Medical Physics
Program Guidelines

Medical Physics Graduate Program

Oregon Health & Science University

School of Medicine

Updated September 2025

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Overview

The following document contains program guidelines for the Medical Physics Graduate Program. These guidelines describe the standards and procedures for completion of a graduate degree in this program. Medical physics students are subject to all OHSU policies as well as the policies of the OHSU Graduate Programs in the School of Medicine as outlined in the Academic Regulations. Program guidelines shall be available on the School of Medicine website, be kept on file with each Program and in the office of the Associate Dean, Graduate Studies. Pursuant to the School of Medicine Graduate Studies Academic Regulations of the Graduate Programs, each program is responsible for informing students of their guidelines and making copies available to students on program websites.

Admissions Policies and Procedures

In order to gain admission into the Medical Physics Graduate Program, substantial undergraduate coursework in physics is required. This can be demonstrated with a degree in physics. This can also be demonstrated with a degree in engineering or another area of the physical sciences with physics coursework that includes at least 3 upper-level undergraduate physics courses. Applicants must indicate how they meet this requirement on their application.

If a student's record does not fully meet all of the requirements listed below but indicates strong potential for success as a graduate student, the student can still be offered admission with approval from the Program Director and the Dean of Graduate Studies.

Admissions criteria for the Medical Physics Graduate Program is based on a combination of factors, including the following admissions requirements as detailed on the program website (https://www.ohsu.edu/school-of-medicine/medical-physics-graduate-program/admission-requirements)

- Undergraduate Degree Type
    - We require a bachelor's degree, most commonly in physics (major or minor), radiation health physics, or engineering fields. Within undergraduate course work, it is a requirement that all of our accepted students have taken a minimum of 3 upper division physics courses, along with core physics courses and laboratory sessions (refer to pre-professional courses listed below).
- Pre-Professional Courses needed for certification by the American Board of Radiology (ABR)
    - Two introductory physics courses (at least 3 semester credit hours each)
    - Three advanced physics courses (at least 3 semester credit hours each). The advanced physics courses should be from the usual advanced physics curriculum. Courses that are primarily related to engineering, chemistry, health, or medical physics are not acceptable. Commonly approved upper-division physics courses include: Electricity and Magnetism; Atomic Physics; Modern Physics; Quantum Mechanics; Optics; Nuclear Physics; Heat and Thermodynamics; Advanced Mechanics.
- Undergraduate/graduate GPA
    - Minimum GPA: 3.0 (on a 4.0 scale)
- GRE scores:
    - General GRE must be taken; no minimum score requirement
- TOEFL or IELTS Scores:
    - TOEFL minimum score requirement

        - Internet-Based (iBT): 80; minimum score of 18 on each section
        - Paper-Based: 550
    - IELTS minimum score requirement: 6.5
- Personal statement
- CV/Resume
- Three letters of reference
- Official transcripts
- Responses to application questions
- Additional PhD Requirements
    - To be eligible for the PhD program, applicants must have earned a Master's in Medical Physics from a CAMPEP-accredited program.

Applications for the Medical Physics Graduate Program are reviewed during the months of January and February of each year. The admissions committee meets once all applications are reviewed. Following this meeting, applicants will be contacted in regards to their admissions status. Applicants will receive a response by the end of April. This process is communicated on the Admissions section of the program's website.

Deferred Admissions

The Medical Physics Graduate Program adheres to the School of Medicine Graduate Studies deferred admissions policy, stating:

- The Medical Physics Graduate Program allows deferred admissions. If a student wishes to defer admissions to a future academic year, the student must submit a written request to the Program Director and the Dean of Graduate Studies. At the time deferred admissions is granted the student will be notified through a written deferral letter of any requirements they must complete prior to matriculating into the program. The student may defer admissions until the next academic year, at which point they will matriculate or withdraw prior to matriculation.

