University of Toronto

OFFICE OF THE VICE-PRESIDENT AND PROVOST

TO: Committee on Academic Policy and Programs

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DATE: April 28, 2006

AGENDA ITEM: 4

ITEM IDENTIFICATION:
Faculty of Medicine: Medical Radiation Sciences Program curriculum redesign

JURISDICTIONAL INFORMATION:
The Committee of Academic Policy and Programs recommends to Academic Board for approval proposals that involve joint programs with external institutions.

PREVIOUS ACTION TAKEN:

HIGHLIGHTS:
The Faculty of Medicine and The Michener Institute for Applied Health Sciences seek the approval of a major curricular redesign for the joint degree and diploma Medical Radiation Sciences (MRS) Program (attached). The basis for the curriculum redesign is the inclusion of five interprofessional education (IPE) courses, and a clinical preparation course that involves simulated experiential learning for the students enrolled in the MRS Program.

Health professional education programs are committed to producing practitioners with the knowledge skills and attitudes necessary to work in the modern health care environment. The ability to work in collaborative teams comprised of many different health care professionals such as physicians, nurses, and allied health practitioners is now a core fundamental skill. Traditionally, health professional students have not been well prepared by their uni-professional undergraduate didactic and clinical teaching programs to practice in an interprofessional environment. The need for curricular reform is well recognized[1][2] and pervasive among all health professional groups, and supported by the Faculty of Medicine and The Michener.

Interprofessional Education: The MRS Program offers 30 % of its current program in an IPE environment. Courses are taught by physicians, physicists and medical radiation technologists to one, two or a mix of all three medical radiation disciplines. This proposal builds on this existing culture and repurposes existing curriculum more explicitly, and adds content to assist students with developing the communication and collaboration skills necessary to work in IPE teams in the clinical environment. All interprofessional courses will be taught in a collaborative fashion with instructors/facilitators for classes, labs and tutorials coming from a cross-section of the participating programs. Although the development of the content and structure of these courses is not yet complete, the expectation is to involve guest presenters from various groups across the health care continuum from professionals to patients.

[1] Health Professions Education: A Bridge to Quality, a report of the Institute of Medicine of the National Academies, http://www.nap.edu
[2] Romanow Report of the Commission on the Future of Healthcare in Canada http://www.hc-sc.gc.ca/english/care/romanow/index1.html

Clinical Simulation Courses: Another hallmark of health professional education is the acquisition of a defined set of core clinical competencies, or skills. Clinical education has evolved over time from a traditional apprenticeship where students learn by observing and doing, to a more formal education program that has analyzed and deconstructed complex clinical tasks into a sequence of skill building activities. The early sequences can now be moved out of the hospital and into controlled educational environments that simulate the clinical environment without the accompanying risks to patients, and concerns regarding safety. The process of simulating clinical learning is becoming a field of health professional education research, and we have an opportunity to contribute at a both a theoretical and practical level.

Both partners believe the inclusion of interprofessional learning opportunities and the simulated clinical experience will better prepare the students for the clinical environment and provide them with a solid foundation of interprofessional and clinical practice. As is noted in the documentation, admission requirements, overall length of the Program and number of credits required for the conferring of the BSc will not be altered. The learning outcomes for the redesigned program are also the same, only the methods to achieve them have been revised.

The Council of the Faculty of Medicine considered and approved the proposal on March 27, 2006.

FINANCIAL AND/OR PLANNING IMPLICATIONS:
There are no new/additional financial resources required.

RECOMMENDATION:
It is recommended that the Committee on Academic Policies and Programs recommend to the Academic Board for approval:

> THAT the Medical Radiation Sciences Program curriculum redesign, as outlined in the attached documentation dated March 21, 2006, effective for September 2007.

GREAT MINDS FOR A GREAT FUTURE

REVISED Proposal for a Curriculum Redesign for the Medical Radiation Sciences Program

A Joint Program between the Department of Radiation Oncology, University of Toronto and The Michener Institute for Applied Health Sciences

The Department of Radiation Oncology, Faculty of Medicine at the University of Toronto in collaboration with the Michener Institute for Applied Health Sciences seek approval for a curriculum redesign of the established joint three year, second entry BSc (University of Toronto), and Diploma (Michener) in Medical Radiation Sciences. The basis for the curriculum redesign is the inclusion of five interprofessional education (IPE) courses, and a clinical preparation course that involves simulated experiential learning for the students. This redesign of the curriculum will better prepare the students for the clinical environment and provide them with a solid foundation of interprofessional practice.

The redesign of the MRS curriculum will require changes to the placement within the curriculum of some existing courses, redistribution of some content into newly developed courses and the elimination of redundant material in other courses (based on changes in practice). Admission requirements, total student enrollment numbers, overall length of the Program and the number of credits required for the conferring of the BSc will not be altered.

Admission Requirements:

The Medical Radiation Sciences Program is a three-year, eight semester program (total 20 full credits); the entrance eligibility will remain consistent with the current admission requirements of

- a minimum of one year (5 full credits) of university education with a minimum B- average
- within the 5 course credits at least a full course in physics and a full course in biology: a course in mathematics (or statistics for Radiation Therapy only)
- a Grade 12U chemistry for Nuclear Medicine discipline only
- demonstrated facility in the use of the English language[1]

[1] Minimum TOEFL score of 250, TWE of 5.0, plus a successful interview and writing test

Student Enrollment:
The total program enrollment (all three years) will remain unchanged at 130 per year (390 total). The enrollment distribution amongst the disciplines will be consistent with the intended 2006/2007 applicant intake

Year I Enrollment:	06/07	07/08	08/09	09/10
Radiological Technology	40	40	40	40
Nuclear Medicine	40	40	40	40
Radiation Therapy	50	50	50	50
Total:	130	130	130	130

Overall Program Length:
Currently the overall program length is eight semesters with the distribution being
Year I: Fall and winter semester
Year II: Fall, winter and summer semester
Year III: Fall, winter and summer semester

The new proposal will not result in a change to the overall length of the program, it will continue to be eight semesters long; however the semesters will be re-arranged to incorporate the changes to content (see below)
Year I: Fall, winter and summer semester
Year II: Fall, winter and summer semester
Year III: Fall and winter semester

Course Content (Proposed changes):
The following is a summary of the changes that are intended for Year I, II and III of the new curriculum. Please refer to Appendix A and B.
Appendix A - represents the current curriculum for the Medical Radiation Sciences Program
Appendix B - represents the proposed redesigned curriculum for the Medical Radiation Sciences Program

YEAR I: Currently the first year after entry into the Program consists of two semesters (September to April); the new curriculum proposes that Year I consists of three semesters (continuous enrollment from September to August). The fall and winter semesters will still include basic medical science and discipline-specific courses, however one IPE course will be added to each of the semesters. The first IPE course will focus on communication within the health care environment, whilst the second IPE course will concentrate on professionalism issues within the clinical milieu. The summer semester, which in the present curriculum is not utilized, will now consist of a clinical practicum of eight-weeks in length and a Selective Course. This clinical practicum will allow us to align all MRS disciplines; the Nuclear medicine discipline currently does not have a provision for students to go out into the clinical environment within Year I.

Year II: Currently consists of three semesters and this will remain in the proposed curriculum. Course content for the fall and winter semesters will remain primarily discipline-specific, with an IPE course being incorporated into each of the semesters: one being research based (which will replace the Research Methods I in the current curriculum), and a course in Collaborative Patient Centered Care. Several new courses will be developed that will allow the MRS Program to respond to the changes in medical imaging and radiation therapy practice. The fifth IPE course will be included in the summer semester of Year II and will address Leadership in Health Care. Currently this semester is the first Clinical Practicum for all three disciplines this will be replaced by Clinical Simulation where the outcome of the course will be the preparation of students for the clinical environment through interprofessional and discipline specific experiential learning and evaluation. The students will also complete a Selective during this semester.

Year III: In the previous curriculum there was continuous enrollment from September to August (three semesters). The proposed curriculum will now have two semesters, which will be clinical practicum semesters (fall and winter). The current Research Methods II Course will remain a Selective in this final year limited to those students who have demonstrated potential for successful engagement in an independent research initiative. Students who do not choose the Research Course will complete one project course with associated written paper and oral presentation (fall semester) and one Selective (winter semester).

