

# Radiation Science

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## College of Medicine

The Radiation Sciences division in the Department of Radiation Medicine offers a Plan B, non-thesis, Master of Science in Radiological Medical Physics degree and a Graduate Certificate in General Radiological Medical Physics. This program is one of a small number of academic medical physics offerings in North America accredited by CAMPEP, the Commission on Accreditation of Medical Physics Educational Programs. Our program offers a small class size (typically eight students per year) and emphasis on clinical training. With the clinical practicum, we offer a unique experience in clinical training with concentration in Radiation Therapy Physics. For more information, please visit <https://radiationmedicine.med.uky.edu/radiation-sciences-graduate-program>.

## Master of Science

### Admission Requirements

In addition to the general requirements of the Graduate School, the Radiological Medical Physics Program requires the following for MS candidates. At a minimum, candidates must show the equivalence of a minor in physics (as defined by CAMPEP). To meet this requirement, candidates must have completed the following: 1) Calculus through Ordinary Differential Equations; 2) The Calculus-based introductory General Physics sequence with labs (2 semesters); and 3) Three upper division Physics electives (junior level or above). Courses in Human Anatomy, Human Physiology, Computer Science, and Scientific Statistics are preferred but, if missing, may be incorporated into the graduate program at the discretion of the Director of Graduate Studies.

### Application Information

Application to the Radiation Sciences program is online through the Graduate School using the link [https://app.applyyourself.com/AYApplicantLogin/fl\\_ApplicantConnectLogin.asp?id=ukgrad](https://app.applyyourself.com/AYApplicantLogin/fl_ApplicantConnectLogin.asp?id=ukgrad). The applicant will be required to submit GRE General Test scores, transcripts for all undergraduate work, a personal statement, and contact information for three persons willing to provide letters of recommendation. Only self-reported, unofficial General GRE scores and transcripts are required at the time of application. Official versions must be submitted upon entry into the program. A CV may be included but is not required. A personal interview, typically on-campus, is required. However, on-line interviews may be allowed in cases of severe travel restrictions. Fluent spoken English skills are required and are assessed during the interview.

Admission to the program occurs once annually with new classes beginning in the Fall semester. The deadline for applications is April 30th, however, offers for admission are usually made early in the preceding spring semester with completion of the class roster by April 1st. There are a limited number accepted into our program (typically 8), therefore it is recommended that applications be completed by January 31st to assure full consideration. Applications received after the class roster is filled will not be reviewed.

### Degree Requirements

The Master of Science in Radiological Medical Physics is interdisciplinary. Plan B (non-thesis) guidelines are utilized for the graduate work, incorporating specific courses in several departments. There is no language requirement. A coursework outline is given as follows.

### Required Program Coursework

PHY/RM 472G	Interactions of Radiation with Matter	(3)
RAS/RM/PHY 545	Radiation Hazards and Protection	(3)
RAS/RM/PHY 546	General Medical Radiological Physics	(3)
RAS/RM 601	Advanced Radiation Dosimetry	(2)
RAS/RM 647	Physics of Diagnostic Imaging I	(3)
RAS/RM 648	Physics of Diagnostic Imaging II	(3)
RAS/RM 649	Physics of Radiation Therapy	(3)
RAS 651	Advanced Laboratory in Diagnostic Imaging Physics	(2)
RAS/RM 695	Research in the Health-Related Radiation Sciences	(2)
RAS 710	Radiation Science Seminar	(1)
RM/BIO 740	Mammalian Radiation Biology	(2)
Elective(s)		(3)
TOTAL CREDIT HOURS		30

### Available Electives (Partial Listing)

RM 660	Graduate Practicum in Radiation Medicine	(1-6)
RAS/RM 650	Brachytherapy Physics	(2)
RM 842	Radiation Oncology	(1)
RM 848	Practicum in Brachytherapy Physics	(1-3)
RM 849	Practicum in External Beam Therapy Physics	(1-6)
EE 630	Digital Signal Processing	(3)
EE 635	Image Processing	(3)

### Course Descriptions

#### RAS 472G INTERACTION OF RADIATION WITH MATTER. (3)

Basic aspects of the interaction of ionizing radiation with matter. Bohr atom, atomic spectra, radioactivity, energetics of decay. Sources of radiation, penetration of charged particles, electromagnetic radiation, and neutrons through matter; excitation and ionization processes; selected nuclear reactions; basic radiation detection and dosimetry. Prereq: PHY 213 or 232; MA 114 (may be taken concurrently); or equivalent. (Same as PHY/RM 472G.)

#### RAS 545 RADIATION HAZARDS AND PROTECTION. (3)

An analysis of common radiation hazards encountered in medicine, research, industry, and the environment. Regulations and procedures for the safe use of ionizing and nonionizing radiations. Lecture, two hours; laboratory, two and one-half hours. Prereq: PHY/RM 472G or consent of instructor. (Same as PHY/RM 545.)