Description of Curriculum and Required Courses

The successful graduate candidate in medical physics (M.S. or Ph.D.) will satisfactorily complete (or demonstrate equivalence) the courses as indicated below:

Course Number	Course Title	Credit Hours
MP 507	Matriculation Seminar	1
MP 507	Seminar: Diagnostic Imaging	1
MP 507	Seminar: Radiation Therapy	1
MP 521	Radiological Anatomy and Physiology	3
MP 531	Radiophysics	3
MP 535	Radiation Shielding and External Dosimetry	3
MP 536	Advanced Radiation Detection	3
MP 538	External Beam Radiation Therapy/Radiopharmaceutical Therapy Dosimetry Lab	2
MP 541	Diagnostic Imaging Physics I	3
MP 542	Diagnostic Imaging Physics II	3
MP 543	Advanced Diagnostic Imaging Physics	3
MP 544	Nuclear Medicine Imaging	3
MP 545	Diagnostic Imaging Physics Practicum	3
MP 546	*Diagnostic Imaging Physics Lab I *(Required for Diagnostic Selection Degrees Only)*	2
MP 547	*Diagnostic Imaging Physics Lab II *(Required for Diagnostic Selection Degrees Only)*	2
MP 561	Radiation Therapy Physics I	3
MP 562	Radiation Therapy Physics II	3
MP 563	*Applied Radiation Therapy Physics Lab I *(Required for Radiation Therapy Selection Degrees Only)*	2
MP 564	*Applied Radiation Therapy Physics Lab II *(Required for Radiation Therapy Selection Degrees Only)*	2
MP 565	Radiation Therapy Physics Practicum	3
MP 570	Radiation Biology for Medical Physicists	3
IPE 501	Interprofessional Education	1
MGRD 650	The Practice and Ethics of Science	1
BSTA 525	Introduction to Biostatistics	4
MP 503	Thesis credits (minimum of 7 credits required)	7

Course Descriptions

MP 507 – Matriculation Seminar: This is a presentation seminar which serves as an introduction to topics and faculty in the Medical Physics Program. This is a mandatory seminar for all incoming students.

MP 521 – Radiological Anatomy: This course covers anatomy and physiology with correlating images for use by medical physicists. This course adheres to the AAMP requirements for Cross Sectional Anatomy. This course also adheres to the CAMPEP Standards for Graduate Program requirements for Anatomy and Physiology.

MP 531 – Radiophysics: The purpose of this course is to provide the medical physics student with an introduction to ionizing radiation and its use in medicine. Topics covered include production of radiation, interactions of radiation with matter, and measurement of radiation. This course is a prerequisite for subsequent courses in medical physics.

MP 535 – Rad Shielding & External Dosimetry: This course covers theoretical principles of shielding for neutron and gamma radiation; fundamentals of external dosimetry for neutrons, photons, and charged particles; applications to problems of practical interest; analytical, numerical, and computer solutions emphasized.

MP 538 – External Beam Radiation Therapy/Radiopharmaceutical Therapy Dosimetry Lab: This course provides deeper study of the radiation biology and dosimetry topics introduced in the prerequisite coursework, including radiation biology models applied to XRT, XRT dose calculations, quantitative imaging, RTP dosimetry methods, and uncertainty analysis. Involves application of topics studied in the lab.

MP 561 – Therapy Physics I: This course covers the physics of radiation generation and delivery relevant to the field of clinical radiation oncology. Topics will include external beam radiation therapy; dosimetric calculations; high dose-rate and low dose-rate brachytherapy; electron beam dosimetry and treatment planning; photon beam dosimetry and treatment planning; special techniques in radiotherapy; and clinical radiation protection and quality assurance.

MP 541 – Diagnostic Imaging I: This course introduces the student to the production and usage of ionizing radiation in medicine. The course will cover x-ray production, x-ray spectrum characteristics and manipulation, and how x-rays are utilized to obtain anatomical information in diagnostic imaging. Imaging modalities to be covered in this course are general radiography, mammography, and fluoroscopy (including interventional radiography).

MP 507 – Seminar Therapy: This is a current topics/student presentation seminar focusing on radiation therapy and therapeutic radiological medical physics.

MP 570 – Radiation Biology: Radiation Biology teaches students the various aspects of the effect of ionizing radiation on living organisms. Inherent in this course are the importance of radiation protection, the pathology of the radiation induced injury, and the consequences of many sources of radiation exposure. This course includes instruction on radiobiological models, their nuances, appropriate applications of these models, and potential for implementation in a clinical setting. Students will be expected to combine various topics such as organ / tissue arrangement, linear energy transfer, mechanisms of DNA damage and results of such damage, as well as biologically effective dose.

