SECTION A:	***QUALIFICATION DETAILS***
QUALIFICATION DEVELOPER (S)	Botswana International University of Science and Technology

TITLE	Doctor of Philosophy in Astrophysics	***NCQF LEVEL***	10
STRANDS (where applicable)			

FIELD	Natural, Mathematical and Life Sciences	***SUB-FIELD***	Physical Sciences	***CREDIT VALUE***	360

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

RATIONALE:

The Botswana Vision 2036 recognizes education and skills development as a foundation for human resource development. The use of science, technology, and innovation in social, economic and business sectors are critical to transform Botswana into a globally competitive knowledge-based economy. The Doctor of Philosophy in Astrophysics qualification has been informed by this mandate to realize the National Development Plan (NDP11) which is aligned with Vision 2036 and the Sustainable Development Goals of the United Nations. This qualification is also informed by the Tertiary Education Policy, as approved by the National Assembly (2008:10). Several documents have also highlighted the need to produce high calibre graduates with strong problem-solving skills, in-depth scientific knowledge and transferable skills desirable in industry and research, to transform

Botswana from a resource-based to a knowledge-based economy and contribute to the Sustainable Development Goals of the United Nations.

Considering the scarcity of human resources in Physics, Astronomy and related fields, the Doctor of Philosophy in Astrophysics qualification is designed to fill the shortage gaps identified in these reports, in alignment with the national priorities as outlined in the Vision 2036 and NDP 11. Botswana will be a partner in the Square Kilometre Array (SKA) project, a large project to build an array of radio telescopes in South Africa and Australia, where BIUST will also host some of the antennas (to provide a larger baseline for interferometry). Botswana is also a partner in the HIRAX project, an array of thousands of radio dishes to be placed in the Karoo region, to search for fast radio bursters (FRBs) and perform cosmological experiments. Finally, Botswana is part of the African VLBI Network (AVN) where telescopes in Southern Africa are essential to provide longer baselines for the Event Horizon experiment to image black holes. Some AVN antennas will be hosted on the BIUST site. We also plan to build a set of 11m antennas from purely Botswana resources (as far as this is possible) to provide an independent scientific facility for Botswana scientists. Botswana also intends to build an optical observatory at BIUST in collaboration with Thailand to monitor and exploit transient objects (including earth-grazing asteroids).

After obtaining a Doctor of Philosophy in Astrophysics qualification, the graduate will possess intensive research experience within a specific field of Astronomy through a supervised project and advanced knowledge in specialization areas of Astronomy, including familiarity with contemporary research within various fields of Astronomy. Astronomers are in strong demand in many fields, for instance, aerospace and defense research, nanotechnology, electronics, computer industries, science and telecommunications, meteorology and climate change, energy and renewable energy, education, health and medicine.

PURPOSE:

The purpose of this qualification is to produce graduates with the most advanced knowledge, skills and competence to:

1. Conduct original research in Astrophysics at the highest scientific level and develop new research streams at national and international research institutions.
2. Work as university lecturers and beyond with the ability to develop a scientific career in Astrophysics at higher educational institutions.

3. Provide expert opinions, analysis, and recommendations to government and non-governmental organizations or individuals, based on their expertise in Astrophysics.
4. Found innovative start-up companies that will transform research outcomes into products to drive industrialization and sustainable socio-economic development in Botswana and the region through Astrophysics.
5. Develop policies and strategies to drive the change from a resource -based to a knowledge-based economy through Astrophysics.

MINIMUM ENTRY REQUIREMENTS (including access and inclusion)

Admission to the Doctor of Philosophy (Physics) degree programme

1. Master's Degree, NCQF level 9 qualification in Physics or cognate field.
2. Access through Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) will be applicable in line Education Trainer and Provider policies.

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SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
1. Conduct original scholarly research on specific problems in Astrophysics and develop new ways to address them	1.1 Formulate the research question(s) at a standard appropriate to the area of specialization within Astrophysics. 1.2 Evaluate existing ideas, issues, and concepts in a specialized field of physics (astrophysics) in order to identify new and open problems. 1.3 Review existing literature on the problem(s) and indicate possible research gaps to focus on the problem(s) under study. 1.4 Justify the relevance of the research problem(s).