#### RAS 546 GENERAL MEDICAL RADIOLOGICAL PHYSICS. (3)

The uses and dosimetric aspects of radiation in medicine will be analyzed, including many basic applications in the fields of diagnostic radiology physics, therapy physics, and nuclear medical physics. Prereq or concur: RM/PHY 472G or consent of instructor. (Same as PHY/RM 546.)

#### RAS 601 ADVANCED RADIATION DOSIMETRY. (2)

Advanced aspects of the interaction of radiation with matter and specialized topics in the dosimetry of ionizing radiations. Modifications of Bragg-Gray theory for application to megavoltage sources. Beta dosimetry. Specialized calibration techniques. Relative response functions of various media. Nontraditional techniques. Dosimetry of radiation fields including complex spectra. Prereq: PHY 472G, RM 546, or equivalent. (Same as RM 601.)

**RAS 647 PHYSICS OF DIAGNOSTIC IMAGING I. (3)**

Specialized and advanced topics in diagnostic imaging, including modulation transfer function analysis, image processing algorithms, acceptance testing, CT, NMR, ultrasound, etc. Prereq: PHY/RM/RAS 546 or consent of instructor. (Same as RM 647.)

**RAS 648 PHYSICS OF DIAGNOSTIC IMAGING II. (3)**

A continuation of RAS/RM 647. Specialized and advanced topics in nuclear medicine imaging physics, including positron emission tomographic procedures, emerging new modalities, and quality control. Prereq: RM/RAS 647 or consent of instructor. (Same as RM 648.)

**RAS 649 PHYSICS OF RADIATION THERAPY. (3)**

Specialized external beam and brachytherapy treatment planning; advanced Bragg-Gray cavity applications, including Ngas and TG21; calibration, acceptance testing, and quality control of therapy physics equipment. Prereq: RAS/RM/PHY 546 and RAS/RM 601, or consent of instructor. (Same as RM 649.)

**RAS 650 PHYSICS OF RADIATION THERAPY II: BRACHYTHERAPY PHYSICS. (2)**

A presentation of the full scope of use of implanted radiation sources for medical purposes. The course includes consideration of all aspects of brachytherapy dosimetry and treatment planning as well as modern and cutting-edge brachytherapy clinical practice. Characteristics of interstitial, intracavitary, and intraluminal implants, as well as remote afterloaders, are considered. Prereq: RAS/RM/PHY 546; RM/PHY 472G; RAS/RM 649 (may be co-requisite). (Same as RM 650.)

**RAS 651 ADVANCED LABORATORY IN DIAGNOSTIC IMAGING PHYSICS. (1-3)**

Specialized experiments involving the use, calibration, and quality control of x-ray and other diagnostic imaging equipment, and the appropriate use of radiation detectors in diagnostic physics measurements. Laboratory, approximately 30 hours per credit. May be repeated to a maximum of three credits. Prereq: RM/PHY 472G, RAS/RM 546; and concurrent: RAS/RM 647, or equivalent, plus graduate standing in the radiation science program.

**RAS 695 RESEARCH IN THE HEALTH-RELATED RADIATION SCIENCES. (1-4)**

Independent directed research on theoretical and practical problems in the health-related radiation sciences. May be repeated to a maximum of eight credits. Prereq: Graduate standing in one of the radiation-related sciences, plus consent of instructor. (Same as RM 695.)

**RAS 710 RADIATION SCIENCE SEMINAR (Subtitle required). (1)**

Topics of current interest relating to radiation and its applications in the areas of radiological medical physics and health physics. May be repeated to a maximum of four credit hours with consent of instructor. Prereq: Graduate standing in a radiation-related science.

**RAS 711 RESEARCH METHODS IN MEDICAL PHYSICS. (1)**

This course will introduce the student to, and give them practical experience in, writing research proposals, research reports and carrying out research work. The course will be jointly taught by various medical physics faculty and guest lecturers. Students will be asked to present their own work to be critiqued by the class. The goal is to give the student a hands-on experience of what is involved in doing funded clinical research on human subjects and getting it published in an academic journal. Prereq: Approval of instructor.

**RAS 767 DISSERTATION RESIDENCE CREDIT. (2)**

Residency credit for dissertation research after the qualifying examination. Students may register for this

course in the semester of the qualifying examination. A minimum of two semesters are required as well as continuous enrollment (Fall and Spring) until the dissertation is completed and defended.

**RAS 849 RADIATION SCIENCES PRACTICUM. (1-6)**

Applied practicum experiences in the radiation sciences. Laboratory, 40 hours per week equals one credit hour. Prereq: Advanced graduate standing the in radiation sciences.