MP 562 – Therapy Physics II: This course covers the physics of radiation generation and delivery relevant to the field of clinical radiation oncology. Topics will include external beam radiation therapy; dosimetric calculations; high dose-rate and low dose-rate brachytherapy; electron beam dosimetry and treatment planning; photon beam dosimetry and treatment planning; special techniques in radiotherapy; and clinical radiation protection and quality assurance.

MP 542 – Diagnostic Imaging II: This course introduces students to Computed Tomography (CT) and Ultrasound (US) imaging, and their applications in medicine. The course will cover x-ray production, detection, and image processing as it relates specifically to CT, as well as general acoustic physics principles and how they are applied to US imaging. Additionally, clinical radiation protection and dosimetry in diagnostic imaging will be taught.

MP 507 – Seminar Imaging: This is a current topics/student presentation seminar focusing on diagnostic radiology and diagnostic medical physics.

MP 536 – Advanced Radiation Detection: This course covers principles and mechanisms underlying nuclear radiation detection and measurements; operation of nuclear electronic laboratory instrumentation; application of gas-filled, scintillation and semiconductor laboratory detectors for measurement of alpha, beta, gamma, and neutron radiation, liquid scintillation equipment; use of Bonner spheres for neutron energy profiles; experimental investigation of interactions of radiation with matter.

MP 565 – Therapy Physics Practicum Therapy: This course will provide an introduction to the medical physicist's role in a clinical department. It will provide an initial overview of clinical procedures performed in radiation medicine to provide an opportunity to integrate the principles learned throughout the graduate program as they apply to the field of Radiation Oncology (Therapy) Physics. This will include clinical observations of procedures / work in dosimetry, physics, CT simulation, and at the linear accelerators during the treatment of patients.

MP 545 – Diagnostic Imaging Practicum Imaging: This course will provide an introduction to how imaging modalities are utilized in a clinical setting. It will provide an initial overview of clinical procedures performed in diagnostic radiology to provide an opportunity to integrate the principles learned throughout the graduate program as they apply to the field of Diagnostic Imaging Physics. This will include clinical observations of procedures in radiography, fluoroscopy, emergency department, OR, interventional radiology, CT, US and PET.

MP 546 – Diagnostic Physics Lab I: The course will cover the applied practice of Diagnostic Imaging Physics in all areas where medical imaging equipment is utilized (Diagnostic Radiology, Interventional Radiology, Cardiac Catheterization Lab, etc). Topics will include current testing and troubleshooting practices of the following imaging modalities: general x-ray, portable x-ray, fluoroscopy (fixed rooms and c-arms), mammography, and ultrasound.

MP 547 – Diagnostic Physics Lab II: The course will cover the applied practice of Diagnostic Imaging Physics in all areas where medical imaging equipment is utilized (Diagnostic Radiology, Interventional Radiology, Cardiac Catheterization Lab, etc). Topics will include current testing and troubleshooting practices of the following imaging modalities: computed tomography (including specialized systems), Primary Interpretation Displays, dental imaging (panoramic, cephalometric, intraoral, etc).

MP 563 – Therapy Physics Lab I: The course will cover the applied practice of therapeutic radiation physics for clinical radiation oncology. Topics will include current methodologies in treatment delivery and planning algorithms; best practices and protocols for quality assurance; special techniques in radiotherapy; and oncology.

MP 543 – Advanced DX Imaging: This course will introduce students to magnetic resonance imaging (MRI). Instruction will be provided on the physical principles behind nuclear magnetic resonance (NMR) and how these phenomenon are exploited in MRI. Advanced MRI techniques and applications, along with clinical testing requirements, will also be covered.

MP 564 – Therapy Physics Lab II: The course will cover the applied practice of therapeutic radiation physics for clinical radiation oncology. Topics will include current methodologies in SRS and ARC QA, treatment planning QA, adaptive radiotherapy, eye plaque brachytherapy, and HDR brachytherapy.

