Graduate Program in Medical Physics

University Name

Self Study

Date

Program Director

Name

Address

Telephone Number

Email Address

Program Website URL

Template Revised October 2013

Instructions

- The CAMPEP standards for graduate programs are printed in blue for reference in each section
- The self study document should address each standard
- The appendices provide required supplemental details

Contents

Introduction

Program Evolution and History

Please provide a brief history of the program's evolution.

Summary of Program Changes Since Last Review

If this is an application for maintenance of accreditation, please list here all significant changes in the program since the previous self-study submission, details to be provided in the appropriate section of the self-study.

1. Program Objective and Goals

The objective of a graduate educational program in medical physics is to provide its graduates with the basic and applied scientific knowledge necessary for further education and research in medical physics, or for entry into a medical physics residency leading to a career in clinical medical physics. Knowledge and skills to be attained during graduate education include:

- *Physics, mathematics and other basic science knowledge required for research or clinical practice in medical physics;*
- *Conceptual and methodological understanding of how research and enquiry lead to the creation of new knowledge and the reinterpretation of existing knowledge;*
- *Assimilation and analysis of current research and scholarship in medical physics;*
- *Competence in using the research process to answer new questions and solve specific problems in research and clinical settings;*
- *Professional attributes and ethical behaviors required of medical physicists;*
- *Communication and interpersonal skills necessary to function in a collaborative environment;*
- *Commitment to continued education so that the resident's knowledge and skills remain current;*
- *Awareness of the complexity of knowledge in the field and receptiveness to other interpretations, new knowledge, and different approaches to problem solving.*

2. Program Structure and Governance

- *Institutions in the United States offering graduate education in medical physics must be accredited by an accreditation organization recognized by the US Department of Education or the Council for Higher Education Accreditation. Programs in other jurisdictions must hold appropriate equivalent recognition.*
- *Graduate programs in medical physics shall be sited in a well-defined and mature university structure with multiple disciplines and departments to ensure stability and continuity.*
- *Mature relationships shall exist within and/or between departments to provide knowledge and understanding of medical physics fundamentals.*
- *On average, two years is needed for full-time students with appropriate backgrounds to acquire a master's degree in medical physics. The time beyond the master's degree for doctoral students to complete degree requirements is variable, but usually is at least 3 years.*
- *Students entering a medical physics education program shall have a strong foundation in basic physics. This shall be documented by either a degree in physics or a degree in engineering or other area of physical science with physics education equivalent to a minor in physics (including at least three upper level undergraduate physics courses or equivalent required for a physics major).*
- *If applicants with deficiencies in their academic background are admitted conditionally into a graduate program, the provision for remedial physics education shall be rigorous and well-defined.*
- *Graduate education shall be supervised and monitored by a steering committee that meets at least 3 times annually. Committee membership shall include but not be limited to the program director and other faculty involved in medical physics education. The process for appointment of the members of the steering committee shall be documented. A pathway for expression of student concerns to the committee shall be available. Minutes of meetings shall be maintained.*
- *The steering committee shall review the graduate educational program in its entirety at least annually, and initiate appropriate remedial action and improvement where needed through the process of Continuous Quality Improvement. Minutes of the program review, including actions taken, shall be maintained.*
- *A program must make information available to the public, preferably through an open-access web site, that describes the program and the achievements of its graduates and students. This information must be updated yearly and include, for each degree program (MS and/or PhD), the number of: applicants to the program, students offered admission, students matriculated, and graduates. Where possible, information on the destinations of graduates must also be provided, i.e., residencies, industry positions, etc.*

3. Program Director

- *A single program director shall be responsible and accountable for ensuring that the graduate program satisfies CAMPEP standards, and shall ensure that quality education occurs in all courses and laboratory exercises.*
- *The program director shall ensure that all student statistics, annual reports, and other information required by CAMPEP are reported accurately and in a timely fashion.*
- *The program director shall be responsible for coordinating the faculty, evaluating and promoting the program.*
- *With guidance from the steering committee, the program director shall be responsible for recruiting students into the program.*
- *The program director shall meet periodically with each student to assess the student's progress, and minutes of the meeting shall be maintained, with a copy provided to the student.*
- *The program director shall determine that each student offered entry into the graduate program satisfies the CAMPEP prerequisites for graduate education in medical physics, or is offered rigorous remedial education to meet the prerequisites.*
- *The program director must possess a PhD or other doctoral degree in medical physics or closely-related discipline, and shall have at least 5 years of experience in medical physics.*
- *With consultation of the steering committee, the program director shall counsel, censure and, after due process, dismiss students who fail to demonstrate appropriate learning ability, competence, industry or ethical behavior.*
- *The program director shall establish and oversee a process of continuous quality improvement (CQI) for the program using an established CQI procedure such as PDSA (Plan, Do, Study, Act).*
- *The process for appointment of the program director shall be documented.*

4. Program Faculty

- *Adequate, qualified faculty shall be available with sufficient time for teaching and mentoring graduate students in medical physics.*
- *The process for appointment of the program faculty shall be documented.*
- *Faculty shall be engaged in scholarly activities including participation in scientific societies and meetings, scientific presentations and publications, and continuing education.*

