UCLouvain

wrdth3160

2024

Technology, Dosimetry and Treatment Planning in Radiotherapy

5.00 credits	20.0 h + 60.0 h	Q1

Teacher(s)	. SOMEBODY ;Sterpin Edmond (coordinator) ;
Language :	English
Place of the course	Bruxelles Woluwe
Main themes	A. Production of radiotherapy beams : - Cobalt-60, - linear accelerators, - neutron beams, proton beams, heavy ion beams. B. Definition of dosimetry quantities for radiotherapy: - PDD, RTM, RTA, OAR, isodoses, BSF, PSF. C. Quality assurance in radiotherapy : - definition and importance - recommendations - quality control in radiotherapy -quality control of CT scanners - quality control of linear accelerators - quality control of treatment planning systems - in-vivo dosimetry D. Calculation methods for external beam therapy - matrix system in TPS - separation of scatter and primary beam - pencil beam methods - Monte Carlo calculations E. Dosimetry for Brachy therapy
Learning outcomes	
Evaluation methods	Lab reports amount for 30% of the mark (15% each). This grade is final (no possiblity to change the grade for a second session). The exam amounts for 70% of the mark (40% for the written part; 30% for the oral part) **All teaching material is available for the written part**. This 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 practical sessions.
	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.
	Physical presence is **mandatory** for the practical sessions. The schedule will be given during the first course. No streaming **nor** recording are foreseen for the practical sessions (one session for dose calculation lab; one session for margin lab).
	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).
	There will be two "lab" assignments for the students
	• Implementation of a pencil beam dose calculation algorithm:
	  • The students will have to solve a dose calculation problem, with a short Python program.
	  • The goal is to show the potential and limitations of pencil beam dose convolution. Monte Carlo data is provided for comparison.
	  • The code and the report need to be given to the teacher. They will be both graded. Conciseness is encouraged for the report
	• Computation of PTV safety margins
	  • The students will be given exercises and also simulation material in order to gain a practical understanding of PTV safety margin recipes
	  • A report will be required. Again, conciseness is encouraged.

Content	Please ignore what is written in the section "Main Themes". What follows replaces. The principle is to teach students the essential theoretical concepts underlying the practice of radiotherapy, both to prepare the student for a possible internship in a radiotherapy department, or to provide a solid knowledge of the field appreciated by companies working in the field. The course is structured around the following objectives 1. Teach students the basic algorithmics of dose calculation engines. The student will have to implement a pencil beam dose calculation algorithm as a lab work. 2. Introduction to detector technology spectific to radiotherapy (including arrays, film, EPID, …) 3. To transmit the general principles underlying the delineation of volumes in radiotherapy (mainly GTV - CTV - PTV), as well as their specificities according to the localizations. The concept of PTV safety margins will be detailed, and illustrated with a lab. 4. Introduce recent developments in the radiotherapy field: probabilistic planning, robust planning, adaptive radiotherapy, automatic planning with artificial intelligence, **Theoretical content** • Treatment delivery technologies • Dose calculation • Detector technology spectific to radiotherapy (including arrays, film, EPID, …) • Clinical background of radiotherapy: definition of GTV, CTV, and PTV • Management of uncertainties in treatment planning (safety margins, probabilistic planning, and robust optimization) • Motion management in radiotherapy • Modern radiotherapy treatment planning techniques (AI-guided treatment planning; adaptive radiotherapy) **Practical content** • Dose calculation lab (the students will have to write down their own code in Python for a pencil beam dose convolution algorithm; and then discuss their strengths and weaknesses; reference Monte Carlo data will be provided) • PTV safety margin computation lab
Inline resources	All slideshows and most appendices are on TEAMS Recordings also
Bibliography	**Teaching material** **Mandatory** • Recorded theoretical lectures • Course slides **Support (optional)** • Papers • “Fundamentals of Ionizing Radiation Dosimetry”, by Andreo, Burns, Nahum, Seuntjens, and Attix (Wiley, 2017) • "Handbook of radiotherapy physics" (Mayles, Nahum, Rosenwald)
Other infos	The course is integrally given in 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	5		🔍
Advanced Master in Radiotherapy-Oncology	RDTH2MC	5		🔍