graduate program at Brock.

Courses taken on a Letter of Permission will not be included in the calculation of the graduate student's Brock University average.

Credit will be granted only when the course is completed successfully with a minimum grade of "B" or 70% at the host institution. Course credit will be granted equal in value to the course weight assigned by the host institution. Any course attempted under a letter of permission shall be recorded on the Brock University transcript as a Pass/Fail grade. The exact name and title of the course(s) taken, the name of the host institution, and the grade assigned by the host institution, will appear as a notation on the Brock University transcript.

If the selected course is dropped after the commencement of classes, notification in writing, and an official transcript or statement, must be submitted immediately by the student to the Faculty of Graduate Studies at Brock University.

Students granted permission to take the final course(s) of their program on a Letter of Permission must ensure that grades, in the form of an official transcript, are received by the Faculty of Graduates Studies by April 25 for those wanting to graduate at Spring Convocation and September 5 for those wanting to graduate at Fall Convocation.

Drop/Withdrawal of Courses

Students wishing to change their course registrations during the drop period may do so through the Web until the system closes for the session. After the system closes, students must submit the Registration Course Add/Drop Form to the Faculty of Graduate Studies by the withdrawal deadline date as published in the Schedule of Important Dates (brocku.ca/webcal/current/graduate/sche.html).

While it is a courtesy to inform the instructor of withdrawal from a course, this does not constitute official withdrawal from either a course or the University.

The date of withdrawal from a course, following the course change period, will be recorded on the student's official transcript.

Grades will be recorded on students' transcripts for all courses in which they have officially registered and from which they have not officially withdrawn.

A student who drops a course during the drop period will be entitled to a full refund of tuition and ancillary fees.

A student who withdraws in good standing may be entitled to a partial refund of tuition fees in accordance with the refund schedule. See: brocku.ca/finance/studentfinance/graduate/

Voluntary Program Withdrawal

Graduate students wishing to voluntarily withdraw from a graduate program must consult with the graduate program concerned and submit the Notice of Voluntary Withdrawal Form to the Faculty of Graduate Studies. The form is available from the Graduate Studies website <http://www.brocku.ca/graduate-studies/current-students/student-forms>

Required Withdrawal from Course

Graduate students may be required to withdraw from a graduate course(s) due to academic or non-academic misconduct.

Required Withdrawal from Graduate Program

Graduate students may be required to withdraw from a graduate program due to unsatisfactory performance or academic or non-academic misconduct.

Academic Accommodation for Religious Obligations

Brock University acknowledges the pluralistic nature of the student community such that accommodations will be made for students who, by reason of religious obligation, must miss an examination, test, assignment deadline, laboratory or other compulsory academic event. Students requesting academic accommodation on the basis of religious obligation should make a formal, written request to their instructor(s) for alternative dates and/or means of satisfying requirements. Such requests should be made during the first two weeks of any given academic term, or as soon as possible after a need for accommodation is known to exist (*i.e.*, posting of the examination schedule), but in no case later than the second-last week of classes in that term.

When a student's presence is required prior to the date on which classes begin, any

student who cannot meet this expectation of attendance for reasons of religious obligation should notify the Faculty of Graduate Studies, in advance.

Accommodation is to be worked out directly and on an individual basis between the student and the instructor(s) involved. Instructors will make accommodation in a way that avoids academic disadvantage to the student. The type of accommodation granted will vary depending on the nature, weight and timing of the work for which accommodation is sought. In cases regarding academic accommodation of students on the basis of religious obligation, any dispute unresolved by discussion between the student and instructor may be appealed, first to the Graduate Program Director and thereafter to the Dean of the Faculty in which the student is registered. If the student is not satisfied with the decision of the Faculty Dean, the student may then appeal to the Dean of Graduate Studies. If the student is not satisfied with the decision of the Dean of Graduate Studies, the student may then appeal to the Student Appeals Board.

A current list of major religious observance days is posted at <http://brocku.ca/registrar/>

VIII. Research Policies and Procedures

As Brock University has signed the Agreement on the Administration of Agency Grants and Awards by Research Institutions with the Canadian Institutes of Health Research, the Natural Sciences and Engineering Research Council of Canada, and the Social Sciences and Humanities Research Council of Canada, being the agencies of the Government of Canada charged with promoting and funding research and research training in Canada, all students must comply with the Agreement including all related Policies, Frameworks, Regulations, and Guidelines with respect to areas such as conflict of interest in research, integrity in research, research involving humans and animals, biohazardous materials, etc. For further information, we encourage students to visit http://www.science.gc.ca/Research_Funding_Collaboration/Policies_and_Guidelines/Institutional_Agreement-WS56B87BE5-1_En.htm

Research Involving Human Participants

At Brock University, human research refers to activities where data from human participants are used as part of an undertaking intended to extend knowledge through a disciplined inquiry or systematic investigation. Human participants are those individuals whose data, or responses to interventions, stimuli, or questions by the researcher, are relevant to answering the research question. The definition of human participant research also extends to secondary and/or non-public sources of information; identifiable, private information about an individual(s) such as that found in health records; and research involving human biological materials from persons living or dead.

All human participant research must undergo ethics review prior to commencing and receive clearance from a Brock University Research Ethics Board (REB) regardless of whether the procedures used are invasive or non-invasive. This policy applies to funded and non-funded research involving human participants conducted in any location on or off campus by Brock University faculty, staff, graduate students, undergraduate students and to anyone conducting research under the auspices or within the jurisdiction of Brock University. If you are in doubt as to whether your research requires REB review, please

contact the Research Ethics Office reb@brocku.ca or (905) 688 5550, extension 3035 for advice.

Failure on behalf of researchers to adhere to Brock University's human research ethics policies and procedures will result in an investigation according to REB compliance procedures and may constitute misconduct under the Brock University Research and Scholarship Integrity Policy.

Please see: <http://www.brocku.ca/research/ethics-and-research-reviews/human-ethics> for additional information and the procedures you must follow to obtain research ethics clearance at Brock. For further information on research ethics guidelines in Canada, we encourage students to visit the Government of Canada's Panel on Research Ethics website <http://ethics.gc.ca/eng/index/>

Research Involving Animals

All research that involves the use of animals must be reviewed and approved by the Brock University Animal Care and Use Committee prior to the initiation of such research or instruction. Please note that no work with animals can be ordered or obtained prior to approval of animal protocol by Brock Animal Care and Use Committee. See: <http://brocku.ca/research/ethics-and-research-reviews/animals> for additional information.

Radiation and Biohazard Safety

At Brock University, safety is everyone's responsibility. All members of the university community should be thoroughly familiar with their safety responsibilities, strive to follow safety practices at all times, act proactively to prevent accidents and injuries, communicate hazards to supervisors, and be prepared for emergencies that may occur in the workplace or on campus. Brock University requires that health and safety be a primary objective in every area of operation and that all persons utilizing University premises comply with procedures, regulations and standards relating to health and safety. See brocku.ca/hr-ehs/environment-health-safety/academic-safety for additional information.