Generally speaking the majority of Program content will remain the same but may be redistributed amongst the different courses; some content has been added/eliminated to reflect changes in practice. This will require the development of new courses and new course codes. In the current curriculum students are required to take Selectives in the final semester in order to meet the BSc/Diploma requirements of the Program. The redesigned curriculum allows the students to take Selective Courses throughout the duration of the Program. The extensive range of Selective Courses that have been developed for the current curriculum will be available for the students and this still provides our graduates with a distinct professional advantage, by increasing the flexibility and wider choice for program content. Based on feedback from the students, utilizing the summer semester of Year I, allows the students to access the national licensing examination 4 months earlier than the present curriculum and will result in earlier graduation and employment compared to the existing program.

Course Descriptions

Brief descriptions of the courses (both existing and courses to be developed) in the UT/Michener Medical Radiation Sciences Program can be found in Appendix C. The descriptions also indicate the distribution of the credit assignment between the two institutions.

Recruitment/Advertisement Materials

The Department of Radiation Oncology, Faculty of Medicine who assumed academic oversight of the MRS Program in 2001, and the Michener are working collaboratively to implement these curriculum changes for enrolment in September 2007. The recruitment cycle for the intake of September 2007 begins in September 2006 and all appropriate recruitment materials and advertisements will reflect the curriculum change, including

the Medical Radiation Sciences Program website hosted by Michener. Program faculty and the Associate Registrar will ensure that applicants for 2007 are made explicitly aware of the curriculum, prior to registration into the MRS Program.

Overlap of the Current and the Proposed Curriculum

Students who are already enrolled in the Program and those entering in September 2006 will be able to complete their degree under the current curriculum subject to their maintaining the appropriate level of academic standing. If, however, certain situations arise that warrant a modification to a student's course of study or students wish to access a selective course during the Year I summer semester, the Program intends to address this in the following manner,

1. Students who entered the Program in Fall 2004 are due to graduate in the summer of 2007
    a. Students who have extensions/modifications made to their clinical practica will complete the clinical and Selectives semester under the current curriculum
    b. Students have the option to apply for two full credits (or four half credits), per academic year, through the advanced standing policy which can be applied to the summer semester if they wish

2. Students who entered the Program in Fall 2005 are due to graduate in the summer of 2008
    a. Students who have taken a leave of absence from Year I will re-enter into the Program in the Fall of 2006 under the current curriculum
    b. Students who take a leave of absence in the Fall 2006 (Year II), will re-enter into the Program in the Fall 2007 (Year II) under the current curriculum
    c. Students who have extensions/modifications made to their clinical practica (Year III) will complete the clinical and Selectives semester under the current curriculum
    d. Students have the option to apply for two full credits (or four half credits), per academic year, through the advanced standing policy summer semester if they wish
    e. The Program will investigate offering selectives courses during the summer 2007 semester

3. Students who enter the Program in Fall 2006 are due to graduate in the summer of 2009
    a. Students who take a leave of absence from Year I will re-enter into the Program in the Fall of 2007 under the proposed curriculum
    b. Students who take a leave of absence in the fall/winter semester (Year II) will be provided with a custom made Program based on the courses that have been successfully completed already, upon their return in Fall 2008. This plan of action is deemed to be the least financially burdensome for the student (yearly fees are due in September every year). In four graduating years there has less than 0.5% (n=9) students who have taken a leave-of-absence in the second year.

c. Students who have extensions/modifications made to their clinical practica (Year III) will complete the clinical and Selectives semester under the current curriculum
d. Students have the option to apply for two full credits (or four half credits), per academic year, through the advanced standing policy summer semester if they wish
e. The Program will investigate offering selectives courses during the summer 2007 semester

Supporting Attachments:

Appendix A: Current Curriculum
Appendix B: Proposed Curriculum
Appendix C: Course Descriptions
A – Radiological Technology
B – Nuclear Medicine
C - Radiation Therapy
Appendix D: Impact Report
Appendix E: Student Report

BSc/Diploma in MEDICAL RADIATION SCIENCES

A Joint Program between the Department of Radiation Oncology University of Toronto and The Michener Institute for Applied Health Sciences

Appendix A: Current Curriculum

Current Curriculum	Term 1 Year 2	Term 2 Year 2	Term 3 Year 2	Term 1 Year 3	Term 2 Year 3	Term 3 Year 3	Term 1 Year 4	Term 2 Year 4	Term 3 Year 4
Radiological Technology	Anatomy (MRS161H1) Radiation Sciences I (MRS165H1) Radiographic Methodology I (MRS101H1) Human Osteology (MRS102H1) Fundamental of Patient care (MRS103H1)	Physiology (MRS162H1) Relational Anatomy (MRS164H1) Radiographic Methodology II (MRS104H1) Imaging Modalities I (MRS105H1) Intro to Clinical Radiological Technology (MRS106H1)	Off	Selective I Pathobiology (MRS168H1) Clinical Behavioural Sciences I (MRS163H1) Imaging Modalities II (MRS107H1) Systems Methodology (MRS108H1)	Research Methods I (MRS169H1) Clinical Behavioural Sciences II (MRS174H1) Comparative Imaging Modalities (MRS167H1) Intro to Pharmacology (MRS109H1) Instrumentation/Digital Imaging (MRS110H1)	Clinical Pract I (MRS111H1) Health Care Systems (MRS175H1)	Clinical Pract II (MRS112H1) Clinical Project I (MRS176H1) Or Research Methods II (MRS180Y1)	Clinical Pract III (MRS113H1) Clinical Project II (MRS177H1) Or Research Methods II (MRS180Y1)	Selective II-VI Research Methods II (MRS180Y1)
Nuclear Medicine	Anatomy (MRS161H1) Radiation Sciences I (MRS165H1) Radiopharmacy (MRS121Y1) Instrumentation I (MRS122H1) Clinical Behavioural Sciences I (MRS163H1)	Physiology (MRS162H1) Relational Anatomy (MRS164H1) Radiopharmacy (MRS121Y1) Instrumentation II (MRS123H1) Intro to Pharmacology (MRS166H1)	Off	Selective I Pathobiology (MRS168H1) NM Imaging Theory I (MRS125H1) NM Health Care Delivery (MRS128H1) NM Imaging Application I (MRS124H1)	Research Methods I (MRS169H1) Clinical Behavioural Sciences II (MRS174H1) Comparative Imaging Modalities (MRS167H1) NM Imaging Theory II (MRS127H1) NM Imaging Application II (MRS126H1)	Clinical Pract I (MRS129H1) Health Care Systems (MRS175H1)	Clinical Pract II (MRS130H1) Clinical Project I (MRS176H1) Or Research Methods II (MRS180Y1)	Clinical Pract III (MRS131H1) Clinical Project II (MRS177H1) Or Research Methods II (MRS180Y1)	Selective II-VI Research Methods II (MRS180Y1)
Radiation Therapy	Anatomy (MRS161H1) Clinical Behavioural Sciences I (MRS163H1) Intro to Radiation Physics (MRS142H1) Radiobiology (MRS143H1) Intro to Patient care in Radiation Therapy (MRS 141H1)	Physiology (MRS162H1) Relational Anatomy (MRS164H1) Introduction to Clinical Oncology I (MRS144H1) Beams and Interactions (MRS 145H1) Comparative Imaging Modalities (MRS167H1)	Off	Selective I Pathobiology (MRS168H1) Treatment planning (MRS148Y1) Clinical Oncology I (MRS146H1) Patient Care in Radiation Therapy II (MRS147H1) Radiotherapy Methodology (MRS149H1)	Research Methods I (MRS169H1) Clinical Behavioural Sciences II (MRS174H1) Treatment planning (MRS148Y1) Clinical Oncology II (MRS150H1) Radiotherapy Methodology (MRS149H1)	Clinical Pract I (MRS151H1) Health Care Systems (MRS175H1)	Clinical Pract II (MRS152H1) Clinical Project I (MRS176H1) Or Research Methods II (MRS180Y1)	Clinical Pract III (MRS153H1) Clinical Project I I (MRS177H1) Or Research Methods II (MRS180Y1)	Selective II-VI Research Methods II (MRS180Y1)

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Appendix B: Proposed Curriculum

