ACADÉMIE DE RECHERCHE ET D'ENSEIGNEMENT SUPÉRIEUR

RÉFÉRENTIEL DE COMPÉTENCES

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MASTER IN MEDICAL PHYSICS

FINALITÉ(S) ORGANISÉE(S)	Spécialisée	NIVEAU (du Cadre des Certifications)	7
SECTEUR	3. Sciences et techniques	DOMAINE D'ÉTUDES	17. Sciences
TYPE	LONG	CYCLE	DEUXIÈME
LANGUE (majoritaire)	ANGLAIS	CRÉDITS	120

A. SPÉCIFICITÉ DE LA FORME D'ENSEIGNEMENT

En vertu du Chap. II Art.4 §3 du décret « Paysage » qui stipule que « par essence, l'enseignement universitaire est fondé sur un **lien étroit entre la recherche scientifique et les matières enseignées** », les universités offrent une formation cohérente à, et par la recherche, soutenant l'acquisition progressive de compétences complexes. Cette spécificité requiert d'inviter les équipes d'enseignants, toutes **actives dans la recherche et reconnues par les communautés scientifiques de référence**, à intervenir aux niveaux 6 (bachelier), 7 (master) et 8 (docteur) du cadre des certifications de l'enseignement supérieur.

Même si l'objectif de l'ensemble des étudiants n'est pas nécessairement de viser le niveau 8 de ce cadre de certification, ils sortiront néanmoins diplômés, aux niveaux 6, 7 ou 8, en ayant progressé sur ce continuum d'enseignement et de recherche qui leur est proposé par les **enseignants-chercheurs** de l'université. Concevoir d'entrée de jeu la formation sous la forme d'un continuum sur deux cycles (niveaux 6 et 7), voire trois (niveau 8), permet aux enseignants d'amener graduellement les étudiants à une maîtrise des savoirs scientifiques et compétences spécifiques - et transversaux - ainsi qu'à une compréhension approfondie des épistémologies sous-jacentes.

Cette formation exige que les enseignants qui l'assument soient formés, dans leur grande majorité, au niveau 8 de ce cadre de certification et **impliqués dans une pratique quotidienne de recherche au sein de laboratoires reconnus par la communauté scientifique**. À ce titre, ils stimulent les mécanismes d'appropriation de la démarche scientifique. Point d'orgue de cette appropriation, **le mémoire incarne l'intégration de compétences complexes en permettant à l'étudiant de prendre part à la création du savoir scientifique**.

Au-delà de la recherche, cette formation de haut niveau permet aux étudiants de faire face à des situations professionnelles complexes, changeantes, incertaines en adoptant une posture inspirée de l'activité de recherche.

Outre les aspects développés dans le cadre des certifications pour les niveaux 6 et 7, l'université veille à développer dans toutes ses formations les compétences suivantes :

- Se construire un bagage méthodologique pertinent dans le champ de la spécialisation théorique, y compris des capacités de création et d'adaptation de modèles, d'instruments ou de procédures ;
- Adopter une approche critique d'un phénomène en mobilisant les modélisations théoriques adéquates ;
- Adopter une approche systémique et globale d'un phénomène : percevoir le contexte et ses enjeux, les différents éléments de la situation, leurs interactions dans une approche dynamique ;
- Synthétiser avec discernement les éléments essentiels d'un phénomène, faire preuve d'abstraction conceptuelle afin de poser un diagnostic basé sur les preuves et de dégager des conclusions pertinentes ;
- Élaborer une démarche rigoureuse d'analyse et de résolution de problématiques incluant traitement de données, interprétation de résultats, formulation de conclusions scientifiques et élaboration de solutions dont la faisabilité et la pertinence sont évaluées ;
- Développer une culture personnelle en épistémologie et histoire de sa discipline ainsi qu'en éthique des sciences, culture indispensable au développement d'une pensée critique et réflexive fondée sur des savoirs qui prennent la science et son développement comme objets.