Field Safety

Brock University is committed to ensuring that scholarship and research is carried out in a safe and responsible manner. In particular, Brock recognizes the importance of encouraging faculty members, staff and students to engage in research beyond the campus walls. However, while all research involves the assessment and management of risk, the level of risk can vary with scholarship.

Risk in field research may include, but is not limited to, the risk to physical health emotional well-being and personal safety. The risks may arise because of the nature of the research itself, from the physical climate, or from the political, social, economic and cultural environment of the fieldwork location.

It is the policy of the University to encourage such activities as may be appropriate to the scholarly needs of the research program of its faculty members, students, affiliated research personnel, and staff and to take every reasonable precaution to protect the personal health, safety and security of its participating members.

In practice, responsibility for safety in field research rests primarily upon the persons who directly supervise and carry out the research on location. Such persons are expected at all times to exercise good judgement and must take all reasonable care in the circumstances to protect the personal health and safety of participating team members. See: http://www.brocku.ca/university-secretariat/facultyhandbook/section3#_genIndex131 to review the Policy on Safety and Liability for Field Research and the related forms/appendices. See [brocku.ca/hr-ehs/environment-health-safety/academic-safety](http://www.brocku.ca/hr-ehs/environment-health-safety/academic-safety) for additional information.

Integrity in Research and Scholarship

Integrity is fundamental to the process of research and scholarship and misconduct damages the entire academic enterprise. While responsibility for maintaining standards of conduct in research and scholarship resides with all members of a research team, it is the responsibility of the university to provide an atmosphere which fosters the highest standards of integrity.

Accordingly, Brock University acknowledges and accepts responsibility for maintaining ethical standards in research and scholarship, and agrees to investigate and resolve promptly and fairly all instances of alleged misconduct.

It is the purpose of this policy to set down principles that promote integrity in research and scholarship, to define categories of misconduct in research and scholarship, and to establish procedures to investigate allegations of research misconduct.

It is expected that all faculty, other employees, including those employed on grants and contracts, and students who engage in research at or under the auspices of Brock University will acquaint themselves with this Policy and all existing regulations and codes of conduct before commencing or continuing with any further research (Section III: 8 Research Ethics, Faculty Handbook; Article 11 - Academic Freedom, Article 12 - Rights and Responsibilities of Faculty Members, Article 14 - Integrity in Research and Scholarship Article 18 - Conflict of Interest, Article 38 - Patents, and Article 39 - Copyright of the BUFA/Brock Agreement on the Terms and Conditions of Employment for Faculty; Academic Regulations and other appropriate sections of the Graduate Calendar; and all future policies and regulations or codes of conduct respecting research and scholarship that may be introduced at Brock University). See: [brocku.ca/university-secretariat/facultyhandbook](http://www.brocku.ca/university-secretariat/facultyhandbook) and http://www.brocku.ca/webfm_send/21442 for additional information.

Intellectual Property

For work done by a student, research assistant or post doctoral fellow, Brock has the following guidelines related to the interpretation of copyright and other aspects of intellectual property rights. These guidelines distinguish, in general, between items done solely by the student and those undertaken as part of a joint research effort. In the former case, the intellectual property is primarily the student's, but the University reserves certain rights as detailed in the remainder of this section. In the latter case, the intellectual property rights involve the student, the research supervisor (and possibly other individuals as well), the University, and on occasion the financial sponsor of the

research. (If the work is anticipated to have commercial possibilities, it is required that the parties involved agree in writing beforehand on the sharing of any financial returns.) While no policy can anticipate or cover all possible situations, the University Policy on Integrity in Research and Scholarship and these guidelines are intended to cover the rights of current and former Brock students, research assistants and postdoctoral fellows both while attending the University, and after they leave the University, whether with or without a degree.

Similarly, while it is difficult to provide a definitive definition of intellectual property (IP), the Government of Canada (Consumer and Corporate Affairs Canada: "Intellectual Property: What It Means To You") indicates that there are at least six types of IP:

1. Patents, for inventions and the creation of new kinds of technology;
2. Copyrights, for literary, educational, artistic, dramatic and musical works;
3. Trademarks, for words, symbols or pictures used to distinguish the goods or services of one person from those of another;
4. Industrial Designs, for the shape, pattern or ornamentation of an industrially produced object;
5. Integrated Circuit Topographics;
6. Plant Breeders Rights.
7. At Brock, given our mission and types of undergraduate and graduate programs, the most likely types of intellectual property to be created includes theses, dissertations, cognate essays, research papers, books, poems, plays, scripts, essays, articles, dictionaries, maps, lyrics, musical scores, sculptures, paintings, photographs, films, videos, tapes, computer software, databases, records, tapes, cassettes, educational materials, WEB based materials and inventions (new kinds of technology). To be protected by law, an item must satisfy three criteria: a) it must be an original creation; b) it must be a specific expression of an idea, not the idea itself; and c) the item must be fixed in a physical form. These creations may occur via term papers, theses or dissertations, research or cognate essays, course projects, cases, studio or laboratory assignments, etc.

Examinations, Reports and Papers Done as Part of Course Requirements

When work that is eligible for copyright is submitted to meet a requirement of a course, the University acknowledges the student's ownership of the copyright, but places the following conditions on the submission of the work to meet course requirements.

1. The original physical document becomes the property of the University. This applies particularly to examination answer scripts, and may also be applied to term papers and other course work.
2. Except for examination answer scripts, the University receives a royalty free, non-exclusive licence to make copies of the work for internal use within the University, and to circulate the work as part of the University library collection.

Theses and Project Reports

As with other papers, the University recognizes that the student holds copyright to the finished thesis. Copies of the thesis shall have on them in a prominent place on the title page the international copyright notice. The student is required to sign a licence to the University library and an additional licence to the National Library. These licences grant the two libraries permission to reproduce the thesis and to circulate it, but do not affect

ownership of the copyright.

However, the University also recognizes that the ideas in the thesis will often arise from interaction with others. In some cases, this interaction will have been solely with the thesis supervisor; in other cases, a larger research team will have been involved. For this reason, it is understood that the copyright refers only to the written document of the thesis. The ideas themselves including any advances in theory, data, patentable ideas, or commercial exploitation of the work may or may not be the exclusive property of the student.

For the student who has worked closely with a supervisor, or as part of a research group, the rights to publish, patent or commercially exploit the results of the research are shared with the supervisor and/or the research group, and with the University. In those cases in which the work has been supported in part by research grants or contracts, there may be other conditions affecting any patent or commercial exploitation. The student should be made aware that such conditions might apply before work begins and bears some responsibility to enquire as to details if they have any concerns.

Computer Programs

Computer programs written as part of employment duties, as for example by a teaching assistant, are the property of the employer, as specified in the Copyright Act. Computer programs written as part of course work, a project or a thesis may also have value as a potentially marketable intellectual property.

