SECTION A:	QUALIFICATION DETAILS				
QUALIFICATION DEVELOPER (S)	UNIVERSITY OF BOTSWANA				
TITLE	Bachelor of Science in Radiation and Health Physics			NCQF LEVEL	7
STRANDS (where applicable)	N/A				
FIELD	Natural Mathematics and Life Sciences	SUB-FIELD	Physical Sciences	CREDIT VALUE	528

New Qualification												Legacy Qualification			√
SUB-FRAMEWORK	General Education				TVET							Higher Education			√
QUALIFICATION TYPE	Certificate	I		II		III		IV		V		Diploma		Bachelor	√
	Bachelor Honours				Post Graduate Certificate							Post Graduate Diploma			
	Masters								Doctorate/ PhD						

RATIONALE AND PURPOSE OF THE QUALIFICATION

Two of the pillars of Botswana vision 2036 (Sustainable Economic Development and Human Social Development) are aimed at promoting individual well-being and ensuring food accessibility. To achieve these goals of vision 2036, the government is prioritising the availability of; (1) quality health professional and facilities and (2) food. Ionising radiations are important tools in medicine for diagnostic and therapy purposes, in agriculture for food irradiation and pest control, and in industries as well. As a result, knowledge of radiation science is very crucial in meeting these pillars. Therefore, proper training and skills development in this subject matter is fundamental to investment and crucial to economic growth. As such, developing a strong radiation and health physics community is one of the highest priorities. This is also in line with the strategic priority 5 of Botswana Education and Training Sector Strategic Plan (ETSSP, 2015-20) policy that recommended skill development across the whole sector of economy.

Strategic priority 8 of Botswana Education and Training Sector Strategic Plan (ETSSP, 2015-20) policy expects tertiary institutions to be responsive to the needs of the economy. Radiation and health physics qualification is therefore a response to develop the needed human capital for applications of ionizing radiations in the various sectors of economy in the country. The qualification will meet the national strategic goal of producing creative, competent, and motivated professional graduates ready for the industry and the service sector, who are capable of independent, critical and innovative thinking as well as lifelong learning.

The qualification will produce graduates who are competent and globally marketable, and who are creative, innovative, and have entrepreneurship skills. It will contribute significantly to the following national strategic goals:

a) Fulfil the vision of transforming to a with knowledge-based economy.
b) Contribute to the country's Vision 2036 and all the goals in the National Development Plan 11 (NDP 11) policy document, and
c) address one of the Sustainable Development Goals [SDGs] of good health and well-being, in agriculture to address another SDGs of zero hunger.

PURPOSE: (itemise exit level outcomes)

The purpose of the qualification is to equip graduates with specialized knowledge, skills, and competences to:

i. Apply specialized knowledge in ionizing radiation in medicine, agriculture and industry for benefit of the population.
ii. Apply advanced technical skills to minimize risks associated with benefits derivable from using ionizing radiation for the different areas of application.
iii. Develop advanced new methods/equipment (or modifying existing ones) use for applying ionizing radiations in the various disciplines.
iv. Contribute to the knowledge-based economy and national development in radiation science and related areas.

MINIMUM ENTRY REQUIREMENTS (including access and inclusion)

For entry to the BSc (Radiation and Health Physics), the following entry requirements shall apply.

- Certificate IV, NCQF Level 4 or equivalent .
- Entry through Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) is accessible to all candidates through institutional policies in line with the national RPL and CAT policies.

SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
LO1. Apply problem-solving skills in the area of radiation and health Physics.	AC1.1 Demonstrate a general understanding of the basic principles of radiation and health physics. AC1.2 Apply experimental skills through sampling and measurements using radiation equipments. AC1.3 Demonstrate theoretical knowledge through analysis and interpretation of experimentally acquired data.
LO2. Monitor personnel and environmental radiation levels and assess associated radiation exposure risks to people.	AC2.1 Demonstrate knowledge of different radiation levels monitoring meters. AC2.2 Use survey meters for radiation levels monitoring in the environment and in workplaces. AC2.3Use a thermoluminescence dosimeter for monitoring of personnel doses. AC2.3 Demonstrate knowledge and apply different radiation risk models for estimation risks of radiation exposures to humans.
LO3. Implement radiation emergency procedures in incidences and accidents involving ionizing radiations.	AC3.1 Demonstrate knowledge of possible radiation incidences and accidents in different radiation facilities. AC3.2 Formulate radiation emergency plan and procedures. AC3.3 Demonstrate knowledge of countermeasures for different radiation emergency scenarios.
LO4. Advice policy makers on issue of radiation safety and security.	AC4.1 Sensitize political leadership on the potentials of human conflict and tragedies that are rooted in climate change.

