



# Graduate Bulletin

2009 - 2011

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**King Fahd University of Petroleum & Minerals**

# **GRADUATE BULLETIN**

**2009 -2011**

**Dhahran 31261, Saudi Arabia**

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# About this Bulletin

The Graduate Bulletin of King Fahd University of Petroleum & Minerals (KFUPM) is an official publication of the University issued by the Office of the Dean of Graduate Studies. The current document was prepared during the 2007/2008 academic year and printed in the spring of 2009. The contents were compiled from inputs received from the various academic departments and administrative offices throughout the University. All changes from the previous Bulletin were verified against the Graduate Council's decisions.

The Bulletin gives, at the time of printing, up-to-date information about all graduate programs, some of which have been recently modified or introduced. It provides detailed information about each graduate academic program offered at KFUPM, a helpful summary of the University policies and procedures pertinent to graduate studies, selected activities and services, and a listing of the administrative officers and faculty. It is hoped that the Bulletin will serve as a useful guide to faculty members, graduate students, and staff whenever questions arise regarding the relevant University's rules and regulations, the graduate courses and their prerequisites, the degree requirements, and other academic matters.

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**Dr. Abdul Muttaleb Jaber**

Professor

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Editor, Graduate Bulletin

2009-2011

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# FOREWORD

The principle objective of the Deanship of Graduate Studies at KFUPM is to offer education beyond the baccalaureate level to those who aspire to become intellectual leaders in the professions and in various fields of teaching and scientific research. It undertakes to assist graduate students in developing and pursuing individual educational programs requiring superior accomplishment through carefully directed intellectual activity. Also, the primary purpose of the graduate programs is to train the creative type of scientist or engineer so urgently needed in educational, governmental and industrial development.

The purpose of this Bulletin is to provide information about the graduate programs of KFUPM to current and prospective students, as well as to the faculty and staff of the University. Information concerning requirements for admission to the graduate programs of KFUPM, the University research supporting units, services available to students, graduate course offerings and listings of the current graduate faculty and administrators of the University are all included in the Bulletin.

In the Graduate programs, KFUPM offers courses leading to the degree of Master of Science, Master of Engineering, Master of Business Administration, Master of City and Regional Planning, Master of Environmental Science, and Doctor of Philosophy in various disciplines.

Since it has been established in 1972, the Deanship of Graduate Studies (previously known as College of Graduate Studies) at KFUPM, has witnessed a phenomenal expansion. Currently 33 programs are being offered at the Master and 9 at the Ph.D. levels. These programs span the fields of Engineering, Science, Management, and Environmental Design.

At the start of the third millennium, the Graduate Studies at KFUPM is facing several challenges. First, the graduate programs

have to be current and dynamic to keep up with and be able to accommodate the fast developments in knowledge and technology. Second, it has to accommodate more students, many of whom will be part-timers who do not fit the traditional model of a full time residential student. Third, the quality of the graduate education provided by KFUPM has to equal or surpass standards set by the international academic community. Fourth, to implement graduate studies of high quality within the unified regulations issued by the Ministry of Higher Education. Fifth, the Deanship of Graduate Studies has to develop effective ways and means to disseminate knowledge into the University and its surrounding community and to contribute and enhance the undergraduate education. In order to meet these challenges, the Deanship is continuously enhancing the flexibility and variety of its course offerings, forged stronger links with the international academic community through such innovative programs as scholarship and research assistantship programs and established a permanent system of independent periodic evaluation of graduate programs. It has also moved steadily to strengthen ties with industry through programs to establish endowment scholarships and industry-related projects.

The University has also been trying to upgrade its standards by having its programs evaluated by international bodies such as Accreditation Board of Engineering Technology (ABET), and the Association to Advance Collegiate School of Business (AACSB).

Currently, about 1000 students are pursuing studies in graduate programs spanning various disciplines. The University has a full-time faculty of more than 800. The faculty members are also very active in research-related work in their areas of specialization, thus contributing to the general atmosphere of intellectual curiosity and creative activity generated on the KFUPM Campus.

**Dr. Salam Adel Zummo**

Dean of Graduate Studies

## MASTER'S PROGRAM IN MEDICAL PHYSICS

### MEDICAL PHYSICS

Medical physics is an applied branch of physics concerned with the application of the concepts and methods of physics to the diagnosis and treatment of human disease. The main areas of medical physics are the treatment of cancer by ionizing radiation (radiation oncology), diagnostic imaging with X-rays, ultrasound and nuclear magnetic resonance (diagnostic radiology), diagnostic imaging with radioisotopes (nuclear medicine) and the study of radiation hazards and radiation protection (health physics).