The University recognizes that such software may arise in two different ways, and accordingly has two policies. In setting forth these policies, it is understood that in those cases in which software development draws upon other software owned or licenced by the University, the terms and conditions of the licence or purchase must be followed.

1. Where a student develops such software at the direct request of a supervisor, and under supervision, it is assumed that there is joint ownership of the intellectual property rights. In such cases, it is recommended that the individuals involved co-author a working paper documenting the software, rather than including it as an appendix to a thesis or report. Prior agreement between the student and supervisor that this is to be the case would be helpful.
2. Where a student develops such software on his/her own, as for example for an independent project in a course, copyright remains with the student. As a condition of using University computing facilities, the student is required to grant the University a royalty-free licence to use the software. This includes the right of the University to distribute copies of the software to Brock faculty, staff and students for the University's administration, education and research activities. This licence does not include the right to use the software for commercial purposes.
3. Further, Graduate Studies encourages all graduate students to have a thorough conversation with their graduate supervisor about intellectual property in an attempt to navigate any potential intellectual property issues in advance. Graduate Studies has created an IP Checklist to help students begin a conversation with their graduate supervisors about intellectual property matters (a copy of which can be found at: brocku.ca/graduate-studies/current-students/intellectual-property)

Research Data

As with computer software, the University recognizes that research is conducted and data are acquired in two different fashions. When the data are acquired as part of a joint or collaborative effort, such as one relying on the equipment within a laboratory, they are not solely the property of the student, although some of the data may ultimately appear in tables or appendices in a completed thesis.

As a general rule, such data are the joint property of the student and the research supervisor, either of whom has the right to make it available to other individuals. Both student and supervisor are responsible for insuring that proper acknowledgement of the contributions of the student, supervisor, and other members of the research team is made when the data is released in any form.

When the data is acquired through the student's individual effort, and without the use of University laboratories or funding, then it is usually the property of the student making that effort. However, exceptions may occur when the student collects data using research instruments including interview schedules and questionnaires developed wholly or in part by the research supervisor or by some other person or agency. In such instances the right to ownership and/or use of the data may be shared among the parties involved.

Given the range of possible alternatives it is not possible to set absolute guidelines in advance covering all such situations. Consequently, it is strongly recommended that students and supervisors make clear agreements in advance concerning the ownership and use of data collected in this fashion. Ownership of data may also be affected by the terms of a research contract that has supported the work.

Equipment

If University resources have been applied to the construction or design of equipment, it is not the property of the student, but of the University. Equipment constructed or designed as part of course or thesis work is the property of the student if the work, materials, and workroom space have been provided by the student or other non-University source. Ownership of newly constructed equipment may also be specified in a research contract that has supported the work.

Graduate Student Intellectual Property Form and IP Checklist

All graduate students must read and familiarize themselves with the intellectual property policies and guidelines of the University (as described above). In addition, the Policy on Integrity in Research and Scholarship requires graduate students and their graduate supervisors to sign an Intellectual Property Form indicating their agreement with the University policies and guidelines or indicating any specific arrangements that have been that differ from these policies and guidelines. Please see: <http://www.brocku.ca/graduate-studies/current-students/intellectual-property>

Further, Graduate Studies encourages all graduate students to have a thorough conversation with their graduate supervisor about intellectual property in an attempt to navigate any potential intellectual property issues in advance. Graduate Studies has created an IP checklist to help students begin a conversation with their graduate supervisors about intellectual property matters (a copy of which can be found at:

<http://www.brocku.ca/graduate-studies/current-students/intellectual-property>

IX. Examinations

Graduate instructors will indicate on the course outline and grading scheme whether formal or informal scheduled examinations are required.

Examination scripts must clearly identify the requirements for completing the examination. The duration in hours and minutes, if relevant, must also be identified. When an instructor transmits grades for a course to the Faculty of Graduate Studies, the examination scripts shall be kept by the instructor for a period of time not less than six months. After that time, they must be shredded. Students have the right to inspect their examination paper under faculty supervision.

If a student is unable to write a formally scheduled examination, or having begun the exam is unable to complete it for reasons of ill-health, a deferred examination will be granted provided adequate supportive documentation has been submitted. Requests made on the basis of compassionate grounds, religious obligations, or other extenuating circumstances will be judged on a case-by-case basis.

Any medical request for a Deferred Examination must be supported by a completed Brock University Student Medical Certificate (and include any relevant medical documentation) certifying that the student was not capable of attempting the examination at the scheduled date and time. A student must first contact the instructor for permission to write a Deferred Examination. Any such application must be accompanied by required supporting documentation and must be submitted within seven working days following the examination.

If the student is not able to contact the course instructor or if the course instructor is not willing to give the student permission to write a Deferred Examination, the student may contact the Director of the Graduate Program, within ten working days following the examination, to submit a request for a Deferred Examination. The Graduate Program Director will forward the request and his/her recommendation to the department Chair (for department based graduate programs) or the Faculty Dean (for programs not located within a department) for consideration and decision.

If not satisfied with the outcome of the request, the student may then refer the matter to the Dean of the Faculty offering the course. If the student is not satisfied with the decision of the Faculty Dean, the student may then refer the matter to the Dean of Graduate Studies. If the student is not satisfied with the decision of the Dean of Graduate Studies, the student may appeal to the Student Appeals Board.

Deferred examinations will normally be written no later than the end of the subsequent graduate term.

X. Evaluation of Student Performance

Grades

The following grades are awarded for graduate courses:

A+ - 90-100

A - 80-89

B - 70-79

C - 60-69

F - 59 or lower

Grading Scheme used prior to 2010-2011

A - 80, 82, 85, 88, 90, 92, 95, 98, 100

B - 70, 72, 75, 78

C - 60, 62, 65, 68

F - 58 or lower

IN (Incomplete) is a temporary grade granted to a student, in exceptional circumstances who has been unable to complete some part of the term work in a course. A grade must be submitted no later than 56 days from the last day of classes in each term. In the case of the thesis, major essay or project, an IN grade should only be granted when the thesis, major essay or project is essentially complete (only minor revision or thesis defence scheduling required). If the IN is not replaced by a letter grade within 56 days, the IN will be changed to the default grade.

IP (In Progress)

A grade of IP may be awarded if a student fails to complete all course requirements within the prescribed time limit. A student who receives an IP grade for a course must re-register for that course in the term following that for which an IP grade is received. With the exception of the thesis, major essay, project or proposal courses, no half-credit graduate course shall be denoted IP for more than one term.

Pass/Fail

A grade of P or F will be awarded for courses completed on Letter of Permission (LOP). The actual grade awarded and the institution that awarded it will be noted at the bottom of the official Brock transcript. Pass/Fail is also used for the evaluation of thesis courses.

