UCLouvain

wrdth3120

2023

Fundamental of dosimetry

3.00 credits	20.0 h	Q1

Teacher(s)	Sterpin Edmond ;
Language :	English
Place of the course	Bruxelles Woluwe
Main themes	A. INTRODUCTION - Definition of absorbed dose, KERMA and CEMA - Different types of ionizing beams used in radiotherapy B. INTERACTIONS WITH MATTER - Charged particles - Photons. - Neutrons. C. INTEGRATING DOSIMETRY DETECTORS - Calibration chain for dosimetry detectors - Calorimetry - Ionization Chambers. - Thermoluminescence. - Films. - Diodes. - Chemical dosimetry D. DETERMINATION OF THE ABSORBED DOSE IN A CLINICAL BEAM UNDER REFERENCE CONDITIONS - Calibration of an ion chamber in terms of Air-KERMA - Calibration of an ion chamber in terms of absorbed dose in water - Dosimetry recommendations based on Air-Kerma standards based on absorbed dose in water - Determination of the absorbed dose under non-reference conditions - Dosimetry audits E. INTRODUCTION TO RADIOTHERAPY TECHNIQUES
Learning outcomes	
Evaluation methods	The written part amounts for 70% of the mark. The oral part 30% of the mark **All teaching material is available for the written part and amounts for 70% of the grade** (30% theoretical questions; 40% exercises).The openbook format should be seen by the student as a way to improve comfort and avoid memorizing lengthy equations or definitions. However, in order to succeed to the exam, it is expected that the student knows the teaching material. Otherwise, it will take too long to the student to answer the questions of the exam. The questions are asked in a way it is possible to answer them without referring to the course if the latter is well known. The oral part amounts to 30% of the score. Short questions are asked and the student need to make developments on the fly. **The teaching material is not available for the oral part**
Teaching methods	The course associates regular theoretical lectures and in-class exercises. All theoretical lectures are either pre-recorded or recorded (if pre-record is not available). Therefore, in-class teaching can be adapted depending on the requests of the students present in class. When a pre-record is available, we favor a dynamic teaching with large developments on the black board on specific parts of the course. The students are encouraged to vision the pre-recorded courses before the in-class session so that they can ask specific questions and developments. Some exercises will be solved in class, while others should be solved at home. Solutions to the exercises will be provided during the semester. Students who cannot attend physically are strongly encouraged to contact the teacher in case of a difficulty to solve an exercise. **The introduction to the course (course schedule; presentation of summary and teaching material; evaluation methodology; practical considerations) will be streamed and recorded.** **After the introduction, no streaming is foreseen for the courses when a pre-record is available. This is the default format (no streaming, but a pre-recorded course).** In the case a pre-record is not available, the course will follow a classic format with a power point presentation. In the latter case (no pre-record), and only in that case, the courses will be streamed as well. It will be made clear to all students when a streaming option will be made available. But the students should assume there is no streaming option.There will be many possibilities for the students having difficutlies to come to the course to ask their questions. Specific (streamed) sessions could be envisaged for answering questions. The contents that will be subject to evaluation **are the ones and only the ones available in recorded material (slides and explanations) + the exercises.**
Content	Please ignore what is written in the section "Main Themes". What follows replaces. This teaching unit consists in acquiring the theoretical principles of radiation dosimetry. The goal is to develop an intuition about dosimetry from basic principles, as a strong foundation before studying the applications of radiation dosimetry in the other courses for radiotherapy, nuclear medicine, and radiology. The course is organized around 7 main themes: 1. The interactions of particles with matter from the point of view of the medical physicist 2. Field and dosimetric quantities. Concept of charged-particle equilibrium 3. Characterization of radiation quality 4. Cavity theory 5. Radiation detectors from a medical physicist's perspective 6. Introduction to reference dosimetry for kV and MV beams 7. Small field dosimetry More detailed content: **1 General introduction**

	2 Direct dose deposition 2.1 Stopping Power - CSDA approximation 2.1.1 Heavy charged particles 2.1.2 Electrons and positrons 2.2 Radiation yield 2.3 Limited stopping power - LET 2.4 Range 2.5 Dose in thin and thick foil **3 Indirect dose deposition** 3.1 Photon interactions (rep.) 3.1.1 Transferred energy 3.1.2 Net transferred energy 3.1.3 Transmitted energy **4. Field and dosimetric definitions and units** 4.1 Radiation field quantities and units (particle fluence, flux…) 4.2 Radiation interaction quantities (cross sections, attenuation coefficients, stopping powers) 4.3 Dosimetric quantities (exposure, absorbed dose, KERMA) 4.4 Relations between field and dosimetric quantities 4.5 Radiation equilibrium **5 Characterization of beam quality** 5.1 Generalities 5.2 KV X-rays 5.3 MV X-rays 5.4 Electron beam specification 5.5 Protons and heavier charged particles 5.6 Energy spectra determination **6 Cavity theory** **7 Overview of Radiation Detectors and Measurements** 7.1 Generalities 7.2 Detector response and calibration coefficient 7.3 Absolute, reference, and relative dosimetry 7.4 General characteristics and desirable properties of detectors 7.5 Brief description of various types of detectors from the point-of-view of the medical physicist **8 Primary radiation standards** **9 Ion chambrer measurements** 9.1 Basic principles 9.2 Correction for influence quantities: temperature-pressure, polarity, ion recombination **10 Reference dosimetry** 10.1 For MV beams 10.2 For kV beams **11 Small field dosimetry**
Inline resources	All slideshows, recordings, and most appendices are on TEAMS
Bibliography	• Handbook of Radiotherapy Physics (Mayles, Nahum, Rosenwald) • Fundamentals of Ionizing Radiation Dosimetry by Andreo et al, 2017 edition.
Other infos	The language of the lectures and all materials is ENGLISH
Faculty or entity in charge	MED

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Biomedical Engineering	GBIO2M	3		
Advanced Master in Radiotherapy-Oncology	RDTH2MC	3		
Certificat universitaire en physique d'hôpital	RPHY9CE	3		
Master [120] in Physics [professional focus of Medical Physics : UCLouvain-KULeuven]	PHYS2M	3		
Master [120] in Medical Physics	PHMD2M	3		