New Curriculum	Term 1 Year 2	Term 2 Year 2	Term 3 Year 2	Term 1 Year 3	Term 2 Year 3	Term 3 Year 3 Clinical Preparation	Term 1 Year 4	Term 2 Year 4	credits
Radiological Technology	IPE - Foundations of Interprofessional Collaboration I	IPE- Foundations of Interprofessional Collaboration II		**IPE – Interprofessional Research**	IPE – Collaborative Patient Centered Care	IPE – Leadership in Health Care			2.5
	Patient Care – Lab (0.25)	Patient Care – Lab (0.25)		PC DS – Lab (0.25)	PC DS – Lab (0.25)				1.0
	Anatomy (MRS161H1) Radiation Sciences I (MRS165H1) Human Osteology (MRS102H1) Instrumentation I (new code required) (2.0)	**Physiology (MRS162H1)** Relational Anatomy (MRS164H1) Radiographic Methodology I (MRS101H1) Instrumentation II (new code required (2.0)	Clinical Practicum I (8 weeks) (1.0) Selective I (0.5) (1.5)	Radiographic Methodology II (MRS104H1) **Intro to Pharmacology (MRS109H1)** Instrumentation III – CT (new code required) Imaging Pathology (new code required (2.0)	**Clinical Behavioural Sciences I (MRS163H1)** Systems Methodology (MRS108H1) Instrumentation IV (new code required) Computed Tomography Methodology (new code required) (2.0)	Interprofessional Collaborative Clinical Simulation – (1.0) IPEPS – Labs (0.5) Selective II (0.5) (2.0)	Clinical Practicum II Research Methods II OR Clinical Project (2.5)	Clinical Practicum III Research Methods II OR Selective III (2.5)	16.5 **20 total**
Nuclear Medicine	IPE- Foundations of Interprofessional Collaboration I	IPE - Foundations of Interprofessional Collaboration II		**IPE - Interprofessional Research**	IPE - Collaborative Patient Centered Care	IPE – Leadership in Health Care			2.5
	Patient Care – Lab (0.25)	Patient Care – Lab (0.25)		PC DS – Lab (0.25)	PC DS – Lab (0.25)				1.0
	Anatomy (MRS161H1) Radiation Sciences I (MRS165H1) Instrumentation I (MRS122H1) Radiopharmacy (MRS121Y1) (2.0)	**Physiology (MRS162H1)** Relational Anatomy (MRS164H1) Instrumentation II (MRS123H1) Fundamentals of Nuclear Medicine (new code required) (2.0)	Clinical Practicum I (8 weeks) (1.0) Selective I (0.5) (1.5)	Nuclear Medicine Methodology I (new code required) Methodology II (new code required) **Intro to Pharmacology (MRS166H1)** Instrumentation III – CT (new code required) (2.0)	**Clinical Behavioural Sciences I (MRS163H1)** Methodology III (new code required) Methodology IV (new code required) Current Topics in Nuclear Medicine and Molecular Imaging (new code required) (2.0)	Interprofessional Collaborative Clinical Simulation – (1.0) IPEPS – Labs (0.5) Selective II (0.5) (2.0)	Clinical Practicum II Research Methods II OR Clinical Project (2.5)	Clinical Practicum III Research Methods II OR Selective III (2.5)	16.5 **20 total**

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Appendix B: Proposed Curriculum

New Curriculum	Term 1 Year 2	Term 2 Year 2	Term 3 Year 2	Term 1 Year 3	Term 2 Year 3	Term 3 Year 3 Clinical Preparation	Term 1 Year 4	Term 2 Year 4	credits
Radiological Technology	IPE - Foundations of Interprofessional Collaboration I	IPE- Foundations of Interprofessional Collaboration II		IPE – Interprofessional Research	IPE – Collaborative Patient Centered Care	IPE – Leadership in Health Care			2.5
	Patient Care – Lab (0.25)	Patient Care – Lab (0.25)		PC DS – Lab (0.25)	PC DS – Lab (0.25)				1.0
	Anatomy (MRS161H1) Radiation Sciences I (MRS165H1) Human Osteology (MRS102H1) Instrumentation I (new code required) (2.0)	Physiology (MRS162H1) Relational Anatomy (MRS164H1) Radiographic Methodology I (MRS101H1) Instrumentation II (new code required (2.0)	Clinical Practicum I (8 weeks) (1.0) Selective I (0.5) (1.5)	Radiographic Methodology II (MRS104H1) Intro to Pharmacology (MRS109H1) Instrumentation III – CT (new code required) Imaging Pathology (new code required (2.0)	Clinical Behavioural Sciences I (MRS163H1) Systems Methodology (MRS108H1) Instrumentation IV (new code required) Computed Tomography Methodology (new code required) (2.0)	Interprofessional Collaborative Clinical Simulation – (1.0) IPEPS – Labs (0.5) Selective II (0.5) (2.0)	Clinical Practicum II Research Methods II OR Clinical Project (2.5)	Clinical Practicum III Research Methods II OR Selective III (2.5)	16.5 **20 total**
Nuclear Medicine	IPE- Foundations of Interprofessional Collaboration I	IPE - Foundations of Interprofessional Collaboration II		IPE - Interprofessional Research	IPE - Collaborative Patient Centered Care	IPE – Leadership in Health Care			2.5
	Patient Care – Lab (0.25)	Patient Care – Lab (0.25)		PC DS – Lab (0.25)	PC DS – Lab (0.25)				1.0
	Anatomy (MRS161H1) Radiation Sciences I (MRS165H1) Instrumentation I (MRS122H1) Radiopharmacy (MRS121Y1) (2.0)	Physiology (MRS162H1) Relational Anatomy (MRS164H1) Instrumentation II (MRS123H1) Fundamentals of Nuclear Medicine (new code required) (2.0)	Clinical Practicum I (8 weeks) (1.0) Selective I (0.5) (1.5)	Nuclear Medicine Methodology I (new code required) Methodology II (new code required) Intro to Pharmacology (MRS166H1) Instrumentation III – CT (new code required) (2.0)	Clinical Behavioural Sciences I (MRS163H1) Methodology III (new code required) Methodology IV (new code required) Current Topics in Nuclear Medicine and Molecular Imaging (new code required) (2.0)	Interprofessional Collaborative Clinical Simulation – (1.0) IPEPS – Labs (0.5) Selective II (0.5) (2.0)	Clinical Practicum II Research Methods II OR Clinical Project (2.5)	Clinical Practicum III Research Methods II OR Selective III (2.5)	16.5 **20 total**

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APPENDIX C

BSc/Diploma Program: Course Descriptions

Students must complete 20 credits to obtain the BSc and Diploma in Medical Radiation Sciences.

A. Radiological Technology

YEAR I

UNIVERSITY OF TORONTO COURSES *(total 2.5 credit)*

Anatomy (0.5 credit) This course is designed to serve as the foundation in Human Anatomy for students in the Medical Radiation Sciences program. The course will introduce students to the anatomy of the human body. The course will follow a systematic structure covering all of the principal functional systems within the body. This approach will examine structures from the microscopic level to the gross anatomical level and will heavily integrate structure with function. Important diseases and disorders pertaining to specific systems will also be discussed. The course precedes Human Physiology (MRS162H1/PSRD120) giving students a comprehensive anatomical background before the detailed function of these systems is addressed in the Physiology course; it will also serve to prepare students for MRS164H1/ANRD120 (Relational Anatomy). This course is taught by faculty from the *Department of Radiation and Oncology* and from the *Division of Anatomy Department of Surgery*.

Physiology (0.5 credits) This course is designed to serve as the foundation in Human Physiology for students in the Medical Radiation Sciences program and will introduce students to the function of the organ systems that comprise the human body. The course will follow a systematic structure covering all of the principal functional systems within the body, such as the cardiovascular and respiratory systems. As such students are expected to be familiar with the anatomical structure of these systems. Clinical examples will be used to illustrate key principles and material where possible.

Clinical Practicum I (1.0 credit) This course is an 8-week intensive hospital-based semester during which students apply the knowledge and skills gained through the previous two semesters. Students will familiarize themselves with their future roles as Radiological Technologists as well as gain an enhanced understanding of the significance of collaborative practice in the clinical setting. Some assessment of clinical competence will occur during this course.

Selective 1 (0.5 credit) *The Departments of Radiation Oncology and Medical Imaging* will deliver selective courses with the purpose of providing graduates of the Medical Radiation Sciences Program with expertise in specialized fields of practices such as MRI, PET, Health Education, Specialized Radiation Therapy Methods, Computer-assisted Image Analysis, and more. These selectives are required for partial fulfillment of further specialization in these professional fields, e.g., MRI technology.

THE MICHENER INSTITUTE COURSES *(total of 4.5 credits)*

Relational Anatomy (0.5 credit) The Relational Anatomy course investigates the gross, cross-sectional and relational anatomy and reviews the physiology and the associated lymphatic systems of the head, central nervous system, neck, spine, thorax, abdomen, male / female pelvis, upper / lower extremities as well as muscles, vessels and the lymphatic system. The study of cross sectional and relational anatomy is applied so that the student will be able to recognize the different scanning planes (sagittal, axial & coronal) and be able to identify the organs or structures seen on CT and MRI cross sectional images. The students will learn the skill of describing anatomy in relation to surrounding structures and organs using medical terminology.