MP 544 – Nuclear Medicine Imaging: This course introduces the students to the uses of radionuclides in medical imaging. The theory & application of detectors and imaging systems in nuclear medicine including collimators, scintillation probes, cameras, SPECT, PET, and hybrid technologies (SPECT/CT, PET/CT, and PET/MRI) will be covered.

MP 503 – Thesis Hours

Sample Academic Plan

Year One Medical Physics Curriculum			
Designation	**Number**	**Major Core Course Title**	**Credits**
Fall Term: Year 1			
MGRD	650	Practice and Ethics of Science	1
MP	521	Radiological Anatomy & Physiology	3
MP	531	Radiophysics	3
IPE	501	Interprofessional Education (auto-enroll)	1
BSTA	525	Introduction to Biostatistics	4
MP	507	Matriculation Seminar (required)	1
Winter Term: Year 1			
MP	561	Therapy Physics I	3
MP	541	Diagnostic Physics I	3
MP	535	Rad Shielding and External Dosimetry	3
Spring Term: Year 1			
MP	562	Therapy Physics II	3
MP	542	Diagnostic Physics II	3
MP	570	Radiation Biology	3
Summer Term: Year 1			
MP	536	Advanced Radiation Detection (Summer A)	3
MP	545	Diagnostic Physics Practicum (Summer B)	3
MP	565	Therapy Physics Practicum (Summer B)	3

Year Two Medical Physics Curriculum Radiation Therapy Physics Selection			
Designation	**Number**	**Major Core Course Title**	**Credits**
Fall Term: Year 2			
MP	563	Therapy Physics Lab I	2
MP	543	Advanced Diagnostic Imaging (MRI)	3
MP	544	Nuclear Medicine Imaging	3
MP	503	Thesis	1*

Winter Term: Year 2			
MP	564	Therapy Physics Lab II	2
MP	538	XRT/RPT Dosimetry Lab	2
MP	503	Thesis	2*
Spring Term: Year 2			
MP	503	Thesis	4*
MP	507	Diagnostic Physics Journal Club	1
MP	507	Therapy Physics Journal Club	1

Year Two Medical Physics Curriculum
Diagnostic Imaging Physics Selection

Designation	Number	Major Core Course Title	Credits
Fall Term: Year 2			
MP	546	Diagnostic Imaging Physics Lab I	2
MP	543	Advanced Diagnostic Imaging (MRI)	3
MP	544	Nuclear Medicine Imaging	3
MP	503	Thesis	1*
Winter Term: Year 2			
MP	547	Diagnostic Imaging Physics Lab II	2
MP	538	XRT/RPT Dosimetry Lab	2
MP	503	Thesis	2*
Spring Term: Year 2			
MP	503	Thesis	4*
MP	507	Diagnostic Physics Journal Club	1
MP	507	Therapy Physics Journal Club	1

*For thesis credits, students can take any number between 1-7 credits each term; a total of 7 thesis credits are needed to graduate.

Time Limits to Achieve Specific Standards or Milestones

M.S. students must complete 61 term hours of approved graduate credits, with all coursework meeting the minimum cumulative grade point average of at least 3.0. The M.S. degree shall be completed in no more than six academic years unless waived for a leave of absence.

Ph.D. students must complete 135 term hours of approved graduate credits, with all coursework meeting the minimum cumulative grade point average of at least 3.0. The Ph.D. degree shall be completed in no more than seven academic years unless waived for a leave of absence.

- Time limit for qualifying exam/Advancement to candidacy: The qualifying exam is designed and given by the Medical Physics Graduate Program and must be taken by the end of the students 12th graduate study term.

Milestones

The Medical Physics Graduate Program outlines several key steps students must take to successfully gain their Master's or Ph.D. degrees. These benchmarks will be met through the following:

Master's Degree

- Master's Coursework: The Medical Physics Program requires that students complete all required didactic and research credits. After their first year which is primarily didactic, students must select their subspecialty in either diagnostic imaging or radiation therapy physics and begin focusing on selecting a research topic. Second year medical physics students must complete key milestones in order to receive a Master's degree with thesis requirement in the Medical Physics Program.
- Master's Research Mentor and Advisory Committee Selection: During the second year fall term, students must choose a research mentor by October 1st. They must also send out the request to establish their Master's Thesis Advisory Committee (TAC) by November 1st. This committee shall be made up of at least three faculty members (who do not all have primary appointments in the same department or institute). Members must have expertise in some aspect of the student's research and must adhere to the requirements of the graduate program for MS thesis. By the end of the fall term, the student must hold their first research meeting with their TAC. The student will present background on their research, the purpose of their study, as well as the general research timeline and plan to the committee.