AG (Aegrotat standing)

Aegrotat standing is the granting of credit for a course(s), based on the course work already completed, when no further assessment - for example, a deferred examination - is considered feasible because of illness or other extenuating circumstances beyond the student's control. Students may only be granted Aegrotat Standing with the approval of the Dean of the Faculty offering the course.

SP (Deffered examination)

A deffered examination has been granted.

CR (Credit)

The satisfactory completion of a graduate credit course for which letter and percentage grading is not feasible.

NC (No-Credit)

The unsatisfactory completion of a graduate credit course for which letter and percentage grading is not feasible.

SA (Satisfactory)

Used for co-op work terms, internship options and non-credit courses.

UN (Unsatisfactory)

Used for co-op work terms, internship options and non-credit courses.

W (Withdrawn)

Where xx is the week of withdrawal

NR (Not reported)**NW (Not withdrawn)**

For graduate courses the grades A+, A, B, C, F, IN (Incomplete), IP (In Progress), Pass/Fail, CR/NC (Credit/No-Credit), SA/UN (Satisfactory/Unsatisfactory), NW (Not Withdrawn), or AG (Aegrotat standing) will be recorded on the transcript.

For all graduate programs except the MBA, graduate credit is only earned for courses in which a grade of A+, A or B is awarded.

For graduate courses in the MBA program, the grades A+, A, B, C, F, In (Incomplete), IP (In Progress), Pass/Fail, CR/NC (Credit/No-Credit), SA/UN Satisfactory/Unsatisfactory, NW (Not Withdrawn), or AG (Aegrotat standing) will be recorded on the transcript. Grades A+, A, B, and C are considered to be passing grades and eligible for graduate credit. However, of the twenty half-credits required to complete degree requirements, a maximum of two-half credits at the C level may be used for degree credit and the student must achieve an overall minimum B average in the twenty half-credits that comprise degree requirements to be eligible to graduate.

Major essay and project grades shall be reported to the Faculty of Graduate Studies in the usual fashion with letter and numerical grades. If a failing grade is awarded for a major essay or project, the student will be withdrawn from the program.

Thesis grades for master's and doctoral programs shall be reported to the Faculty of Graduate Studies as either a Pass or Fail grade. A Pass grade must be further differentiated as one of: Acceptable as is, Acceptable with minor revisions, Acceptable with major revisions. A fail grade will be awarded if two or more committee members find the thesis unacceptable or if the External Examiner does not approve the thesis. If a failing grade is awarded for a thesis, the student will be withdrawn from the program.

No graduate degree candidate can fulfill more than 25% of the minimum degree requirements by courses utilizing the Credit/No-Credit method of evaluation.

Grading Procedure

Each instructor shall make available to the class at the beginning of the term, the method by which student performance shall be evaluated.

Grade Changes

After grades have been submitted to the Faculty of Graduate Studies they may not be changed except by submission of a Request to Change a Grade Form (found at: <http://www.brocku.ca/graduatestudies/current-students-forms>) signed by the instructor and the Graduate Program Director. Requests made for changes of grade beyond 180 days from the end of the term in which the grade was assigned, must also include the signature of the Faculty Dean.

Academic Performance Information

Student academic performance information is available following the end of each term of study via mybrocku.ca/portal

Final grades may only be released by the Faculty of Graduate Studies.

Minimum Academic Requirements for Continuation in a Graduate Program

Graduate students must achieve and maintain satisfactory academic performance to be eligible to continue in a graduate program. Graduate program committees will review the performance of their enrolled graduate students on a regular basis, preferably each term.

At minimum, graduate programs will ensure that there is a formal meeting of each PhD supervisory committee at least once within the academic year (May-April). Each PhD supervisory committee must report annually on the student's progress and the Graduate Program Director must forward such reports to the Faculty of Graduate Studies. The report will formally document the supervisory committee's assessment of the progress of the student in the program.

Graduate students must maintain a minimum cumulative average of at least a B- (70 per cent) during each term of study. If a graduate student falls below the minimum cumulative average the student will be automatically placed on academic probation for the subsequent term by the Faculty of Graduate Studies. Additionally a graduate program may recommend required program withdrawal. A probationary student must achieve the minimum cumulative average, normally during the probationary term, to be eligible to continue as a graduate student.

In graduate programs with a research exit requirement (thesis, major essay/research paper) satisfactory academic progress during the research phase will be determined through academic progress reviews by the graduate program committee (normally once per term) as outlined in the program's Graduate Handbook. An unsatisfactory academic progress decision, as determined by the graduate program committee, may result in a program's decision to place the student on academic probation for the subsequent term or a request for required program withdrawal.

An unsatisfactory academic progress decision, as determined by the graduate program committee at any point during the student's graduate program, may result in a program's decision to place the student on academic probation for the subsequent term or a request

for required program withdrawal.

Calculation of Averages

The average which is used to determine academic standing is computed by dividing the sum of the numeric grades assigned to credits by the total number of credits attempted.

*Average = The sum (credit weight x grades)divided by the Total number of credits attempted

**See regulations on repeated courses.

Only courses taken at Brock University and on OVGS as part of the graduate degree will be used in determining a student's average. Courses taken on a Letter of Permission will be marked as Pass/Fail and will not be used in determining any student average. The exact name and title of the course taken on Letter of Permission, including the grade received at the offering institution, will be included as a note on the student's transcript. Courses designated as Extra will not be used in determining any student average. Courses awarded as Advanced Standing or Transfer Credit will not be used in determining any student average.

For the purposes of calculating averages, a value of 45 percent is used for all "F" grades of 45 or lower.

XI. Graduate Supervision and Supervisory Committees

The role of a supervisor is threefold: to advise, to monitor and to mentor. Supervisors not only provide guidance, instruction and encouragement in the research activities of their students, but also take part in the ongoing evaluation and examination of their students' progress and performance. Supervisors and students have a mutual obligation to meet on a regular basis. The frequency of such meetings will depend on the discipline/field of study, type of program, and the students' progress. At least one, preferably several, meetings should be arranged in each academic term. Supervisors should also be reasonably accessible for meetings requested by their students.

The Policy on Integrity in Research and Scholarship requires graduate students and their graduate supervisor to sign an Intellectual Property Form indicating their agreement with University policies and guidelines or indicating any specific arrangements made that differ from these policies and guidelines.

The graduate supervisor should discuss with graduate students under their supervision, at an early stage of their program, authorship practices within the discipline and encourage the dissemination of research results by publication in scholarly and research journals, presentations at conferences, and seminars.

The graduate supervisor should discuss with graduate students under their supervision other relevant university policies, including the Respectful Work and Learning Environment Policy and the Occupational Health and Safety Policy.

Each graduate program will ensure that a graduate supervisor and supervisory committee are designated for each graduate student completing a required major essay,

project or thesis requirement.

The graduate supervisor in consultation with the graduate student will propose the supervisory committee composition. The committee composition must be approved by the Graduate Program Director and must be in place and operational by no later than the proposal stage of the major essay, project or thesis.