Radiation Sciences I (0.5 credit) (Radiological and Nuclear Medicine Technology students) This course encompasses the study of the nature of radiation and provides a current and thorough overview of the effects of radiation on biological systems. The physics and biological effects of radiation are introduced, as they are relevant to both Radiological and Nuclear Medicine Technology students. The scope of this course includes studying the fundamentals of radiation physics and radiation biology, in addition to providing a general knowledge of the different types of radiation and their various interactions with matter. The course examines the biological response to radiation in depth, ranging from the cellular level to whole body response. The pillars of radiation protection and safety are also covered.

Radiological Instrumentation 1 (0.5 credit) This course presents a broad theoretical framework for understanding the principles of X-ray imaging equipment and lays the groundwork necessary for the practical aspects of equipment use. Laboratory sessions reinforce lecture content through problem-solving exercises.

Radiological Instrumentation II (0.5 credit) This course introduces the student to the fundamental principles of radiographic imaging. Topics include creating, processing and analyzing the image.

Human Osteology (0.5 credit) - A comprehensive review of osteology with emphasis on practical application to radiography of the normal axial and appendicular skeleton.

Radiographic Methodology I (0.5 credit) This course allows students to obtain basic knowledge of radiation protection, image quality/assessment, and radiographic positioning necessary to perform radiographic studies. This course will focus on imaging of the appendicular skeleton.

Foundations of Interprofessional Collaboration I (0.5 credit) This course will help learners to understand the development and utility of teams within an interprofessional environment. Learners will develop skills for effective verbal, nonverbal, and written communication; effective information gathering/listening skills, as well as communication skills for identifying and resolving conflict will be presented.

Foundations of Interprofessional Collaboration II (0.5 credit) This course will encompass the theories and principles of professionalism as they pertain to health care practice, interprofessional collaboration, ethics, and reflective practice. Learners will explore the development of the professional identity and professional socialization, issues of professional hierarchy and their implications on team-based care, and the role of reflection in personal and professional development.

Patient Care Lab I (0.25 credit) **and II** (0.25 credit) These laboratory-based courses will introduce learners to medical terminology as well as basic patient care skills such as body mechanics and safe methods of transfer patients, infection control and isolation procedures, and oxygen therapy. These labs will require demonstration of communication skills and professionalism in preparing the student for the clinical environment.

YEAR II

UNIVERSITY OF TORONTO COURSES *(total 2.0 credits)*

Introduction to Pharmacology (0.5 credit) (Radiological and Nuclear Medicine Technology) Provided by the *Department of Pharmacology*, this course is an overview of pharmacology, which integrates with physiology. The course is divided into two sections. The first section is common to both Nuclear Medicine Technology and Radiological Technology; the second section is program specific and consists of hands-on learning sessions. The course begins with a presentation of the general principles of pharmacology and is followed by the study of the pharmacology of drug groups related to nuclear medicine and radiology interventional procedures.

Clinical Behavioural Science (0.5 credit). This course has been developed by the *Department of Public Health Sciences (Division of Behavioral Science).* This course provides an overview of the ethical, societal and personal factors that influence and impact health care services. The role of the health care provider and the dynamics of the provider/patient relationship will be examined from a critical perspective. Through an interprofessional education session students will explore alternate models of healthcare provision. This course will combine theory and practical application, allowing the student to reflect on his or her own values and beliefs through case studies, reading and discussion.

Selective II (0.5 credit) The *Departments of Radiation Oncology and Medical Imaging* will provide students with selective courses relevant to the field of Medical Radiation Sciences. MRI, PET, Health Education, Specialized Radiation Therapy Methods, and Computer-assisted Image Analysis are examples of current course offerings. Students may also seek courses at the University of Toronto as an alternative.

Interprofessional Research (0.5 credit) This course offers and examination of models and contemporary issues relevant to interprofessional education and research as applied in health care and education settings. The course uses conceptual framework for articulating applied practice

and research. Learners will engage in multiple education modalities for the purpose of obtaining competence in distinguishing high quality research, writing a literature review, and completing a research proposal. Research directions for interprofessional education and practice will be articulated in light of existing literature and identified needs for the construction of future knowledge.

THE MICHENER INSTITUTE COURSES *(total of 6.0 credits)*

Radiographic Methodology II (0.5 credit) This course will focus on the radiographic positioning and imaging of the axial skeleton. Continued attention to radiation protection and development of imaging assessment skills will support the acquisition of required competencies in radiographic practice. Through problem-based learning students will be able to further hone their critical thinking skills necessary for the clinical environment.

Radiological Instrumentation III (0.5 credit) This is a collaborative course for students in Nuclear Medicine, Radiological Technology, and Radiation Therapy. Students will be provided with an overview of computed tomography including an introduction to the basics of computed tomography equipment, image formation and display, and terminology. Students will learn about the clinical application of computed tomography as well as radiation safety issues relevant to the use of this modality.

Radiological Instrumentation IV (0.5 credit) Principles of quality control and continuous quality improvement applicable to diagnostic imaging will be presented and explored using practical examples drawn from legislative requirements and radiological practice.

Radiological Methodology III (0.5 credit) This course is a study in radiographic and fluoroscopic imaging of the body systems. Systems Methodology will focus on the importance and application of contrast media to visualize the body systems. This course will enhance the fundamental knowledge and skills in safe X-radiation practices, patient care skills and image assessment acquired in Radiographic Methodology I and II.

Radiographic Methodology IV (0.5 credit) This course will review key computed tomography (CT) concepts and explore the significance of CT procedures and protocols used to visualize human anatomy. Students will learn how to set-up and manipulate protocols as well as how to reconstruct acquired image data in preparation for diagnostic reporting.

Imaging Pathology (0.5 credit) This course introduces the student to basic disease processes of the respiratory, cardiovascular, gastrointestinal, genitourinary, central nervous, and musculoskeletal systems. Emphasis is placed upon identifying the effects of pathological conditions upon radiographic image appearances.

Collaborative Patient Centred Care (0.5 credit) This course will explore the role of collaboration in the provision of patient-centred care. Learners will work collaboratively as members of a patient care team to develop and provide a holistic approach to decision making,

patient care, and patient education using scenario-based cases, role-playing, standardized-patients, etc.

Patient Care Lab III (0.25 credit) **and IV** (0.25 credit) These laboratory-based courses will build upon the skills the students have already acquired in Patient Care Labs I and II. Students will participate in sessions dealing with issues such as documentation, acute situation management, and ethic-legal responsibilities as well practical skills such as portable/trauma imaging. These labs will require demonstration of communication skills and professionalism in preparing the student for the clinical environment.

Leadership in Health Care (0.5 credit) This course is designed to provide students with experiential learning opportunities to develop leadership skills through participation in interprofessional health care teams. The learner will be provided with a broad overview of current theories, principles, and perspectives on the role of leadership in the interprofessional environment; students will glean valuable knowledge that will contribute to and enhance their understanding of the multiple dimensions of leadership.

Interprofessional Collaborative Clinical Simulation (1.0 credit) This course will provide learners with the opportunity to further their knowledge of the roles, responsibilities, and rights of the many players involved in health care provision. Learners will explore health care issues relevant to clinical practice from a multi-professional perspective, as they will be working in interprofessional teams. A variety of educational models and tools including problem-based learning, scenarios, and role-playing within simulated health care environment will be encountered during this course. For students of the Medical Radiation Science Program, this course will also incorporate a large component of the content previously taught in Comparative Imaging Modalities (MRS167H1).

Radiological Technology Simulation (0.5 credit) This 13-week course is designed to prepare the learner for entry into the clinical environment of the medical imaging department, as part of the clinical component of his/her program. Through simulation of the clinical environment, the learner will have the opportunity to integrate and apply his/her knowledge, skills, and behaviours to clinical case scenarios. Ultimately the learner must demonstrate the requisite level of performance in order to proceed into the clinical environment. Competency will be assessed in some aspects of performance.