Ph.D. Degree:

- Ph.D. Coursework: Ph.D. students must complete all coursework required for the Master's Thesis track. These courses satisfy the CAMPEP-required didactic elements of a graduate program in medical physics. Ph.D. students must complete 135 term hours of approved graduate credits, with all coursework meeting the minimum cumulative grade point average of at least 3.0.
- Ph.D. Doctoral Dissertation Mentor and Advisory Committee Selection: The Ph.D. student must select a doctoral dissertation mentor with approval by the Medical Physics Program Director. The mentor must be a member of the OHSU graduate faculty and be familiar with aspects of the student's research field. The Dissertation Advisory Committee (DAC) guides and advises the student in their dissertation research and general preparation of the final dissertation document. The committee must be appointed within 1 year after advancement to candidacy or upon commencement of the dissertation research, whichever is earlier, and must consist of no fewer than four members of the graduate faculty (who do not all have primary appointments in

the same department or institute). The candidate's mentor shall be one of the members of the committee and the committee must meet at least semi-annually to keep track of dissertation and research progress.

Required Formal Evaluations

Required formal evaluations for the medical physics graduation program include the following:

M.S. Oral Examination

- Oral Examination and Master's Thesis Defense: In the spring term, students must submit their request for oral examination. This must be completed a minimum of 4 weeks prior to their oral examination date. Upon a successful oral examination and thesis submission, the TAC members will approve the thesis for final submission to the OHSU Library as indicated by the Certificate of Approval form.

Ph.D. Advancement to Candidacy

- Advancement to Ph.D. Candidacy: Students must meet several requirements to enter Ph.D. candidacy status. Requirements include completion of CONJ 650: The Practice and Ethics of Science (or an approved alternate course), passing the Medical Physics Program qualifying exam, submitting a grant application and any other academic program requirements as listed above. The qualifying exam is designed and given by the Medical Physics Graduate Program and must be taken by the end of the student's 12th graduate study term. The qualifying examination is the first formal examination in the process of obtaining a doctoral degree. Successful passing of this exam advances a Ph.D. student to the level of Ph.D. candidate. The exam is a 4-hour written test comprised of core medical physics questions (50%) and advanced specific selection (diagnostic or therapy) and research related questions (50%). As part of their advancement to Ph.D. candidacy, the student must also prepare a federal funding agency format (e.g. NIH) grant application. The grant application write up must be submitted no later than 30 days after the written exam date. Students must score at least 70% to pass the written exam, and must have their grant application deemed acceptable by their dissertation advisor. Students on academic probation or with an "incomplete" grade cannot take the qualifying examination. If the student does not successfully pass the qualifying exam, they will be required to take an oral exam ascertaining they have adequate knowledge to advance to candidacy. If the student obtains a grade below 60%, they will be required to repeat the qualifying exam within a year. When these items are successfully completed the Program Director will recommend advancement to Ph.D. candidacy to the Associate Dean.

Ph.D. Oral Examination

- Ph.D. Oral Examination Defense: The student will work with their mentor/advisor to make a request to the Associate Dean for an oral examination date. The oral examination shall be open to the public and may be held in person or remotely. Before the oral examination date, the student must distribute their dissertation to the DAC a minimum of two weeks prior to their oral examination.

Criteria Used to Evaluate Student Performance

Medical physics students are evaluated based on the use of examinations, lab reports, attendance, and student participation on a course-by-course basis.