A thesis supervisory committee must at minimum comprise three members, the graduate supervisor and two additional faculty members. At least one of the three must be a full-time Brock University faculty member. A project or major essay supervisory committee must at minimum comprise the graduate supervisor and a second reader. Any changes to the composition of the supervisory committee must be made in consultation with the graduate student and the Graduate Program Director. The student or any member of the supervisory committee may, with just cause, request in writing a change in the composition of the supervisory committee.

If either the graduate student or supervisor wishes to initiate a change in supervisor and the change cannot be resolved at the graduate program level, a request must be presented in writing, with explanation, to the Graduate Program Director, and approved by the Faculty Dean and the Dean of Graduate Studies in consultation with the Graduate Program Director.

The graduate supervisor will inform graduate students under their supervision, and the Graduate Program Director, of any anticipated extended supervisor absence. In cases where the absence will be for a period of one month or more, supervisors will arrange for suitable communication methods and/or interim supervision e.g. through the use of supervisory committee members. Such arrangements will be communicated, by the supervisor, to graduate students under their supervision, and the Graduate Program Director.

If a student's graduate supervisor leaves Brock University during the student's program, the Graduate Program Director has the responsibility to ensure that the student can exercise one of the following options:

1. Remain at Brock and change supervisor and perhaps major essay, project or thesis topic.
2. Remain at Brock and complete the existing major essay, project or thesis even though the appropriate expertise may not be available at Brock for supervision. In this case, the supervisory committee may seek advice from experts off campus, or may arrange for the student to work off campus. It will be the responsibility of the supervisory committee (augmented, if necessary, by outside expertise), to advise the student on all matters regarding the major essay, project or thesis preparation. The student is not precluded from seeking advice from the former Brock faculty member, but the former Brock faculty member has no privileged position with respect to the major essay, project or thesis. The supervisory committee will take precedence in all cases.
3. Apply to transfer to the university to which the student's former supervisor has moved.
4. Any special arrangements described in ii) or iii) above must be approved by the

Faculty Dean and the Dean of Graduate Studies.

XII. Doctoral Candidacy Requirements

Each graduate program offering a doctoral degree is responsible for establishing detailed doctoral candidacy requirements. These requirements must be outlined as part of the graduate program's procedures. Completion of the doctoral candidacy requirement is reported by the Graduate Program Director to the Faculty of Graduate Studies and is notated on the student's transcript.

XIII. Graduate Research Proposals

Graduate students completing a major essay, project or thesis must submit and have approved by their supervisory committee a proposal of research in accordance with their graduate program's procedures.

Following approval of the research design, human or animal ethics approval (or any other necessary approval) must be secured prior to the commencement of the research study.

XIV. Graduate Theses, Major Research Paper Documents

Master's and doctoral thesis documents must adhere to the Faculty of Graduate Studies minimum format requirements and any program specific format requirements.

The format requirements for major essay, major research paper and project documents are specified and outlined by individual graduate programs.

XV. Thesis Defences

Graduate thesis defences will normally be open defences. A request for a closed defence must be approved by the Dean of Graduate Studies and will be based on certified medical or compassionate grounds.

The arrangements for a thesis defence will commence once all members of the supervisory committee have signed off indicating their approval that the student and the thesis are ready for defence.

The examination committee of a master's thesis defence will minimally comprise the supervisory committee and an external examiner. With the approval of the Dean of Graduate Studies and the academic Faculty Dean, the external examiner may be external to the candidate's graduate program but internal to Brock University.

The examination committee of a doctoral defence will minimally comprise the supervisory committee, an internal examiner (from outside the graduate program but within Brock University) and an external examiner. The approval of the external examiner is the responsibility of the Dean of Graduate Studies or designate.

Typically a thesis defence will occur four to six weeks following the external examiner's receipt of the thesis document. External examiners shall submit their report no later than one week prior to the defence. External examiners shall as part of their report identify whether the thesis is ready for defence and whether the thesis is to be recommended for submission to internal/external thesis award competitions.

If the external examiner reports that the thesis is not ready for defence, the student must revise the thesis within a reasonable period of time in response to the examiner's comments and the thesis will then be resubmitted to the external examiner. A decision by the external examiner that the thesis is not ready for defence is binding.

A change of external examiner, in exceptional circumstances, must be justified in writing to the Faculty Dean or designate for a master's thesis and the Dean of Graduate Studies or designate for a doctoral thesis.

The external examiner's report will be shared with the examination committee and the graduate student prior to the defence.

The recommended format and procedures for a master's thesis defence are outlined by the Faculty of Graduate Studies. Each graduate program will publish their approved master's defence procedures. The Faculty Dean or designate will chair master's defences.

The required format and procedures for a doctoral defence are outlined by the Faculty of Graduate Studies. The Dean of Graduate Studies or designate will chair doctoral defences.

If a student is unable to attend the defence, or having begun the defence is unable to complete it for reasons of ill-health, a deferred defence will be granted provided adequate supporting documentation has been submitted. Requests for a deferral of a defence will be considered on the basis of compassionate grounds or other extenuating circumstances and will be judged on a case-by-case basis by the Dean of Graduate Studies. The defence will normally be re-scheduled within one month of the original defence date.

Students should typically be given two to four weeks to complete minor revisions which are to be approved by the graduate supervisor and four to twelve weeks to complete major revisions which are to be approved by the graduate supervisor and the chair of the defence.

Extraordinary exceptions to thesis defence procedures must be approved by the Dean of Graduate Studies.

XVI. Submission and Deposit of Thesis

Submission of thesis

When the thesis is in its final form (following defence), has been approved by the graduate program, and meets FGS Thesis Format Specifications, the student will submit the thesis to the Brock University Digital Repository. The student must also submit to the Faculty of Graduate Studies the Certificate of Approval, the Library and Archives Canada (LAC) Non-Exclusive License to Reproduce Theses, and the Brock University thesis and Major Research Paper Copyright Licence. Under certain circumstances (e.g. to protect confidential commercial information, patentable material, pending application, or where immediate commercial publication is anticipated) a graduate student may request a restriction on the circulation of the thesis for up to a period of twelve months.

XVII. Academic Integrity

Brock University encourages the pursuit of knowledge and scholarship through the provision of academic programs and a learning environment of the highest quality. Academic Integrity is a core value that supports the University's mission.

It is expected that graduate students shall demonstrate competency in the acknowledgment of the work of others and an understanding of the rigour of academic study, by acting ethically and with integrity in all academic work as well as in the conducting of research and the reporting of research results. The trust Brock University bestows on its graduate students demands a higher standard of care be taken in the pursuit of graduate scholarship.

All graduate students have the responsibility to familiarize themselves with the Academic Integrity Policy, <http://www.brocku.ca/academic-integrity/academic-integrity-policy>, as well as any policy related to their participation as a member of the University community.

XVIII. Academic Misconduct

Academic misconduct may take many forms: The following identifies academic behaviours the University considers inappropriate and which may lead to disciplinary procedures under the Academic Integrity Policy. This list is not comprehensive and should not be seen as complete.