YEAR III

In Year III, students must complete Clinical Practicum I & II as well as *one* of the following choices:

(A) Research Methods II (1.0 credit)
OR
(B) Clinical Project Course (0.5 credit) and Selective III (0.5 credit)

UNIVERSITY OF TORONTO COURSES *(total 4.5 or 5.0 credits)*

Research Methods II (1.0 credits). For students who are interested in pursuing graduate studies and an academic career in Medical Radiation Sciences, this course allows the completion of a novel research project under close supervision by a faculty member in the *Department of Radiation Oncology, Medical Imaging or another Department in the Faculty of Medicine*. The completion of a research project will require the writing and presentation of a scientific paper to a group of expert faculty. Students will be encouraged to complete work of publishable quality.

Clinical Practicum II (2.0 credits) One full semester of clinical practice in a radiological technology teaching centre with assessment of clinical competence.

Clinical Practicum III (2.0 credits) One full semester of clinical practice in a radiological technology teaching centre with assessment of clinical competence.

Selective III (0.5 credit) The *Departments of Radiation Oncology and Medical Imaging* will provide students with selective courses relevant to the field of Medical Radiation Sciences. MRI, PET, Health Education, Specialized Radiation Therapy Methods, and Computer-assisted Image Analysis are examples of current course offerings. Students may also seek courses at the University of Toronto as an alternative.

THE MICHENER INSTITUTE COURSES *(total 0.5 credits)*

Clinical Project Course (0.5 credit). This course consists of a written and oral presentation of a scholarly study of an aspect of radiation science as it applies to the specific professional stream of the student. The project will be conducted generally within the context of clinical training, utilizing the resources and technical expertise of faculty and professionals in the clinical teaching environment; a faculty mentor will supervise the written and oral presentation components. This course will require creativity, self-directed learning, writing and presentation skills that will be developed in the previous years of study.

U of T total of 10.0 credits and TMI a total of 10.0 credits = 20 credits (Year 4, Option A)
OR
U of T total of 9.5 credits and TMI a total of 10.5 credits = 20 credits (Year 4, Option B)

APPENDIX C

BSc/Diploma Program: Course Descriptions

Students must complete 20 credits to obtain the BSc and Diploma in Medical Radiation Sciences.

B. Nuclear Medicine Technology

YEAR I

UNIVERSITY OF TORONTO COURSES *(total 2.5 credits)*

Anatomy (0.5 credit) This course is designed to serve as the foundation in Human Anatomy for students in the Medical Radiation Sciences program. The course will introduce students to the anatomy of the human body. The course will follow a systematic structure covering all of the principal functional systems within the body. This approach will examine structures from the microscopic level to the gross anatomical level and will heavily integrate structure with function. Important diseases and disorders pertaining to specific systems will also be discussed. The course precedes Human Physiology (MRS162H1/PSRD120) giving students a comprehensive anatomical background before the detailed function of these systems is addressed in the Physiology course; it will also serve to prepare students for MRS164H1/ANRD120 (Relational Anatomy). This course is taught by faculty from the *Department of Radiation and Oncology* and from the *Division of Anatomy Department of Surgery*.

Physiology (0.5 credits) This course is designed to serve as the foundation in Human Physiology for students in the Medical Radiation Sciences program and will introduce students to the function of the organ systems that comprise the human body. The course will follow a systematic structure covering all of the principal functional systems within the body, such as the cardiovascular and respiratory systems. As such students are expected to be familiar with the anatomical structure of these systems. Clinical examples will be used to illustrate key principles and material where possible.

Clinical Practicum I (1.0 credit) This course is an 8-week intensive hospital-based semester during which students apply the knowledge and skills gained through the previous two semesters. Students will familiarize themselves with their future roles as Nuclear Medicine Technologists as well as gain an enhanced understanding of the significance of collaborative practice in the clinical setting. Some assessment of clinical competence will occur during this course.

Selective 1 (0.5 credit) *The Departments of Radiation Oncology and Medical Imaging* will deliver selective courses with the purpose of providing graduates of the Medical Radiation Sciences Program with expertise in specialized fields of practices such as MRI, PET, Health Education, Specialized Radiation Therapy Methods, Computer-assisted Image Analysis, and

more. These selectives are required for partial fulfillment of further specialization in these professional fields, e.g., MRI technology.

THE MICHENER INSTITUTE COURSES *(total of 4.5 credits)*

Relational Anatomy (0.5 credit) The Relational Anatomy course investigates the gross, cross-sectional and relational anatomy and reviews the physiology and the associated lymphatic systems of the head, central nervous system, neck, spine, thorax, abdomen, male / female pelvis, upper / lower extremities as well as muscles, vessels and the lymphatic system. The study of cross sectional and relational anatomy is applied so that the student will be able to recognize the different scanning planes (sagittal, axial & coronal) and be able to identify the organs or structures seen on CT and MRI cross sectional images. The students will learn the skill of describing anatomy in relation to surrounding structures and organs using medical terminology.

Radiation Science I (0.5 credit) This course encompasses the study of the nature of radiation and provides a current and thorough overview of the effects of radiation on biologic systems. The physics and biological effects of radiation are introduced, as they are relevant to both Radiological and Nuclear Medicine Technology students. The scope of this course includes studying the fundamentals of Radiation Physics and Radiation Biology, in addition to providing a general knowledge of the different types of radiation and their various interactions with matter. The course examines the biological response to radiation in depth, ranging from the cellular level to whole body response. The pillars of Radiation Protection and Safety are also introduced.

Fundamentals of Nuclear Medicine (0.5 credit) This course will introduce learners to the principles of nuclear medicine imaging, the role of nuclear medicine in therapy, and the physiological, biochemical and pathobiological rational for using radionuclides to evaluate the function of the musculoskeletal system. Through focusing on the technical aspects of bone scanning students will begin to explore the principles of flow, blood pooling, and delayed scanning. During the laboratory sessions students acquire the technical skills necessary to perform these procedures in a safe and efficient manner, helping to prepare learners for their upcoming clinical practicum.

Radiopharmacy (0.5 credit) This course encompasses the two broad domains of radiopharmacy and radiation safety. The course emphasizes the acquisition of the knowledge, skills, and judgment essential for the practice of both of these aspects of nuclear medicine technology. Topics include the methods of administration, pharmacokinetics/biodistribution, mechanisms of localization and the routes of elimination of commonly used radiopharmaceuticals. Radiation safety practices and monitoring are emphasized throughout this course. Canadian regulations and guidelines governing the safe handling of radionuclides and the preparation of radiopharmaceuticals are studied and applied. The student has the opportunity to perform and evaluate the results of quality control procedures on these imaging agents as well as on pertinent radiopharmacy equipment. After a discussion of general radiopharmaceutical design, the properties of an ideal radiopharmaceutical are assessed. The principles of co-ordination chemistry, technetium, iodine, and fluorine chemistry, and colloid chemistry are applied to a consideration of radiolabelling techniques.

Nuclear Medicine Instrumentation I (0.5 credit) **and II** (0.5 credit) Theory and practice of radiation detection in nuclear medicine: physics, component parts, electronics and circuitry, quality control and statistical analysis of output from radiation detectors including well counters, hand-held meters, gamma and PET cameras. Laboratory experience with planar and SPECT gamma cameras. Typical hardware and software of computers used in nuclear medicine. Laboratory exercises in image acquisition, display and analysis. An introduction to PACS and its relevance to Nuclear Medicine will also be included. Students will be introduced to the Group Imaging Project during this course.

Foundations of Interprofessional Collaboration I (0.5 credit) This course will help learners to understand the development and utility of teams within an interprofessional environment. Learners will develop skills for effective verbal, nonverbal, and written communication; effective information gathering/listening skills, as well as communication skills for identifying and resolving conflict will be presented.

Foundations of Interprofessional Collaboration II (0.5 credit) This course will encompass the theories and principles of professionalism as they pertain to health care practice, interprofessional collaboration, ethics, and reflective practice. Learners will explore the development of the professional identity and professional socialization, issues of professional hierarchy and their implications on team-based care, and the role of reflection in personal and professional development.

Patient Care Lab I (0.25 credit) This laboratory-based course will introduce learners to some of the basic skills in patient care such as measuring vital signs, how to safely move/transfer patients, etc.

Patient Care Lab II (0.25 credit) This laboratory-based course is a continuation of Patient Care Lab I and will introduce learners to some of the discipline specific patient care skills necessary for clinical practice

YEAR II

UNIVERSITY OF TORONTO COURSES *(total 2.0 credits)*

Introduction to Pharmacology (0.5 credit) (Radiological and Nuclear Medicine Technology) Provided by the *Department of Pharmacology*, this course is an overview of pharmacology which integrates with physiology. The course is divided into two sections. The first section is common to both Nuclear Medicine Technology and Radiological Technology; the second section is program specific and consists of hands-on learning sessions. The course begins with a presentation of the general principles of pharmacology and is followed by the study of the pharmacology of drug groups related to nuclear medicine and radiology interventional procedures.