	AC4.2 Promote the benefits of using methods based on ionizing radiations in medicine, industry and agriculture. AC4.3 Provide expert opinions on the effects of ionizing radiation on humans and how to avoid/minimize these effects. AC4.4 Draft/review rules and regulations for safe use of ionizing radiations for social, economic, and political well-being of citizens.
LO5. Develop and Implement safety protocols and procedures for users of radioisotopes and machines emitting ionizing radiations.	AC5.1 Demonstrate good knowledge of international and national rules and regulations for radiation safety and security and for different practices where ionizing radiations are made use of. AC5.2 Demonstrate good knowledge of radiation safety principles and devices. AC5.3 Apply knowledge acquired in x-ray centres and industries.
LO6. Use nuclear Physics and radiation protection simulation softwares for applications in medicine, industry and research.	AC6.1 Apply different simulation softwares to simulate radiation transports in patients and in materials. AC6.2. Apply the softwares to real life problems in hospitals and industries. AC6.3. Develop Monte carlo codes for radiation transports in matter.
LO7. Calculate patients' treatment doses for applications in medicine.	AC7.1 Demonstrate knowledge of different types of doses used to assess patients' risks. AC7.2 Demosntrate knowledge of different types of parameters used to quantify treatment doses and softwares for estimating them. AC7.3 Apply the knowledge acquire in real life treatment of patients.
LO8. Execute research activities in the area of radiation and health Physics	AC8.1 Justify the importance of research in radiation and health physics.

	AC8.2 Discover radiation and health physics related research problems. AC8.3 Identify appropriate designs for the research problems. AC8.4 Obtain relevant ethical clearances. AC8.5 Do extensive literature reviews on the subject matters. AC8.6 Carry our measurements and/or collect scientific research data. AC8.7 Write reports for presentation and discussion of findings at conferences, to policy makers, to sponsors or for publications.

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SECTION C		***QUALIFICATION STRUCTURE***				
COMPONENT	***TITLE***	***Credits Per Relevant NCQF Level***				***Total Credits***
		Level [5]	***Level [6]***	***Level [7]***	***Level [8]***	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/Units*	Communication and Academic Literacy Skills	***12***				**12**
	Computing Skills Fundamentals I	***8***				**8**
	Academic and Professional Communication II	***12***				**12**
	Computing Skills Fundamentals II	***8***				**8**
CORE COMPONENT *Subjects/Courses/ Modules/Units*	Geometrical Optics and Mechanics	***16***				**16**
	General Chemistry	***16***				**16**
	Introductory Mathematics	***16***				**16**
	Electricity, Magnetism and Elements of Modern Physics	**16**				**16**

	General Chemistry II	**16**				**16**
	Introductory Mathematics II	**16**				**16**
	Properties of Matter, Basic Thermodynamics and Introduction to Nuclear Physics		***12***			**12**
	Introduction to Mathematical Statistics		***12***			**12**
	Calculus I		***12***			**12**
	Introduction to Analytical Chemistry		***8***			**8**
	Introduction to Environmental Health		***16***			**16**
	Radiation Physics I		***12***			**12**
	Radiation Therapy I		***12***			**12**
	Basic Electronics		***12***			**12**
	Physics Practical 3.1		***4***			**4**
	Physics Practical 4.1		***4***			**4**

	Radiation and Health Physics Internship I		***12***			***12***
	Radiation Physics II			***12***		***12***
	Radiation Therapy II			***12***		***12***
	Introduction to Radiography			***12***		***12***
	Introduction to Radiology			***12***		***12***
	Radiobiology and Protection			***12***		***12***
	Physics Medical Imaging			***12***		***12***
	Radiation Detection and Instrumentation			***12***		***12***
	Environmental Physics			***12***		***12***
	Radiation and Health Physics Internship II			***12***		***12***
	Nuclear Rules and Regulations				***12***	***12***
	Fundamentals of Nuclear Energy				***12***	***12***

	Environmental Radioactivity				***12***	***12***
	Anatomy and Physiology for Medical Physics				***12***	***12***
	Applied Nuclear Physics				***12***	***12***
	Radiation Protection and Dosimetry				***12***	***12***
	Applied Radiation Safety Techniques				***12***	***12***
	Research Project				***24***	***24***
OPTIONAL COMPONENTS *Subjects/Courses/ Modules/Units*	**Optional Courses:** **Students should select one course from each of the Optional Components Groups**					
Group A	Electricity and Magnetism		***12***			***12***
	Structured Programming		***12***			***12***
	Epidemiology		***12***			***12***
Group B	Mathematics and Statistics I			***12***		***12***
	General Climatology			***12***		***12***