### ADMISSION REQUIREMENTS

Motivated applicants who have a B.S. degree in science or engineering from a university of recognized standing are invited to apply for admission to the Master's degree in medical physics, provided they satisfy the general admission requirements of the Graduate School. Applicants must have a suitable scientific background to enter the medical physics program demonstrated by the completion of the following KFUPM courses or their equivalent: Methods of Applied Mathematics (MATH 301), Modern Physics (PHYS 212), Experimental Physics I (PHYS 303). Applicants must make up any deficiencies in their prior program within two semesters of enrollment. Once accepted in the program, graduate students are required to take a full time course load.



## ACADEMIC PROGRAM

The following are the requirements for the Master's degree in Medical Physics.

Course	Credit hours
1. Completion of core courses	18
2. Completion of elective courses	15
3. Completion of clinical training	6
4. Completion of Med Phys Project	3
5. Passing the comprehensive examination	-
<b>Total Credit Hours</b>	<b>42</b>

### Core Courses

The following core courses are required for the Master's degree in Medical Physics.

COURSE #	TITLE	CR
MEPH 500	Human Anatomy Physiology .....	3
MEPH 510	Radiobiology .....	2
MEPH 561	Radiological Physics and Dosimetry .....	3
MEPH 563	Radioisotopes in Medicine and Biology .....	3
MEPH 566	Radiotherapy Physics .....	3
MEPH 567	Diagnostic Radiology Physics .....	4
MEPH 569	Health Physics .....	4
		<b>22</b>

### Elective Courses

A candidate for the Master's degree in medical physics will also be required to take 15 credit hours to be chosen as follows:

1. A minimum of 3 credit hours to be selected from the following list of courses.

COURSE #	TITLE	CR
MEPH 581	Laboratory in Radiological Physics – Radiotherapy.....	1
MEPH 582	Laboratory in Radiological Physics – Diagnostic Radiology .....	1
MEPH 583	Laboratory in Radiological Physics – Nuclear Medicine .....	1
MEPH 584	Laboratory in Radiological Physics – Health Physics .....	1
MEPH 585	Laboratory in Radiological Physics – CT, MRI, and DSA .....	1
MEPH 586	Laboratory in Radiological Physics – Medical Ultrasound .....	1

2. The remaining credit hours are to be selected from the following list of courses.

A minimum of 12 credit hours to be selected from the following list of courses.

COURSE #	TITLE	CR
MEPH 501	Physics for Medicine and Biology .....	3
MEPH 511	Instrumentation for Medical Physics .....	3
MEPH 568	Magnetic Resonance Imaging (MRI).....	2
MEPH 570	Advanced Brachytherapy Physics.....	2
MEPH 571	Advanced External Radiation Oncology.....	3
MEPH 573	Imaging in Medicine .....	3
MEPH 574	Applications of Digital Imaging: DSA, CT, MRI .....	2
MEPH 575	Diagnostic Ultrasound Physics .....	3
MEPH 591	Selected Topics in Medical Physics .....	3
MEPH 592	Independent Reading.....	3
EE 614	Digital Signal Processing .....	3
EE 617	Image Processing and Holography .....	3
MATH 513	Mathematical Methods for Engineers .....	3

## CLINICAL TRAINING

Clinical medical physics training is obtained in the Laboratory in Radiological Physics courses (MEPH 581-586). Each laboratory involves performing particular experiments and procedures in hospitals. Additional clinical medical physics training is obtained in the clinical training course (MEPH 590). The course consists of a 16-week hospital-based clinical rotation in: diagnostic imaging (x-rays, CT, DSA, fluoroscopy, diagnostic ultrasound), MRI, nuclear medicine, radiation therapy, mammography, radiation protection, and health physics. A student in this course observes and practices clinical procedures under the direct supervision of a senior clinical medical physicist. The student will write a monthly progress report about the clinical procedures he learned and performed. The evaluation and the follow-up of each student will be done in cooperation between the supervising medical physicist from the hospital and a medical physics faculty member from KFUPM.

## COMPREHENSIVE EXAMINATION

All candidates for the Master's Degree in Medical Physics are required to take a written comprehensive examination prior to receiving the degree. The examination is offered near the end of each semester and consists of questions on the core courses. Candidates are advised to take this exam at the end of the semester in which they complete the courses. A candidate who fails the examination may repeat it at a later regularly scheduled time. Only one such repeat is permitted.