Clinical Behavioural Science (0.5 credit). This course has been developed by the *Department of Public Health Sciences (Division of Behavioral Science)*This course provides an overview of the

ethical, societal and personal factors that influence and impact health care services. The role of the health care provider and the dynamics of the provider/patient relationship will be examined from a critical perspective. Through an interprofessional education session students will explore alternate models of healthcare provision. This course will combine theory and practical application, allowing the student to reflect on his or her own values and beliefs through case studies, reading and discussion.

Interprofessional Research (0.5 credit) This course offers and examination of models and contemporary issues relevant to interprofessional education and research as applied in health care and education settings. The course uses conceptual framework for articulating applied practice and research. Learners will engage in multiple education modalities for the purpose of obtaining competence in distinguishing high quality research, writing a literature review, and completing a research proposal. Research directions for interprofessional education and practice will be articulated in light of existing literature and identified needs for the construction of future knowledge.

Selective II (0.5 credit) The *Departments of Radiation Oncology and Medical Imaging* will provide students with selective courses relevant to the field of Medical Radiation Sciences. MRI, PET, Health Education, Specialized Radiation Therapy Methods, and Computer-assisted Image Analysis are examples of current course offerings. Students may also seek courses at the University of Toronto as an alternative.

THE MICHENER INSTITUTE COURSES ***(total of 6.0 credits)***

Nuclear Medicine Methodology I (0.5 credit) **and II** (0.5 credit) - Theory underlying assessment of function using *in vivo* and *in vitro* nuclear medicine procedures including SPECT and PET imaging. These courses cover the physiological, biochemical and pathobiological rational for using radionuclides to evaluate the function of the following systems: gastrointestinal, genitourinary, and cardiovascular. The courses also cover a number of specialized aspects of nuclear medicine methodology, including 12-lead electrocardiography, in vivo non-imaging studies, and applications to oncology, pediatrics, and geriatrics. The laboratory components deal with the practical skills required for these assessments.

Nuclear Medicine Methodology III (0.5 credit) **and IV** (0.5 credit) - Theory underlying assessment of function using *in vivo* and *in vitro* nuclear medicine procedures including SPECT and PET imaging. These courses cover the physiological, biochemical and pathobiological rational for using radionuclides to evaluate the function of the following systems: respiratory, central nervous, endocrine, haematopoietic, and reticulendothelial. Clinical applications to oncology, pediatrics, and geriatrics for the aforementioned systems will also be explored. The laboratory components deal with the practical skills required for these assessments.

Nuclear Medicine Instrumentation III (0.5 credit) This is a collaborative course for students in Nuclear Medicine, Radiological Technology, and Radiation Therapy. Students will be provided with an overview of computed tomography including an introduction to the basics of computed tomography equipment, image formation and display, and terminology. Students will learn about

the clinical application of computed tomography as well as radiation safety issues relevant to the use of this modality.

Current Topics in Nuclear Medicine & Molecular Imaging (0.5 credit) This course will enable students to explore leading-edge topics in nuclear medicine and molecular imaging. Students will participate in a variety of learning activities including online group discussions, research dissemination, and literature reviews

Collaborative Patient Centred Care (0.5 credit) This course will explore the role of collaboration in the provision of patient-centred care. Learners will work collaboratively as members of a patient care team to develop and provide a holistic approach to decision making, patient care, and patient education using scenario-based cases, role-playing, standardized-patients, etc.

Patient Care Lab III (0.25 credit) **and IV** (0.25 credit) This laboratory-based course is a continuation of Patient Care Lab II and will introduce learners to additional discipline specific patient care skills necessary for clinical practice.

Leadership in Health Care (0.5 credit) This course is designed to provide students with experiential learning opportunities to develop leadership skills through participation in interprofessional health care teams. The learner will be provided with a broad overview of current theories, principles, and perspectives on the role of leadership in the interprofessional environment; students will glean valuable knowledge that will contribute to and enhance their understanding of the multiple dimensions of leadership.

Interprofessional Collaborative Clinical Simulation (1.0 credit) This course will provide learners with the opportunity to further their knowledge of the roles, responsibilities, and rights of the many players involved in health care provision. Learners will explore health care issues relevant to clinical practice from a multi-professional perspective, as they will be working in interprofessional teams. A variety of educational models and tools including problem-based learning, scenarios, and role-playing within simulated health care environment will be encountered during this course.

Nuclear Medicine Simulation (0.5 credit) This 13-week course is designed to prepare the learner for entry into the clinical environment of the medicine-imaging department, as part of the clinical component of his/her program. Through simulation of the clinical environment, the learner will have the opportunity to integrate and apply his/her knowledge, skills, and behaviours to clinical case scenarios. Ultimately the learner must demonstrate the requisite level of performance in order to proceed into the clinical environment. Competency will be assessed in some aspects of performance. For students of the Medical Radiation Science Program, this course will also incorporate a large component of the content previously taught in Comparative Imaging Modalities (MRS167H1).

YEAR III

In Year III, students must complete Clinical Practicum I & II as well as *one* of the following choices:

(A) Research Methods II (1.0 credit)
OR
(B) Clinical Project Course (0.5 credit) and Selective III (0.5 credit)

UNIVERSITY OF TORONTO COURSES *(total 4.5 or 5.0 credits)*

Research Methods II (1.0 credits). For students who are interested in pursuing graduate studies and an academic career in Medical Radiation Sciences, this course allows the completion of a novel research project under close supervision by a faculty member in the *Department of Radiation Oncology, Medical Imaging or another Department in the Faculty of Medicine*. The completion of a research project will require the writing and presentation of a scientific paper to a group of expert faculty. Students will be encouraged to complete work of publishable quality.

Clinical Practicum II (2.0 credits) One full semester of clinical practice in a nuclear medicine teaching centre with assessment of clinical competence.

Clinical Practicum III (2.0 credits) One full semester of clinical practice in a nuclear medicine teaching centre with assessment of clinical competence.

Selective III (0.5 credit) The *Departments of Radiation Oncology and Medical Imaging* will provide students with selective courses relevant to the field of Medical Radiation Sciences. MRI, PET, Health Education, Specialized Radiation Therapy Methods, and Computer-assisted Image Analysis are examples of current course offerings. Students may also seek courses at the University of Toronto as an alternative.

THE MICHENER INSTITUTE COURSES *(total 0.5 credits)*

Clinical Project Course (0.5 credit). This course consists of a written and oral presentation of a scholarly study of an aspect of radiation science as it applies to the specific professional stream of the student. The project will be conducted generally within the context of clinical training, utilizing the resources and technical expertise of faculty and professionals in the clinical teaching environment; a faculty mentor will supervise the written and oral presentation components. This course will require creativity, self-directed learning, writing and presentation skills that will be developed in the previous years of study.

U of T total of 10.0 credits and TMI a total of 10.0 credits = 20 credits (Year 4, option A)
OR
U of T total of 9.5 credits and TMI a total of 10.5 credits = 20 credits (Year 4, Option B)

APPENDIX C

BSc/Diploma Program: Course Descriptions

Students must complete 20 credits to obtain the BSc and Diploma in Medical Radiation Sciences.

C. Radiation Therapy

YEAR I

UNIVERSITY OF TORONTO COURSES *(total 5.0 credits)*

Anatomy (0.5 credit) This course is designed to serve as the foundation in Human Anatomy for students in the Medical Radiation Sciences program. The course will introduce students to the anatomy of the human body. The course will follow a systematic structure covering all of the principal functional systems within the body. This approach will examine structures from the microscopic level to the gross anatomical level and will heavily integrate structure with function. Important diseases and disorders pertaining to specific systems will also be discussed. The course precedes Human Physiology (MRS162H1/PSRD120) giving students a comprehensive anatomical background before the detailed function of these systems is addressed in the Physiology course; it will also serve to prepare students for MRS164H1/ANRD120 (Relational Anatomy). This course is taught by faculty from the *Department of Radiation and Oncology* and from the *Division of Anatomy Department of Surgery.*

Physiology (0.5 credits) This course is designed to serve as the foundation in Human Physiology for students in the Medical Radiation Sciences program and will introduce students to the function of the organ systems that comprise the human body. The course will follow a systematic structure covering all of the principal functional systems within the body, such as the cardiovascular and respiratory systems. As such students are expected to be familiar with the anatomical structure of these systems. Clinical examples will be used to illustrate key principles and material where possible.