5. Institutional Support

- *The institution sponsoring the graduate program shall provide administrative support, including educational resources, budget, graduate office/cubicle space, conference room(s), audiovisual facilities, and office support (e.g., copiers, internet access, e mail accounts, telephone).*
- *The institution must express commitment to long-term financial and administrative support of the graduate program.*
- *Financial support of students, if any, shall be described clearly prior to the entry of students into a graduate program.*
- *Students entering a program shall be provided an orientation to ensure their efficient and safe integration into the program.*
- *Introductory instruction shall be provided on potential hazards that students may encounter and appropriate measures to take to prevent risks to themselves and equipment.*
- *Instruction shall be provided in patient privacy issues, professional and research ethics, and regulations appropriate to medical physics research and clinical practice.*

6. Educational Environment

- *A graduate program shall be sited in an environment that encourages open discussion and communication, and facilitates the exchange of knowledge, experience and ideas.*
- *Conferences and journal clubs should be used to provide an opportunity for students to practice their presentation and leadership skills.*
- *Students shall have access to a variety of journals, books, and resource materials appropriate to medical physics, as well as to the internet and a general science library.*
- *Students shall have access to clinical facilities appropriate for a medical physics graduate program. Procedures shall be in place (1) to allow the student reasonable access to clinical equipment, (2) to provide students sufficient training and technical support to ensure safe and proper use of equipment, and (3) to ensure that equipment is left in the proper state for continuing clinical use.*
- *Students shall be provided with a pathway for feedback concerning the quality of their instruction and the diligence of their teachers and mentors, with protection of the students from repercussions if the pathway is used. Feedback on individual courses and on the entire graduate program should be sought from program graduates.*
- *Issues and concerns identified by feedback from graduates shall be evaluated by the steering committee, and remedial action taken where appropriate.*
- *In the educational environment, the duties of quality and safety related to patient care shall be emphasized.*

7. Scholarly Activities

- *Graduate students should be encouraged to engage in research projects, to develop a systematic approach to problem solving and gain a familiarity with scientific method;*
- *All educational and scholarly activities engaged in by students shall be recorded in an activities journal maintained personally by each student and examined periodically by the program director to ensure that the student is progressing satisfactorily.*

8. Graduate Curriculum

Course work in a graduate education program in medical physics shall consist of a minimum of 6 courses, for a total of 18 credit hours, where 1 credit hour equals 1 hour of instruction per week for a single 15 week semester.

Please supply course name and number for each topic listed.

1 Radiological physics and dosimetry	Course Name/Number
• Atomic and nuclear structure	
• Classification of radiation	
• Quantities and units to describe radiation fields	
• Quantities and units to describe radiation interactions	
• Indirectly ionizing radiation: photons	
• Exponential attenuation	
• Photon interactions	
• Indirectly ionizing radiation: neutrons	
• Neutron interactions	
• Directly ionizing radiation	
• Interactions of directly ionizing radiation	
• Radioactive decay	
• Charged particle equilibrium	
• Radiation dosimetry – general	
• Radiation dosimetry – calorimetry	
• Radiation dosimetry – chemical	
• Cavity theory	
• Ionization chambers	
• Calibration of photon and electron beams	
• Dosimetry and phantoms for special beams	
• In vivo dosimetry (TLD, OSL)	
• Relative dosimetry methods	
• Neutron dosimetry	
• Pulse mode detectors	

2 Radiation protection and safety	Course Name/Number
• Introduction and historical perspective	
• Interaction physics applied to radiation protection	
• Protection principles (time, distance, shielding)	
• Handling radiation and radioactive sources	
• Radiation survey/contamination equipment	
• Personnel monitoring	
• Radiation dose limits	
• Protection regulations	
• Shielding Principles: Beams and sources	
• Application of statistics	
• External exposure	
• Internal exposure	

• Environmental dispersion	
• Radioactive waste	
• Safety of MRI	
• Safety of ultrasound	
• Protection regulations	

3 Fundamentals of medical imaging	Course Name/Number
• History of medical imaging	
• Mathematical Models	
• Reconstruction mathematics	
• Radiography	
• Digital radiography	
• Fluoroscopy	
• Digital fluoroscopy	
• Image-guided intervention	
• Computed tomography	
• Cone-beam computed tomography	
• Nuclear medicine imaging	
• Magnetic resonance imaging	
• Ultrasound	
• Photoacoustic, thermoacoustic, etc.	
• Contrast agents	
• Radiopharmaceuticals, nanoparticles, etc.	
• Image fusion, registration, segmentation, quantitation	
• Quality assurance in medical imaging	

4 Radiobiology	Course Name/Number
• History of radiation injuries in humans	
• Radiation interactions in cells/tissues	
• Radiation injury to DNA	
• Repair of DNA damage	
• Indirect effects of radiation	
• Chromosomal damage and repair	
• Target theory and cell survival curves	
• Free radical formation	
• Apoptosis, reproductive cell death	
• Cell kinetics	
• Cell recovery processes	
• Cell cycle sensitivity	
• Radioprotectors, radiosensitizers	
• RBE, OER, LET	
• Tissue injuries	
• Acute effects of radiation	
• Delayed effects of radiation	
• Radiation carcinogenesis	