Examinations and Tests

- Impersonation of a candidate in an examination or test.
- Copying information from another Student.
- Making information available to other Students.
- Use of unauthorized material.
- Submission of a take-home examination written by someone else.

Laboratories

- Copying a laboratory report or allowing someone else to copy one's report.
- Using another Student's data unless specifically allowed by the Instructor.
- Allowing someone else to do the laboratory work.
- Using direct quotations or sections of paraphrased material in a lab report without acknowledgement.
- Faking or falsifying laboratory data.

Essays, Assignments and Theses

- Submission of an essay or thesis written in whole or in part by someone else as one's own.
- Preparing an essay, thesis or assignment for submission by another Student.
- Copying an essay, thesis or assignment, or allowing one's essay, thesis or assignment to be copied by someone else.

- Using direct quotations or large sections of paraphrased material without acknowledgement.
- The buying or selling of, or contracting for, term papers, theses, computer programs or other assignments.
- The submission of the same piece of work in more than one course without the permission of the Instructors.
- Submitting whole or part of a computer program or code with or without modifications or obfuscation as one's own.

False or Misleading Representation

- Failure to disclose prior academic records required for admission decisions or other academic purposes.
- Obtaining medical or other certificates under false or misleading pretences.
- Altering documents or certificates, including but not restricted to, health claims, iMS, tests, and examinations.
- Submitting false credentials for any purpose.
- Forging or falsifying Brock University documents, including but not restricted to hard copy or electronic.

Unprofessional or Inappropriate Behaviour

- Exhibiting unprofessional or dishonest behaviour related to, or in a field placement, practicum or internship.

Individual Instructors or graduate programs will point out areas of specific concern not covered above. Students should be encouraged to consult Instructors in case of doubt.

Plagiarism means presenting work done (in whole or in part) by someone else as if it were one's own and applies to all forms of student work. The work of others can include, but is not limited to, written work, ideas, music, performance pieces, designs, artwork, computer codes and Internet resources. Associated dishonest practices include faking or falsification of data, cheating or the uttering of false statements by a student in order to obtain unjustified concessions.

Plagiarism should be distinguished from co-operation and collaboration. Often, students may be permitted or expected to work on assignments collectively, and to present the results either collectively or separately. This is not a problem so long as it is clearly understood whose work is being presented, for example, by way of formal acknowledgment or by footnoting.

Instructors should inform students what constitutes acceptable workmanship, proper form of citation and use of sources. In addition, Instructors shall clearly define their expectations regarding collaboration and group work.

Procedures

All cases of suspected academic dishonesty shall be investigated in accordance with the Academic Integrity Policy. A determination of academic misconduct shall be based on

discussion between the student and the instructor, as well as a review of the evidence presented.

Graduate students shall not be penalized for suspected academic misconduct. It is the responsibility of the instructor to demonstrate the accuracy of the charge.

If the instructor can document a case of academic misconduct, the instructor shall inform, concurrently, the Graduate Program Director and the Director, Graduate Studies; the latter will not process any application for withdrawal from the course pending the outcome of the investigation of the case. If a charge of academic misconduct is subsequently brought by the instructor, no withdrawal from a course shall be considered valid.

The student may, if wished, be accompanied to interview or meeting with a Graduate Program Director or Dean by one member of the University community to act as an adviser. The student shall inform the Graduate Program Director or Dean prior to the meeting of his or her desire to have an adviser present. Persons who are not members of the University community, such as parents, family members, friends, legal counsel or others are not permitted to participate in the hearing process. A member of the University community acting as an adviser to the Student may be required to verify his or her membership within the University community before the hearing proceeds.

The Graduate Program Director shall inform the student of the allegation of academic dishonesty, in writing, by letter or electronic message to the student's university email account within ten (10) working days of being informed by the instructor of the allegation.

The instructor and the Graduate Program Director together will interview the student; inform the student of their suspicion of academic dishonesty and attempt to discover the circumstances. The Graduate Program Director shall:

1. explain the purpose of the meeting and inform the student of his or her rights and responsibilities;
2. ask the instructor to outline the specifics of the alleged academic dishonesty and review pertinent documentation and evidence with the student;
3. give the student fair opportunity to provide verbal response and offer any documentation or information in reply to the accusation of academic dishonesty;
4. inform the student of his or her discipline recommendation.

If the Graduate Program Director determines that no grounds for a charge exist, or there is not sufficient evidence with which to proceed, she/he shall inform the student, the Dean of the Faculty representing the graduate program and the Director, Graduate Studies, within ten (10) working days. No record of the occurrence shall exist.

An instructor, in consultation with the Graduate Program Director may recommend a discipline outcome that does not include a specific academic penalty. In these particular cases, the instructor and Graduate Program Director shall meet with the student to determine an appropriate course of action. No record of the occurrence shall be retained.

Should the Graduate Program Director determine there is sufficient evidence of academic misconduct, s/he shall inform the student of such and refer the case to the Dean of the Faculty representing the graduate program along with any supporting evidence and discipline recommendations from the program.

The Dean shall contact the student, in writing, within ten (10) working days of being informed by the Graduate Program Director. Electronic notification to the student's university email account shall be considered an acceptable form of written communication. The student shall have ten (10) working days from the date of the letter or electronic message informing him/her of the Dean's request to meet and discuss the alleged dishonesty. The student should respond to the notification within the timeframe and in the manner (letter, electronic, or telephone) directed.

The Dean shall meet with the student to discuss the circumstances of the case and seek to discover any new information that may be relevant to the situation.

The Dean shall:

1. explain the purpose of the meeting;
2. review the specifics of the alleged academic dishonesty as well as any pertinent documentation and evidence with the student;
3. give the student fair opportunity to provide verbal response and offer any documentation or information in reply to the accusation of academic dishonesty;
4. inform the student the case shall be forwarded to the Dean of Graduate Studies;
5. refer the case to the Dean of Graduate Studies along with any supporting evidence and discipline recommendations.

The Dean of Graduate Studies shall consult with the Dean of the Faculty representing the graduate program regarding the circumstances of the case and discuss appropriate discipline outcomes or penalty, prior to meeting with the student.

The Dean of Graduate Studies shall contact the student in writing within ten (10) working days of being informed by the Faculty Dean. Electronic notification to the student's university email account shall be considered an acceptable form of written communication. The student shall have ten (10) working days from the date of the letter or electronic message informing him/her of the Dean's request to meet and discuss the alleged dishonesty. The student should respond to the notification within the timeframe and in the manner (letter, electronic, or telephone) directed.

When a case is forwarded to the Dean of Graduate Studies, prior to deciding a discipline outcome or penalty, h/she shall verify with the Director, Graduate Studies, that the student has not had a previous discipline for academic misconduct.

The Dean of Graduate Studies shall meet with the student to discuss the circumstances of the case and seek to discover any new information that may be relevant to the situation.