Introduction to Clinical Oncology (0.5 credit) (*Department of Radiation Oncology)* This course introduces students to the principles of oncology in order to prepare them for the in-depth study of individual disease sites in Oncology I & II. Topics covered include epidemiology and etiology, prevention and screening, classification of cancers, presenting signs and symptoms, histopathology, routes of spread, diagnostic and staging procedures, prognostic factors, and management approaches. The pathobiology of other disease processes will be discussed as well. Case scenarios are used to illustrate the relevance of each of the oncologic principles.

Introduction to Radiation Physics (0.5 credit) (*Department of Radiation Oncology)* This course examines the different types of radiation and how they interact with matter. Pertinent properties of both the radiation and the materials that dictate the nature of the interaction are discussed. A review of the structure of matter also reveals the physical origin of radiation

production. Based on the understanding of radiation interactions with matter, radiation units and methods of radiation dosimetry are described. Finally, the principles of operation of radiation therapy machines and the importance of quality assurance procedures in the radiation therapy department are discussed. This course includes a lab component that will take place at a nearby cancer centre.

Radiation Beams & their Interactions (0.5 credit) (*Department of Radiation Oncology)* This course introduces the student to the application of the radiation beam to the patient in the therapy environment. Topics will include: absorption characteristics of the radiation beam in air and in a phantom, beam data and characteristics, application of calculation factors for patient calculations and an introduction to treatment planning. This course includes a lab component that will take place at a nearby cancer centre.

Radiobiology & Radiation Protection (0.5 credit) (*Department of Radiation Oncology)* This course provides an in-depth study of the radiobiological effects of ionizing radiation at the molecular, cellular, tissue and whole-body level. Topics covered will include: cell populations and tumour biology, radiation effects on tumours and probability of tumour recurrence, effects of total body irradiation, late effects of radiation, tolerance doses and the alpha-beta ratio. The Radiation Protection section of this course provides in-depth studies of radiation hazards, radiation protection regulations and legislation, dose limitations, administration organizations for radiation protection regulations, proper radiation protection practices, personnel and area monitoring for radiation therapy. This course includes a lab component that will take place at a nearby cancer centre.

Methodology in Radiation Therapy I (0.5 credit) The course will introduce the learner to the radiation therapy treatment delivery process. The learner will develop psychomotor and problem-solving skills that will be utilized for application of radiotherapy treatment. The learner will have the opportunity to practice technical and client communication, interpreting documentation, image acquisition and assessment, quality assurance procedures, setup, and safety. The fundamentals of radiation therapy simulator planning will be introduced.

Clinical Practicum I (1.0 credit) This course is an 8-week intensive hospital-based semester during which students apply the knowledge and skills gained through the previous two semesters. Students will familiarize themselves with their future roles as Radiation Therapists as well as gain an enhanced understanding of the significance of collaborative practice in the clinical setting. Some assessment of clinical competence will occur during this course.

Selective 1 (0.5 credit) *The Departments of Radiation Oncology and Medical Imaging* will deliver selective courses with the purpose of providing graduates of the Medical Radiation Sciences Program with expertise in specialized fields of practices such as MRI, PET, Health Education, Specialized Radiation Therapy Methods, Computer-assisted Image Analysis, and more. These selectives are required for partial fulfillment of further specialization in these professional fields, e.g., MRI technology.

THE MICHENER INSTITUTE COURSES *(total of 2.0 credits)*

Relational Anatomy (0.5 credit) The Relational Anatomy course investigates the gross, cross-sectional and relational anatomy and reviews the physiology and the associated lymphatic systems of the head, central nervous system, neck, spine, thorax, abdomen, male / female pelvis, upper / lower extremities as well as muscles, vessels and the lymphatic system. The study of cross sectional and relational anatomy is applied so that the student will be able to recognize the different scanning planes (sagittal, axial & coronal) and be able to identify the organs or structures seen on CT and MRI cross sectional images. The students will learn the skill of describing anatomy in relation to surrounding structures and organs using medical terminology.

Foundations of Interprofessional Collaboration I (0.5 credit) This course will help learners to understand the development and utility of teams within an interprofessional environment. Learners will develop skills for effective verbal, nonverbal, and written communication; effective information gathering/listening skills, as well as communication skills for identifying and resolving conflict will be presented.

Foundations of Interprofessional Collaboration II (0.5 credit) This course will encompass the theories and principles of professionalism as they pertain to health care practice, interprofessional collaboration, ethics, and reflective practice. Learners will explore the development of the professional identity and professional socialization, issues of professional hierarchy and their implications on team-based care, and the role of reflection in personal and professional development.

Introduction to Patient Care in Radiation Therapy I (0.25 credit) **and II** (0.25 credit) The purpose of this course is to prepare the student with the knowledge and skills of basic patient care that will be utilized in the clinical setting. This course includes topics in medical terminology, communication, individualized client care, client support mechanisms and care of the health care provider. A laboratory component will enable the student to practice the fundamental skills of basic communication, assessment and documentation, lifting and moving, basic infection control, measurement of vital signs, and oxygen therapy.

YEAR II

UNIVERSITY OF TORONTO COURSES *(total 6.0 credits)*

Clinical Oncology I (0.5 credit) **and II** (0.5 credit) (*Department of Radiation Oncology)* These integrated courses span the full academic year. Each of the oncologic principles learned throughout the *Introduction to Clinical Oncology* course will be applied to the major adult and pediatric disease sites. Case scenarios are used to illustrate the relevance of the information being presented. Students will also have the opportunity to review the literature and assess the impact research has on clinical practice.

Treatment Planning (1.0 credit) The purpose of this course is to build on the fundamentals of radiation physics and enable students to further develop dosimetric problem-solving skills through the application of theory to clinical situations. Topics will include: planning methods for

photon and electron beams, contouring, quality assurance, beam modifications for patient data, three-dimensional conformal planning, brachytherapy, intensity modulated radiation therapy and stereotactic radiotherapy. The student will also learn how apply various calculation methods to determine the required radiation dose for treatment. In addition, each student will have an opportunity to practice beam modeling in a laboratory setting. The goal of each lab is to reinforce and demonstrate the principles of radiation therapy treatment planning by creating and assessing treatment plans for various clinical scenarios.

Clinical Behavioural Science (0.5 credit).This course has been developed by the *Department of Public Health Sciences (Division of Behavioral Science)*. This course provides an overview of the ethical, societal and personal factors that influence and impact health care services. The role of the health care provider and the dynamics of the provider/patient relationship will be examined from a critical perspective. Through an interprofessional education session students will explore alternate models of healthcare provision. This course will combine theory and practical application, allowing the student to reflect on his or her own values and beliefs through case studies, reading and discussion.

Methodology in Radiation Therapy II (0.5 credit) This course will build on the skills developed in Methodology in Radiation Therapy I, anatomy, oncology, and treatment planning courses. This course is designed to foster critical thinking and problem-solving skills that students require for simulator planning and the treatment delivery processes. Laboratories will include conventional simulation, virtual simulation and re-simulation along with image assessment and archiving.

Methodology in Radiation Therapy III (0.5 credit) Through opportunities for integration and application of the learner's knowledge of anatomy, oncology, physics and treatment planning, the student will be able to justify and/or appraise the choice of treatment and simulator techniques. Current issues in radiotherapy planning and treatment will be critically examined. Laboratory practice will include specialized treatment and planning techniques integrated with client communication.

Interprofessional Research (0.5 credit) This course offers and examination of models and contemporary issues relevant to interprofessional education and research as applied in health care and education settings. The course uses conceptual framework for articulating applied practice and research. Learners will engage in multiple education modalities for the purpose of obtaining competence in distinguishing high quality research, writing a literature review, and completing a research proposal. Research directions for interprofessional education and practice will be articulated in light of existing literature and identified needs for the construction of future knowledge

Interprofessional Collaborative Clinical Simulation (1.0 credit) This course will provide learners with the opportunity to further their knowledge of the roles, responsibilities, and rights of the many players involved in health care provision. Learners will explore health care issues relevant to clinical practice from a multi-professional perspective, as they will be working in interprofessional teams. A variety of educational models and tools including problem-based

learning, scenarios, and role-playing within simulated health care environment will be encountered during this course. For students of the Medical Radiation Science Program, this course will also incorporate a large component of the content previously taught in Comparative Imaging Modalities (MRS167H1).