• Radiation mutagenesis	
• Radiation teratogenesis	
• Other embryo/fetal effects	
• Risk estimates of radiation	
• History of linear no-threshold theory	
• Predictions of cancers in populations	
• Radiation epidemiology	
• Evidence of cancers in populations	
• Concept of radiation hormesis	
• Tumor radiobiology	
• Time, dose, fractionation	
• Molecular mechanisms	
• Drug/radiation interactions	

5 Anatomy and Physiology	**Course Name/Number**
• Anatomy nomenclature	
• Pathology nomenclature	
• Skin	
• Skeleton/joints	
• Muscles and ligaments	
• Brain/CNS	
• Autonomic nervous system	
• Visual system	
• Thorax	
• Abdomen	
• Pelvis	
• Respiratory system	
• Digestive system	
• Urinary system	
• Reproductive system	
• Circulatory system	
• Lymph system	

6 Radiation Therapy Physics	**Course Name/Number**
• History of radiation oncology	
• Principles of radiation oncology	
• External beam treatments	
• Sources of external beams	
• Calibration of external beams	
• Acquisition of external beam data	
• Treatment planning principles	
• Multifield radiation therapy	
• IMRT, VMAT	
• Motion management	
• Brachytherapy	

• Brachytherapy sources	
• Storing and shielding brachytherapy sources	
• Brachytherapy delivery devices	
• Brachytherapy treatment planning principles	
• Special techniques in radiotherapy	
• Radiation therapy with neutrons, protons, light ions	
• Radiation protection in radiation therapy	

7 Professionalism and Ethics	**Course Name/Number**
Professionalism	
o Definition of a profession and professionalism	
o Elements of a profession	
o Definition of a professional	
o Elements of professionalism	
o How is professionalism judged?	
o Do's and don'ts of professionalism	
o Physician's charter and applicability to physicists	
Leadership	
o Vision and charisma	
o Qualities of leaders	
o Rules of leadership	
o Causes of leadership failure	
Ethics	
o Ethics of a profession	
o Ethics of an individual	
o Interactions with colleagues and co-workers	
o Interactions with patients and the public	
o Confidentiality	
o Peer review	
o Negotiation skills	
o Relationships with employers	
o Conflicts of interest	
o Ethics in research	
o Use of animals in research	
o Use of humans in research	
o Relationships with vendors	
o Publication ethics	
o Ethics in graduate and resident education	
o Selected case studies	

Appendix A - Letters of Invitation and Institutional Commitment

Appendix B - Documentation of Institutional Accreditation

Appendix C - Course Summaries

Course Title:

Course No.:

Instructor:

Text:

Credits:

Semester(s) Offered:

Recommended References:

Evaluation Scheme:

Course Outline:

List of Topics by week

Course Appendix: 1 set of exams and/or other means of evaluating student performance, and at least 1 set of student evaluations of the course and course instructor(s)

Appendix D – List of Students Admitted

Please provide a chronological list of students admitted into the program for the past 5 years.

Ref #	Degree program / start year	Previous Degrees	GPA, GRE and TOEFL scores

Appendix E – Current Students

Please provide an alphabetical list of current students.

Student	Program	Supervisor	Year Entered	Funding Source

Appendix F - Program Graduates

Reverse Chronological List of MSc Program Graduates - past 10 years

Student Reference	Degree Granted, Date	Time in Program	Thesis Title, Supervisor	Current Occupation	Board Certification

Reverse Chronological List of PhD Program Graduates - past 10 years

Student Reference	Degree Granted, Date	Time in Program	Thesis Title, Supervisor	Current Occupation	Board Certification

Appendix G - Faculty Biographical Sketches and Program Roles

Alphabetical List of Faculty

Name	Primary Specialty	Courses Taught (last 5 years)

Biographical sketches in alphabetical order (last name, first name), maximum 3 pages each, in the format provided below.

Biographical Sketch – Last Name, First Name

Academic Appointment(s):	
Other Appointment(s):	
Education:	
Post Graduate Training:	
Certification(s):	
Role(s) in Graduate Program:	Examples: Course lecture for *Basic Interactions of Radiation with Matter* (3 semester hours, 40 contact hours) Member of Program Steering Committee Member of Program Admissions Committee
Academic Supervision:	Examples: Current supervisor for 2 PhD students; past supervisor for 8 PhD students and 3 MS students
Clinical Responsibilities:	
Research Interests:	
Research Summary (Number of each in the last 5 years, unless otherwise noted):	a) Peer-reviewed papers in refereed journals (total / last 5 years): Example: 78 (total) / 15 (last five years) b) Book chapters and conference proceedings: c) Published abstracts: d) Presentations at national/international conferences:
Research Funding Support:	
Listing of Selected Publications (last 5 years):	