Academic performance is evaluated based on the fulfillment of the Student Learning Outcomes through the completion of the Medical Physics Graduate Program degree requirements while upholding good academic standing as established in the Academic Regulations of the School of Medicine Graduate Programs. The Medical Physics Program Student Learning Outcomes are as follows:

Student Learning Outcomes

Medical Physics M.S. Degree

1. At the end of the Medical Physics Graduate Program, the graduate will be able to explain the components, functionality and design of x-ray systems utilized in imaging and therapeutic devices found in Radiation Medicine or Diagnostic Radiology.
2. At the end of the Medical Physics Graduate Program, the graduate will be able to explain the components, functionality and design of a linear accelerator utilized for external beam radiation therapy treatment in Radiation Medicine.
3. At the end of the Medical Physics Graduate Program, the graduate will be able to communicate the risks associated with the use of radiation to members of the general public, patients, and professionals in healthcare.
4. At the end of the Medical Physics Graduate Program, the graduate will be able to apply radiation safety principles in the calculation and design of radiation shielding. This will include communicating with a team of individuals from equipment manufacturers, design and construction, architects, hospital administration and clinicians.
5. Upon graduation, students will be prepared to take Part 1 of the American Board of Radiology Initial Certification Exam.
6. Students will execute a research project based on in-depth knowledge of scientific literature, experimental design, and statistical tools.
7. At the end of the Medical Physics Graduate Program, students will be able to explain the biological and chemical pathway for radiation-induced carcinogenesis, including time intervals and all potential outcomes.
8. Students will exhibit professional and ethical characteristics in the clinical areas where medical imaging exams and radiation therapy treatments are performed.
9. At the end of the Medical Physics Graduate Program, the graduate will have knowledge of ways in which social justice and equity impact medical physics practice through the review and discussion of notable historical radiation accidents, experiments, and events.

Medical Physics Ph.D. Degree

1. At the end of the Medical Physics Graduate Program, the graduate will be able to explain the components, functionality and design of x-ray systems utilized in imaging and therapeutic devices found in Radiation Medicine or Diagnostic Radiology.
2. At the end of the Medical Physics Graduate Program, the graduate will be able to explain the components, functionality and design of a linear accelerator utilized for external beam radiation therapy treatment in Radiation Medicine.
3. At the end of the Medical Physics Graduate Program, the graduate will be able to communicate the risks associated with the use of radiation to members of the general public, patients, and professionals in healthcare.
4. At the end of the Medical Physics Graduate Program, the graduate will be able to apply radiation safety principles in the calculation and design of radiation shielding. This will include

communicating with a team of individuals from equipment manufacturers, design and construction, architects, hospital administration and clinicians.

5. Upon graduation, students will be prepared to take Part 1 of the American Board of Radiology Initial Certification Exam.
6. Students will execute a research project based on in-depth knowledge of scientific literature, experimental design, and statistical tools.
7. At the end of the Medical Physics Graduate Program, students will be able to explain the biological and chemical pathway for radiation-induced carcinogenesis, including time intervals and all potential outcomes.
8. Students will exhibit professional and ethical characteristics in the clinical areas where medical imaging exams and radiation therapy treatments are performed.
9. Contribute to the application and translation of new Medical Physics knowledge through scholarly inquiry, discovery, and dissemination.
10. Demonstrate the ability to transfer knowledge through the formal education process (ability to teach in the formal educational setting).
11. At the end of the Medical Physics Graduate Program, the graduate will have knowledge of ways in which social justice and equity impact medical physics practice through the review and discussion of notable historical radiation accidents, experiments, and events.

Remediation Opportunities

If a medical physics graduate student earns a grade of C or below in a course, the student will have an opportunity to remediate. This remediation will be dictated by the course faculty. Remediation must be completed within one academic term. If remediation is unsuccessful, the Program will follow the stated academic regulations.

Program-Specific Regulations Concerning Academic Probation

The Medical Physics Program-specific regulations concerning academic probation include the following:

- **Academic Counsel:** Students who earn below a term GPA of 3.0 are required to meet with the Program Director as a form of counsel and to determine any corrective actions or help that may be required. This is an informal meeting aimed at helping students improve academic performance without any long-term impact on their academic record.
- **Academic Probation:** Students who have a cumulative GPA below 3.0 will be placed on Academic Probation, in accordance with the Academic Regulations for the School of Medicine Graduate Programs.
- **Dismissal:** Students on academic probation must increase their cumulative GPA to above 3.0 within one academic term. Failure to do so may cause the student to be recommended for dismissal from the Medical Physics Graduate Program at the discretion of the Program Director. Students who do no increase their cumulative GPA to above 3.0 within four terms are dismissed from the program.