Radiotherapy Simulation (0.5 credit) This 13-week course is designed to prepare the learner for entry into the clinical environment of the radiation therapy department, as part of the clinical component of his/her program. Through simulation of the clinical environment, the learner will have the opportunity to integrate and apply his/her knowledge, skills, and behaviours to clinical case scenarios. Ultimately the learner must demonstrate the requisite level of performance in order to proceed into the clinical environment. Competency will be assessed in some aspects of performance

Selective II (0.5 credit) The *Departments of Radiation Oncology and Medical Imaging* will provide students with selective courses relevant to the field of Medical Radiation Sciences. MRI, PET, Health Education, Specialized Radiation Therapy Methods, and Computer-assisted Image Analysis are examples of current course offerings. Students may also seek courses at the University of Toronto as an alternative.

THE MICHENER INSTITUTE COURSES *(2.0 credits)*

Computed Tomography Instrumentation (0.5 credit) This is a collaborative course for students in Nuclear Medicine, Radiological Technology, and Radiation Therapy. Students will be provided with an overview of computed tomography including an introduction to the basics of computed tomography equipment, image formation and display, and terminology. Students will learn about the clinical application of computed tomography as well as radiation safety issues relevant to the use of this modality.

Collaborative Patient Centered Care (0.5 credit) This course will explore the role of collaboration in the provision of patient-centred care. Learners will work collaboratively as members of a patient care team to develop and provide a holistic approach to decision making, patient care, and patient education using scenario-based cases, role-playing, standardized-patients, etc.

Patient Care in Radiation Therapy III (0.25 credit) **and IV** (0.25 credits) These course build upon the knowledge and skills gained from Introduction to Patient Care in Radiation Therapy I and II by addressing the care needs of oncology patients undergoing radiation therapy treatment. Emphasis will be placed on assessment, intervention and patient care skills specific to the practice of radiation therapy. The course will also cover basic principles of pharmacology, chemotherapy, nutrition and palliation. Labs will emphasize communication, assessment, and client education skills with the use of role playing exercises and evaluation. Case studies will be utilized to provide learners with the opportunity to integrate patient care communication and technical skills.

Leadership in Health Care (0.5 credit) This course is designed to provide students with experiential learning opportunities to develop leadership skills through participation in interprofessional health care teams. The learner will be provided with a broad overview of current theories, principles, and perspectives on the role of leadership in the interprofessional environment; students will glean valuable knowledge that will contribute to and enhance their understanding of the multiple dimensions of leadership.

YEAR III

In Year III, students must complete Clinical Practicum I & II as well as *one* of the following choices:

(A) Research Methods II (1.0 credit)
OR
(B) Clinical Project Course (0.5 credit) and Selective III (0.5 credit)

UNIVERSITY OF TORONTO COURSES *(total 4.5 or 5.0 credits)*

Research Methods II (1.0 credits). For students who are interested in pursuing graduate studies and an academic career in Medical Radiation Sciences, this course allows the completion of a novel research project under close supervision by a faculty member in the *Department of Radiation Oncology, Medical Imaging or another Department in the Faculty of Medicine*. The completion of a research project will require the writing and presentation of a scientific paper to a group of expert faculty. Students will be encouraged to complete work of publishable quality.

Clinical Practicum II (2.0 credits) One full semester of clinical practice in a radiation therapy teaching centre with assessment of clinical competence.

Clinical Practicum III (2.0 credits) One full semester of clinical practice in a radiation therapy teaching centre with assessment of clinical competence.

Selective III (0.5 credit) The *Departments of Radiation Oncology and Medical Imaging* will provide students with selective courses relevant to the field of Medical Radiation Sciences. MRI, PET, Health Education, Specialized Radiation Therapy Methods, and Computer-assisted Image Analysis are examples of current course offerings. Students may also seek courses at the University of Toronto as an alternative.

THE MICHENER INSTITUTE COURSES *(total 0.5 credits)*

Clinical Project Course (0.5 credit) This course consists of a written and oral presentation of a scholarly study of an aspect of radiation science as it applies to the specific professional stream of the student. The project will be conducted generally within the context of clinical training, utilizing the resources and technical expertise of faculty and professionals in the clinical teaching environment; a faculty mentor will supervise the written and oral presentation components. This course will require creativity, self-directed learning, writing and presentation skills that will be developed in the previous years of study.

U of T total of 16.5 credits and TMI a total of 3.5 credits = 20 credits (Year 4, Option A)
OR
U of T total of 16.0 credits and TMI a total of 4.0 credits = 20 credits (Year 4, Option B)

Appendix D

GREAT MINDS FOR A GREAT FUTURE

THE Michener INSTITUTE For Applied Health Sciences

Proposal for a Curriculum Redesign for the Medical Radiation Sciences Program

A Joint Program between the Department of Radiation Oncology, University of Toronto and The Michener Institute for Applied Health Sciences

This report has been prepared as an addendum to the Proposal for a Curriculum Redesign for the UT/Michener Medical Radiation Sciences Program presented to the Education Committee Faculty of Medicine on March 6th, 2006.

Impact of the Curriculum Redesign on

a. Faculty

Michener has taken the lead on the course development for the Interprofessional (IPE) courses, utilizing faculty from all their health professional programs with representation from the disciplines within the Medical Radiation Sciences (MRS) Program. Course development for the IPE courses has been incorporated into Michener faculty workload and funding. The MRS Program has hired a Project Manager for a 2-year period who will coordinate the curriculum redesign for the Program as well as liaise between the three disciplines within MRS to ensure consistency and continuity. For the summer semesters clinical coordinators and partners are actively participating in the development of the clinical practicums and have expressed interest in teaching and facilitating sessions. There is no anticipated impact on faculty.

b. Recruitment

With the redesign of the curriculum the MRS Program anticipates an increase in the number and quality of applicants to the Program. The Program will attract applicants who are actively seeking an innovative, evidenced –based curriculum that is reflective of the health care environment coupled with the established reputation of the University of Toronto professional programs.

c. University

There will be a 15% increase in BIU revenue to the Faculty of Medicine, as a result of re-distribution of course load between UofT and The Michener Institute.

d. Students - financial

There will be no increase in annual tuition fees as a result of the changes to the curriculum.

With the current curriculum OSAP eligible students receive OSAP assessment for 8 months in Year 1, 12 months in Year 2 and 12 months for Year 3, for a total of 30 months. As a result of changes to the curriculum for the 2007 intake, OSAP eligible students receive OSAP assessment for 12 months in Year 1, 12 months in Year 2 and 8 months in Year 3, for a total of 30 months. If an OSAP eligible student works in the summer session of Year 1, the OSAP entitlement for Year 2 will be decreased by the summer income.

Appendix E

University of Toronto Department of Radiation Oncology/ Michener Institute for Applied Health Sciences Medical Radiation Sciences Program

Student Leadership Team (SLT) Report

This report has been generated at the request of the MRS Program Administration in support of the curriculum changes.

The proposed curriculum has been presented to both the Joint Curriculum Committee (with student representation from all three disciplines and all three years), as well as the Student Leadership Team (SLT) for review and input. Overall, it has been well received by students. Many issues that had arisen with the current curriculum have been addressed. As a result of the proposed changes, students will be able to graduate in May and write an earlier sitting of the licensing exam, the selectives have been better integrated into the structure of the program and the 8 week clinical placement in the first year will provide earlier exposure to the prospective clinical environment.

Newly integrated components such as IPE, patient care labs, the new CT course and the simulation semester were all well received in theory. Further elaboration on these aspects of the proposed curriculum will provide students a better opportunity to further comment with respect to these items. Continued student involvement is thus critical to the process of developing course content and ongoing communication must be maintained between faculty and student representatives.

Students can often contribute feedback on potential issues that might not have been considered by administrators and faculty involved in developing the proposed curriculum. Presentation of the proposed curriculum at the SLT meeting on March 16, 2006 generated much discussion surrounding the feasibility of the eight week clinical placement within the first academic year. The intent of this first clinical placement was well understood and appreciated by students. Further communication regarding potential financial constraints and relocation issues surrounding this component would help to ensure its acceptance upon implementation.

Ongoing communication between faculty, administrators, and the SLT is essential as emerging concerns are addressed and course content is developed. Involving the MRS student body in the development and review of the proposed curriculum will ensure the necessary support and confidence in the changes that will be implemented in the fall of 2007.

Respectfully submitted

Ghada Chidiac and Caitlin Gillan
On behalf of the UT/Michener MRS Student Leadership Team

March 21st 2006