The Dean of Graduate Studies shall:

1. explain the purpose of the meeting;
2. review the specifics of the alleged academic dishonesty as well as any pertinent

- documentation and evidence with the student;
- 3. give the student fair opportunity to provide verbal response and offer any documentation or information in reply to the accusation of academic dishonesty;
- 4. inform the student of his or her discipline decision at the end of the meeting;
- 5. inform the student of his or her right to appeal to decision.

If the Dean of Graduate Studies is satisfied that a case of academic misconduct has been proven:

1. The Dean shall inform the Director, Graduate Studies, who shall insert a notation identifying the discipline for academic misconduct in the student's academic file, and/or on the student's transcript.
2. The notation shall be removed from the file when the student graduates or three (3) years after the last registration.
3. The Director, Graduate Studies shall inform the student in writing within ten (10) working days of the action taken and outline the possible penalties for future infractions.
4. The Registrar shall note the transgression on the student's transcript in the case of a second or subsequent offences. The notation shall be removed from the transcript when the student graduates or three (3) years after the last registration.
5. Should the student request an appeal, his or her penalty shall remain in effect pending the outcome of the appeal.
6. A penalty becomes in effect when designated by the Dean.

Penalties

If the Dean of Graduate Studies is satisfied that academic misconduct has occurred s/he shall notify the Director, Graduate Studies, who in the case of first offenders, shall insert a notation in the Student's academic file and/or on the Student's transcript. In addition, the Dean of Graduate Studies may impose, singularly or in combination, any of the following penalties:

1. oral or written disciplinary warning or reprimand;
2. requirement to complete an academic integrity assignment or program;
3. lower grade or failure on the assignment or examination;
4. a reduction in the course grade that exceeds the value of the assignment;
5. failure in the course;
6. removal from program of study;
7. notation on student's official transcript;
8. suspension from the University, with a transcript notation; for a definite period;
9. expulsion from the University, with a transcript notation
10. withholding or rescinding a Brock degree or certificate.

XIX. Graduate Student Appeals

All graduate students have the right to appeal academic decisions. An appeal is a request that an academic decision (e.g., a grade or standing in a program) be changed, based on the evidence supplied by the student or that a regulation be waived on compassionate grounds or because of extenuating circumstances. This section outlines Brock's academic appeals procedures. Students should note that appeals to the Student Appeals Board is a

final recourse in dealing with academic appeals. Students must ensure that they follow the prescribed process and meet with required individuals prior to submitting an appeal to the Student Appeals Board. Students who submit an appeal to the Student Appeals Board without following the prescribed procedure will have the appeal returned without decision.

Types of Appeals

Appeal of Grades

Students who have a question regarding the final grade in a course must first discuss the matter with the course instructor or their supervisor (in the case of their thesis, project or major essay). In the event of an unresolved disagreement, the student must refer the matter to the Graduate Program Director. If not satisfied, the student must then refer the matter to the Faculty Dean. If the student is not satisfied with the outcome of the request, the graduate student may appeal the decision to the Dean of Graduate Studies. If the student is not satisfied with the decision of the Dean of Graduate Studies, the student may then appeal to the Student Appeals Board

Appeals of final grades, including the assignment of a failing grade for non-attendance in a course, must be made within 180 days of the posting of grades by the Faculty of Graduate Studies. Failure in itself is not a valid reason for appeal. If the absence of the instructor, or other factors make an appeal within 180 days impossible, the intention to appeal should be indicated to the Graduate Program Director within 180 days of the posting of grades by the Faculty of Graduate Studies.

Appeals Related to Academic Requirements/Decisions

A request for an exemption to a graduate program degree requirement must be directed to the Graduate Program of the student's program. If not satisfied with the outcome of the request, the student will then refer the matter to the Faculty Dean. If not satisfied with the outcome of the request, the graduate student may appeal to the Dean of Graduate Studies. If not satisfied with the outcome of the request the graduate student may appeal to the Dean of Graduate Studies. If the student is not satisfied with the decision of the Dean of Graduate Studies, the student may then appeal to the Student Appeals Board.

A request for an exemption to a University degree requirement must be directed first to the Faculty Dean. If not satisfied with the outcome of the request the graduate student may appeal to the Dean of Graduate Studies. If the student is not satisfied with the decision of the Dean of Graduate Studies, the student may then appeal to the Student Appeals Board.

Requests for Retroactive Registration and Backdated Withdrawal

Within 12 weeks of the last day of classes, a backdated withdrawal will be considered upon the receipt of a request which is supported by documentation verifying medical reasons or compassionate grounds that prevented the student from withdrawing by the last date to do so. Requests submitted without supporting documentation will not be considered.

Prior to the last day of lectures, a request for retroactive registration will be considered upon the receipt of supporting documentation that outline the reason(s) why formal registration did not occur. This documentation must be accompanied by a Registration Course Add/Drop Form signed and dated by the course instructor and the Graduate Program Director verifying that the student has been in continuous attendance.

Requests under C. i) and C. ii) are considered and a decision rendered by the Director of Graduate Studies (or designate). There is no charge for these requests. Students wishing to appeal the decision of the Director of Graduate Studies must refer the matter to the Dean of Graduate Studies. If the student is not satisfied with the decision of the Dean, the student may then appeal to the Student Appeals Board.

When appropriate, the grade NW (Not Withdrawn) may be assigned by the Student Appeals Board within the specified appeal period and when supporting documentation is supplied by the student.

Appeals Procedures

Method of Appeal to the Student Appeals Board

All appeals directed to the Student Appeals Board must be received in type-written form. Submissions not received in this form will be returned to the student without decision. Appeals should be submitted to the Administrative Co-coordinator, Senate Students Appeals Board, in care of the Office of the Registrar, must provide any additional documentation not submitted to the Dean of Graduate Studies and must be accompanied by the appeal fee.

Appeals must clearly state the arguments and expectations of the student. The responsibility is on the student to demonstrate the validity of their appeal and to provide full and appropriate supporting documentation. Dissatisfaction with, or ignorance or neglect of University policy or published deadlines shall not constitute sufficient grounds for appeal.

Appeals of academic decisions must be made within 30 days of the date of the letter informing the student of the academic decision or within 30 days of the posting date of grades which informs the student of the academic decision and/or final grade.

Appeals of a charge of academic misconduct must be made within 30 days of the date of the letter informing the student of the decision of the Dean of Graduate Studies.

A student may abandon an appeal at any time during the appeal process.

Hearings at the Student Appeals Board

Meetings of the Student Appeals Board are held in camera.

In accordance with the rules of natural justice, students appealing to the Student Appeals Board have a right to a fair hearing. This includes the right to be notified of the date at which the student's appeal will be considered, the right to attend and present verbal arguments and the right to question the Dean of Graduate Studies (or the person

designated by the Dean).

Students must inform the Administrative Co-coordinator, Senate Students Appeals Board, of their intention to attend the meeting.