B. SPÉCIFICITÉ DE LA FORMATION

This programme 'Master of Medical Physics', for which KU Leuven and UCLouvain are joining forces, aims to train 'medical physics experts with a specialization in radiology, nuclear medicine or radiotherapy' as defined by the Royal Decree of April 26, 2012 amending the Royal Decree of July 20, 2001 on regulations for the protection of the population, employees and the environment against the danger of ionizing radiations (Belgisch Staatsblad/Moniteur belge of 01.06.2012 - p. 31118 to 31120 - art. 12).

Apart from providing a strong background in fundamental sciences related to radiation physics (e.g. nuclear physics, mathematics, and radiochemistry), and in the anatomy and physiology of the human body, including the effects of ionizing radiations, the programme focuses strongly on techniques and technology in each of the three specializations of medical physics, i.e. radiology, nuclear medicine, and radiotherapy. It further contains a significant part of clinical work via two clinical training periods in a hospital (internships), as well as a large research component with the master's thesis, also in a hospital. The programme, finally, also includes several courses on different aspects of safety and on ethics.

Medical physics experts usually work in a hospital setting, in the medical industry, a research institution or for a governmental organization. They have extensive knowledge of medical imaging and nuclear medicine (in particular radiology, the different scanner-related techniques and preparations with radioactive isotopes for diagnosis or therapy), and of the different forms of radiotherapy. Especially in a hospital, where the majority of graduates end up, a medical physics expert bears an important responsibility. As a medical specialist in healthcare with knowledge of physical principles, the medical physics expert ensures that new and existing medical equipment and techniques are used safely and responsibly to optimize the diagnosis and treatment of patients. His/her tasks include: quality control of equipment that can release ionizing radiation, preparations with radioactive isotopes, support of the medical team in drawing up radiation plans, radiation protection, device-related dosimetry, cooperation (together with the medical team) in patient-related dosimetry, the calibration of instruments and measuring devices for dosimetry and radioactivity measurement, the development, implementation and follow-up of procedures for quality control, and the provision of advice in the preparation of specifications for the purchase of new devices. At the same time, the medical physics expert keeps abreast of recent developments in the field, such as new safety standards, and recent research and technical developments and innovations.

KU Leuven and UCLouvain, together with their respective hospitals UZ Leuven (University Hospital Leuven) and Cliniques universitaires Saint-Luc (at Woluwe), have extensive clinical expertise in medical imaging, nuclear medicine and the various forms of radiotherapy, as well as expertise in both education and research and development around these medical technologies.

The new programme 'Master of Medical Physics' will offer a joint diploma and will replace the programmes that are currently existing at both KU Leuven and UCLouvain. KU Leuven is currently offering an advanced master in medical physics, while UCLouvain offers a 'professional focus (finalité spécialisée): physique médicale' in its master of physics programme.

In combination with these master programmes both universities also currently offer a professional internship, in the form of a postgraduate certificate programme, so as to meet the criteria for obtaining the certificate of 'deskundige in de medische stralingsfysica/expert en radiophysique médicale' (expert in medical physics). At both universities the trajectory giving access to this 'certificate' can also be started by first obtaining the degree of Master of Biomedical Engineering and then continuing with an abridged programme of the medical physics studies.

With this new master programme of two years:

- both universities would like to realize a better match with the recent scientific and technical evolution in the field of medical physics, thereby educating medical physics experts with state- of-the-art knowledge and competencies. In this respect it is interesting to mention that in the past few years both universities joined forces to construct (together with other partners) a center for proton therapy, the first in Belgium, at the UZ Leuven campus, which became operational in the summer of 2020.
- both universities would like to realize a better match with the needs of the labour world. Indeed, the scientific and technical advancements have led to an increase in the amount of medical physics-related diagnostics as well as therapies, leading to a larger demand for medical physics experts.