### Degree Plan for the Master's Program in Medical Physics

COURSE #	TITLE	LT	LB	CR
<b>First Semester</b>				
MEPH 500	Human Anatomy	3	0	3
MEPH 510	Physiology Radiobiology	2	0	2
MEPH 561	Radiological Physics and Dosimetry	3	0	3
MEPH 567	Diagnostic Radiology Physics	3	3	4
		<b>11</b>	<b>3</b>	<b>12</b>
<b>Second Semester</b>				
MEPH 563	Radioisotopes in Medicine and Biology	2	3	3
MEPH 566	Radiotherapy Physics	2	3	3
MEPH 58x	Elective Lab in Radiological Physics	0	3	1
XXX xxx	Elective	3	0	3
		<b>7</b>	<b>9</b>	<b>10</b>
<b>Third Semester</b>				
MEPH 569	Health Physics	3	3	4
MEPH 58x	Elective Lab in Radiological Physics	0	3	1
MEPH 58x	Elective Lab in Radiological Physics	0	3	1
XXX xxx	Elective	3	0	3
MEPH 599	Seminar	1	0	0
		<b>7</b>	<b>9</b>	<b>9</b>
<b>Fourth Semester</b>				
MEPH 590	Clinical Training	0	0	6
MEPH 600	Medical Physics Project	0	0	3
		<b>0</b>	<b>0</b>	<b>9</b>
<b>Total Credit Hours</b>				<b>42</b>

## COURSE DESCRIPTION

### **MEPH 500 Human Anatomy and Physiology (3-0-3)**

The course will cover subjects including cell physiology, organs and systems physiology and anatomy. The student will learn to identify gross anatomical structures, define the major organ systems, and describe the physiological mechanisms for repair, maintenance, and growth. Anatomical structures and physiological function should be correlated with imaging modalities to view them.

*Prerequisite:* Instructor Consent

### **MEPH 501 Physics for Medicine and Biology (3-0-3)**

Forces on bones and muscles; body fluid flow; electrodynamics of nerve impulses; electrocardiograms; magnetocardiograms and magnetoencephalograms; diffusion processes, membrane transport, kidney function; biological effects in magnetic resonance and ultra-low frequency electromagnetic radiation; laser applications.

*Prerequisite:* PHYS 212 or equivalent

### **MEPH 510 Radiobiology (2-0-2)**

Effects of ionizing radiations on living cells and organisms, including physical, chemical, and physiological bases of radiation cytotoxicity, mutagenicity, and carcinogenesis.

*Corequisites:*MEPH 561

### **MEPH 511 Instrumentation for Medical Physics (2-3-3)**

Concepts of medical instrumentation, transducers, and medical electronics design. Various types of sensors and measurement apparatus used for the calibration of medical imaging and therapy systems will receive particular attention.

*Prerequisite:* PHYS 303 or equivalent

### **MEPH 561 Radiological Physics and Dosimetry (3-0-3)**

Interactions and energy deposition by ionizing radiation in matter; concepts, quantities and units in radiological physics; principles and methods of radiation dosimetry.

*Prerequisites:* PHYS 212; MATH 202 or equivalent

**MEPH 563 Radioisotopes in Medicine and Biology (2-3-3)**

Physical principles of radioisotopes used in medicine and biology and operation of related equipment; lecture and lab.

*Prerequisite:* PHYS 212 or equivalent

**MEPH 566 Radiotherapy Physics (2-3-3)**

Ionizing radiation use in radiation therapy to cause controlled biological effects in cancer patients. Physics of the interaction of the various radiation modalities with body-equivalent materials, and physical aspects of clinical applications; lecture and lab.

*Prerequisite:* MEPH 561

**MEPH 567 Diagnostic Radiology Physics (3-3-4)**

Physics of x-ray diagnostic procedures and equipment, radiation safety, general imaging considerations; lecture and lab.

*Prerequisites:* PHYS 212; MATH 202 or equivalent

**MEPH 568 Magnetic Resonance Imaging (MRI) (2-0-2)**

Physics and technology of magnetic resonance imaging (MRI), emphasizing techniques employed in medical diagnostic imaging. Major topics: physics of MR, pulse sequences, hardware, imaging techniques, artifacts, and spectroscopic localization.

*Prerequisite:* MEPH 567

**MEPH 569 Health Physics (3-3-4)**

Physical and biological aspects of the use of ionizing radiation in industrial and academic institutions; physical principles underlying shielding instrumentation, waste disposal; biological effects of low levels of ionizing radiation; lecture and lab.

*Prerequisite:* MEPH 561

**MEPH 570 Advanced Brachytherapy Physics (2-0-2)**

The use of radioactive sources for radiotherapy including: materials used, source construction dosimetry theory and practical application, dosimetric systems, localization and reconstruction. The course covers low dose rate, high dose rate and permanently placed applications.