Students are entitled to bring one faculty, staff or student member of Brock University (who shall act as an advisor) to the meeting of the Student Appeals Board.

Where a member of the University community has a close personal relationship, defined as any relationship, arising from being a member of immediate or extended family (parent, guardian, partner, sibling, aunt, uncle, cousin, or in-law) with a student; that person shall not participate in or contribute to that student's appeals hearing.

Where a member of the University community and the student are engaged in activities (academic work, research projects, teaching programs, employment situations, etc) where the member of the University community is a Faculty supervisor, manager, or in a position of authority; that person shall not participate in or contribute to that student's appeals hearing.

In situations where the relationship of a member of the University community and a student may pose a real, apparent, or potential conflict of interest; both parties must formally disclose in writing the conflict of interest, upon discovery, to the Administrative Co-ordinator, Student Appeals Board prior to the hearing.

If a student has asked to attend the meeting of the Student Appeals Board, the Dean (or the person designated by the Dean) whose decision is being appealed will be invited to attend the meeting of the Student Appeals Board.

The Student Appeals Board may request the attendance of appropriate individuals to appear before the Board to provide information pertinent to the appeal.

Where the appeal is against an assigned final grade, the faculty member named in the appeal will be invited to attend the meeting of the Student Appeals Board.

In instances where a faculty member, Graduate Program Director, or Faculty Dean is named in an appeal, the student's submission will be available to the individual named.

At the request of the student, the written response of the faculty member, Graduate Program Director, Faculty Dean, or the Dean of Graduate Studies to an appeal will be made available to the student.

The student and the Dean of Graduate Studies, and where applicable the Graduate Program Director, faculty member, or Faculty Dean, will be informed, in writing, of the decision of the Student Appeals Board.

The decision of the Student Appeals Board is final.

XX. Degree Completion

Degree Audit

The graduate program submits to the Faculty of Graduate Studies the completed Graduate Record Form indicating that all program requirements have been satisfactorily completed. The completion of graduate degree requirements outlined on the Graduate Record Form will be reviewed and approved by the Dean of Graduate Studies (or designate). If academic documentation for graduation is not submitted by the student's program at least one month prior to the convocation date, the student will be required to postpone graduation to the following convocation

Application for Graduation

Application for graduation is processed online via the University portal, *my.brocku.ca*, click on Student Self Serve, then from the list of options click on GraduationApp. Payment is made online and the application can be tracked through the various processing stages. Application deadlines are July 1 for Fall Convocation and February 1 for Spring Convocation. Details regarding the convocation ceremonies go to <http://www.brocku.ca/registrar/grad>

Candidates should note that in addition to the Application for Graduation Form, all degree requirements must be completed by the dates published in the academic calendar before any degree will be awarded.

The convocation ceremony is physically accessible for both graduands and their guests.

Diplomas

Diplomas are prepared for students who have completed degree requirements as prescribed by Senate. Diplomas are presented at Convocation to students graduating from a degree program. Degree program graduates who are not able to attend Convocation may request that their diploma be sent to them by mail or picked up. Diplomas and certificates will be held in the Office of the Registrar for five years after the date of graduation.

Diplomas will be designed to indicate the degree name on the first line, the program and/or field of specialization (where applicable) on the second line, and Co-op designation (where applicable) on the third line.

Replacement of Diploma

Graduates may request, with payment of the required fee, a duplicate or reprinted diploma or certificate. A "duplicate copy" of a student's diploma or certificate will be issued 1) when a student requires a second copy of their diploma or certificate; 2) when, on request for a new diploma, the first copy of the diploma is not returned; and 3) when a statutory declaration (stating that the diploma or certificate has been lost, destroyed) is not submitted. A diploma or certificate will be "reissued" (noting the date of reissue) when the first diploma or certificate is returned or a statutory declaration is submitted. The words "duplicate copy" or "reissued" will be affixed to all diplomas and certificates requested in this manner.

APPENDIX 3: EXPERIMENTAL LAB MODULES AT NIAGARA COLLEGE



PURPOSE:

This agreement has been developed by Niagara College and Brock University to allow usage of Niagara college labs (V12, V 12a, V 13, V 13a, V 13b, V 13c, V 14, V 14a, V 14b, V 14c, V 14e, V 14f, V 15) and Photonics personnel at Niagara College up to a maximum of 12 hours per week for a 2-week period during the Spring 2014 term.

TERMS AND CONDITIONS:

- Students must follow rules as stated in the “Student Guidelines and Safety Procedures”.
- Proper safety equipment must be worn at all times within the lab spaces.
- Student list must be provided by Brock University of all students that may use the labs at Niagara College.
- Student transcripts must be provided to Niagara College faculty to prove competency and familiarity of lab equipment.

STUDENT GUIDELINES AND SAFETY PROCEDURES

1. Students are responsible for all tools, equipment and resource materials that they are using. No tools or equipment may be taken from the lab area. Any intentional damage to equipment that is the property of Niagara College will be charged to the student(s) responsible.
2. Safety glasses are required to be worn at all times by the students in the work area of the lab. Any student that does not meet this rule will be asked to leave the lab. This rule does not apply to the classroom area unless specified by the instructor. Students are responsible to supply their own safety glasses. Proper work attire is required in the lab areas at all times.
3. All injuries must be reported immediately to the instructor and a detailed incident report must be completed.
4. For safety reasons, only registered students are permitted in the lab areas. Upon request, students must present student identification.
5. All students are required to have a valid parking permit to park on campus.

May 6, 2013

Dr. Adel Esayed
Chair, School of Technology Studies
Niagara College

Ejaz S. Ahmed
Dean, Faculty of Mathematics and Science
Brock University

Edward Sternin
Chair of Physics
Brock University

Murray Knuttila
Vice-President, Academic
Brock University

Subject: Agreement Brock University / Niagara College
Date: Mon, 25 Mar 2013 10:22:07 -0400
From: Alexander McGlashan <amcglashan@niagaracollege.ca>
To: Thad Harroun <thad.harroun@brocku.ca>
CC: Adel Esayed <aesayed@niagaracollege.ca>, Erica Horton
<ehorton@niagaracollege.ca>, Gayle Breitenbach
<gbreitenbach@niagaracollege.ca>

Hi Thad,

Adel is estimating a cost of \$6300 on the part of the college to run 12 contact hours / wk for two weeks. The students would be accessing the Photonics Labs (Thin Film Lab, Spectroscopy, Photometrics and the Class IV laser lab).

We are currently in the process of trying to put together a memorandum of understanding. Let me know if we need to start framing the details around the actual lab activities for those two weeks.

Thanks,
Alex

Alexander G. McGlashan
Coordinator of Photonics Engineering Technology
Technology Division
Niagara College of Applied Arts & Technology
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Email: amcglashan@niagaracollege.ca

APPENDIX 4 - CURRICULAE VITAE

To follow beginning on p. 101.