Apart from this, the recent Royal Decree of 13 February 2020, known as the “Medical Exposures e Decree”, amends the Royal Decree of 20 July 2001, also known as the “General Regulations” (ARBIS), in several places. It thereby requires that every license holder of an establishment with medical-radiological installations must install a medical physics service, analogous to the services for physical control and for prevention and protection at work (cf. art.27bis and 27ter, FANC Law). The development of a full service of medical physics in many hospitals, in order to comply with the new legislation as an institution, will certainly stimulate the demand for experts in medical physics.

- both universities would like to rationalize by combining the resources used for their current medical physics programmes which both address a limited number of students. Combining the expertise in education, training and research in medical physics that is available at both universities and in their respective hospitals, will lead to a higher-quality education.
- both universities would also like to realize a better match with the European guidelines on the medical physics education.
- this new 2-years master programme is a first important step towards a common national medical physics programme. There is a general consensus among the relevant actors in Belgium to organize the medical physics education in the near future at a national level, with two main parts:
  - two years of academic master organized by the universities,
  - two years of professional training (internship + professional courses) organized at national level.

  This has been discussed at several meetings during the past two years, e.g.
  - during the discussion with external experts from the medical physics programmes at the University of Liège and Ghent University / VUB (Vrije Universiteit Brussel) as part of the so-called Cobra internal quality assessment of the existing KU Leuven master programme in medical physics (on March 19th, 2019),
  - at a meeting of all parties involved (i.e the educational programmes, hospitals, the ministry, the FANC-Federal Agency of Nuclear Control, and the Belgian Hospital Physicists Association, BHPA) at the FANC (on October 1st, 2019),
  - at a meeting at the Symposium of the BHPA (on February 7th, 2020).
- with this new programme, we of course still want to provide access to the ‘certificate of medical physics expert’ (‘certificaat van deskundige in de medische stralingsfysica’ or ‘certificat d’expert en physique médicale’). Therefore the ‘postgraduate certificate’ and the ‘certificat’ programmes that are now existing at both universities, and which contain mainly the clinical training, will also be modified so as to match with this new master programme.

The joint programme was developed via intensive collaboration between the programme directors and the lecturers from both universities that are responsible for the core part of the programme. The joint character is especially apparent from the fact that a significant part of the courses are taught by mixed teaching teams, i.e. involving lecturers from both institutes.

C. COMPÉTENCES VISÉES PAR LA FORMATION

Students graduating in the master in medical physics need :

1. To have a good basic knowledge of the medical and biomedical sciences relevant to professional action within the context of medical physics.
2. To have a thorough theoretical and practical knowledge of nuclear physics, ionizing and non-ionizing radiation physics, and computational methods for medical physics.
3. To have a thorough theoretical and practical knowledge of dosimetry, techniques and technology, legal aspects and information technology relevant to medical physics.
4. To have a good knowledge of the ethical aspects of research in medical physics.
5. To consult and use professional literature, also in other languages, for research and development purposes. To acquire an attitude of lifelong learning as to knowledge and skills.
6. To be able to explore new domains in the field through independent study and to acquire new insights, results and methods.
7. To be able to identify the essence of a situation and to draw up a working model for this. To be able to design experimental and/or theoretical procedures to study contemporary research problems in medical physics and to improve existing solutions.
8. Independently perform experiments or calculations, process results statistically and evaluate these with a critical-scientific attitude.
9. To be able to make decisions about radiation protection independently and with a sense of responsibility.
10. To have insight into failure mode and analysis of the consequences for processes in medical physics.
11. To be able to report the results of his/her own research to national and/or international colleagues and to a wider audience, both in writing and orally.
12. To be able to make colleagues and others involved aware of the importance of radiation protection and quality control, and be able to communicate this to the medical team.
13. To be able to identify and use the imaging and treatment techniques specific to medical physics.
14. To have insight into clinical questions.