	Elements of Air pollution I			***12***		***12***
Group C	Elements of Air pollution II				***12***	***12***
	Microprocessor and digital systems				***12***	***12***
	ELECTIVES **Any of the two courses listed that are not offered by the Faculty of Science**					
ELECTIVE COMPONENTS *Subjects/Courses/ Modules/Units*	Principles of Management	***12***				***12***
	Principles of marketing	***12***				***12***
	Introduction to psychology	***12***				***12***
	Introduction to Information Technology	***12***				***12***
	Introduction to Accounting	***12***				***12***
	Fundamentals of Business Law		***12***			***12***
	Information systems Foundation	***12***				***12***

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	***Credit Value***
5	***136***
6	***140***
7	***132***
8	***120***
TOTAL CREDITS	***528***

Rules of Combination:

(Please Indicate combinations for the different constituent components of the qualification)

This qualification comprises of:

A. Fundamental Courses – 40 Credits

B. Core Courses – 428 Credits

C. Optional Courses- 36 credits (Students choose one course from each group; A, B and C)

D. Elective courses – 24 credits

TOTAL CREDITS: **528 Credits**

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ASSESSMENT ARRANGEMENTS

Formative assessment: contributes a maximum of 50% towards the final grade.

Summative assessment: contributes a maximum of 50% towards the final grade.

Assessments are carried out by BQA (or equivalent organization) accredited assessors.

MODERATION ARRANGEMENTS

Internal and external moderation is conducted at the end of each semester by registered and accredited moderators in accordance with applicable policies and regulations.

Internal

Internal moderation is performed by BQA-accredited moderators in the department whose areas of expertise are relevant to the courses to be moderated.

External

External moderation is carried out by BQA (or equivalent organization) accredited moderators from other institutions recruited for this purpose.

RECOGNITION OF PRIOR LEARNING

The qualification is designed to allow award through RPL in accordance with institutional and national RPL policy.

CREDIT ACCUMULATION AND TRANSFER

Learners may transfer academic credits towards the award of the qualification as may be determined as per the institutional policies and national RPL policy.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal Pathway:

- Bachelor of Science: Radiography
- Bachelor of Science: Nuclear Science.
- Bachelor of science: Physics.
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Vertical progression: candidate may progress to:

- Master of Science: Medical Physics (NCQF 8).
- Master of Science: Nuclear Engineering (NCQF 8).
- Master of Science: Radiation Safety (NCQF 8).
- Master of Science: Nuclear Science (NCQF 8).

Employment opportunities

- Radiation scientists
- Instrumentation technicians
- Dosimetrists.
- National Radiation regulator (RPI) officers
- Medical health physicists
- Radiation safety officers
- Independent consultancy (mining industries)

QUALIFICATION AWARD AND CERTIFICATION

Qualification Award:

Bachelor of Science in Radiation and Health Physics candidates meeting the prescribed requirements will be awarded the **Bachelor of Science in Radiation and Health Physics qualification (528 credits)** in accordance with the qualification composition rules and applicable policies.

Certification Award

A candidate meeting the prescribed requirements will be awarded Bachelor of Science in Radiation and Health Physics (528 credits) and will be issued a certificate and an official transcript.

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

Radiation and Health Physics is hybrid qualification made of two fields: Applied Radiation Science and medical physics. The comparability has therefore been centred on outcomes and assessment criteria from these two fields. Benchmarking has been done against qualification offered by reputable entities around the world (both regionally and internationally) regarding outcomes and assessment criteria, degree of difficulty and notional learning time to appreciate what is typical of this level and type of qualification out there, in relation to graduate profiling, scope and depth of content. However, the qualification is rigorous, covering core courses in physics, mathematics, and Radiation science. This qualification has been compared with the following qualifications offered regionally and internationally

1. Bachelor of science (Honours) in nuclear energy: SAQA qualification ID: 98811 offered at University of Johannesburg, RSA

2. Bachelor of radiography (Honours) in nuclear medicine: SAQA qualification ID: 15135 offered at University of Pretoria, RSA

3. Bachelor of Science (BS) degree in Radiation Protection. Thomas Edison University, United States of America (USA)

4. Bachelor of Science (Honours) in Health Physics and Radiation Science. OntarioTech Engineering & Applied Science. Canada

5. Bachelor of Science (Honours) in Radiation Health Physics. Oregon state university. United states of America, USA.

REVIEW PERIOD

The qualification shall be reviewed every 5 years.

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