*Prerequisite:* MEPH 566

**MEPH 571 Advanced External Radiation Oncology (3-0-3)**

Physics of ionizing radiation therapy with emphasis on external beam dosimetry and treatment planning.

*Prerequisite:* MEPH 566

**MEPH 573 Imaging in Medicine (3-0-3)**

The conceptual, mathematical and statistical aspects of imaging science, and a survey from this formal viewpoint of various medical imaging modalities, including film-screen radiography, positron and x-ray computed tomography, and magnetic resonance imaging.

*Prerequisites:* PHYS 212; MATH 301 or equivalent

**MEPH 574 Applications of Digital Imaging: DSA, CT, MRI (2-0-2)**

This course will focus on practical aspects of digital diagnostic imaging. The course will cover digital subtraction angiography (DSA), x-ray transmission computed tomography (CT), and nuclear magnetic resonance imaging (MRI).

*Prerequisites:* MEPH 561, MEPH 567

**MEPH 575 Diagnostic Ultrasound Physics (2-3-3)**

Propagation of ultrasonic waves in biological tissues; principles of ultrasonic measuring and imaging instrumentation; design and use of currently available tools for performance evaluation of diagnostic instrumentation; biological effects of ultrasound; lecture and lab.

*Prerequisites:* PHYS 212; MATH 202 or equivalent

**MEPH 581 Laboratory in Radiological Physics – Radiotherapy (0-3-1)**

Practicing the protocol for the determination of absorbed dose from high-energy photon and electron beams. Performing dosimetry and quality assurance for radiation therapy machines. Participating in treatment plans of cancer patients.

*Prerequisite:* MEPH 566

**MEPH 582 Laboratory in Radiological Physics – Diagnostic Radiology (0-3-1)**

Measuring the performance of clinical x-ray, mammography, fluoroscopy and angiography machines. Performing dosimetry tests and quality assurance.

*Prerequisite:* MEPH 567

**MEPH 583 Laboratory in Radiological Physics – Nuclear Medicine (0-3-1)**

Practicing the acceptance and quality assurance procedures for Nuclear Medicine imaging and non-imaging hardware. Practicing regulations and record keeping associated with the acquisition and dispensing of radio-pharmaceuticals. Radiation safety of patients, personnel, and area monitoring.

*Prerequisite:* MEPH 563

**MEPH 584 Laboratory in Radiological Physics – Health Physics (0-3-1)**

Performing dosimetry procedure to monitor ionizing radiation in hospital and radiation areas. Performing shielding tests and shielding design. Practicing regulations and record keeping associated with radiation monitoring and radiation safety.

*Prerequisite:* MEPH 569

**MEPH 585 Laboratory in Radiological Physics – CT, MRI, and DSA (0-3-1)**

Performing acceptance and quality assurance tests on CT, DSA and MR scanners and machines. Performing dosimetry measurements to insure radiation safety.

*Prerequisite:* MEPH 567

**MEPH 586 Laboratory in Radiological Physics – Medical Ultrasound (0-3-1)**

Performing acceptance and quality assurance tests for clinical diagnostic ultrasound scanners. Operating clinical ultrasound equipment independently.

*Prerequisites:* PHYS 212; MATH 201 or equivalent

**MEPH 590 Clinical Training (0-0-6)**

The course consists of a 16-week hospital-based clinical rotation in: diagnostic imaging (x-rays, CT, DSA, fluoroscopy, diagnostic ultrasound), MRI, nuclear medicine, radiation therapy, mammography, radiation protection, and health physics. The student will write a monthly progress report about the clinical procedures he learned and performed.

*Prerequisite:* Department Approval

**MEPH 591 Selected Topics in Medical Physics (3-0-3)**

Various subjects of interest to medical physics faculty and students.

*Prerequisite:* Consent of the Instructor

**MEPH 592 Independent Reading (3-0-3)**

The course can be taken under the supervision of a faculty member to conduct an in-depth study of a subject.

*Prerequisite:* Consent of the Instructor

**MEPH 599 Seminar (1-0-0)**

Graduate students are required to attend the regular departmental seminars. This course carries no credit and is graded on a Pass or Fail basis.

*Prerequisite:* Graduate Standing

**MEPH 600 Medical Physics Project (0-0-3)**

The project is an independent study performed under the supervision of a medical physics faculty advisor. The report should include an introduction to the topic, literature review, research methodology, analysis of data, conclusions and recommendations, appendices and references. The report will be presented and evaluated by a faculty committee.

*Prerequisite:* Graduate Standing