	1.5 Formulate the research question(s) at a standard appropriate to the area of specialization.
2. Improve and develop concepts, theories and operational methods in Astrophysics	2.1 Develop and improve concepts, theories, software and operational methods. 2.2 Undertake a critical analysis of literature with proper use of citations. 2.3 Select appropriate research methods and associated research design. 2.4 Elaborate and refine the research proposal formulated in 1.5.
3. Apply the most advanced scientific knowledge relating to Astrophysics to produce a piece of original research.	3.1 Conduct experiments tests and analysis on observational or theoretical datasets. 3.2 Evaluate the results of experiments and express conclusions within the theoretical and observational framework. 3.3 Observe, analyse and interpret celestial phenomena and develop numerical methods and techniques. 3.4 Apply analytical, critical, and creative thinking skills to solve problems in astrophysics. 3.5 Draw appropriate inferences and conclusions. 3.6 Generate new ideas or ways of viewing problems in astrophysics and propose how to solve them. 3.7 Produce a substantial report giving a detailed account of the research undertaken.
4 Prepare scientific papers and reports to disseminate information.	4.3 Produce written reports that effectively communicate complex disciplinary and interdisciplinary ideas and information for the intended audience and purpose.

	4.4 Make oral presentations that communicate complex disciplinary and interdisciplinary information effectively to the target audience. *4.5* Present the results of the research work in workshops, seminars, or conference settings. *4.6* Publish the results of the research work in peer-reviewed journals and articles.

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SECTION C	***QUALIFICATION STRUCTURE***				
COMPONENT	***TITLE***	***Credits Per Relevant NCQF Level***			***Total Credits***
		Level [ ]	***Level [ ]***	***Level [10]***	
CORE COMPONENT *Subjects/Courses/ Modules/Units*	Doctoral Thesis in Astrophysics			360	360

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	***Credit Value***
10	360
TOTAL CREDITS	360
Rules of Combination: ***(Please Indicate combinations for the different constituent components of the qualification)***	
The core consists of a thesis worth 360 credits with no fundamentals or electives	

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ASSESSMENT ARRANGEMENTS
All assessments, formative and summative, leading to the award of credits in this qualification shall be based on the qualification exit-level outcomes. • Formative Assessment - Formative assessment will be administered continuously and it will be informed by periodic presentations and seminars and formal semesterly progress reports submitted to the departmental boards for transmission to the Postgraduate School. • Summative Assessment (100%) - Learners shall undergo a summative assessment in the form of a written thesis and oral examination which entails fulfilment of requirements for the Doctor of Philosophy (Astrophysics) degree as outlined in the Postgraduate Policy and Guidelines at the Education Trainer and Provider.
MODERATION ARRANGEMENTS
Moderation shall be conducted by examiners with a doctoral degree in Physics or related field.
RECOGNITION OF PRIOR LEARNING
Recognition of Prior Learning (RPL) will be considered in the award of the Doctor of Philosophy (Astrophysics) qualification in accordance with existing RPL policies at the Education Trainer and Provider and the principles that are provided for by BQA/any other national policies
CREDIT ACCUMULATION AND TRANSFER
Credit Accumulation and Transfer (CAT) will be considered in the award of the Doctor of Philosophy (Astrophysics) qualification in accordance with existing RPL policies at the Education Trainer and Provider and the principles that are provided for by BQA/any other national policies
PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)
Learning Pathways **Horizontal Articulation** • Doctor of Philosophy in Physics Education • Doctor of Philosophy in Medical Physics • Doctor of Philosophy in Big Data Science • Doctor of Philosophy in Computational Physics

- Doctor of Philosophy in Condensed Matter Physics.

Vertical Articulation

Level 10 is the highest NCQF level and at which the Doctor of Philosophy (Astrophysics) degree is pegged, so there will be no vertical pathway.

Employment Pathways

- Physics/Astronomy Lecturer
- Astronomy Researcher
- Telescope Operator
- Computational Physicists
- Software developer
- Data scientist.

QUALIFICATION AWARD AND CERTIFICATION

Qualification award:

Learners enrolled in the Doctor of Philosophy in Astrophysics qualification must accumulate 360 credits to qualify for the award of the degree.

Certification:

Candidates meeting prescribed requirements will be awarded a Doctor of Philosophy in Astrophysics in accordance with standards prescribed for the award of the qualification and applicable policies.

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

The qualification was compared regionally and internationally, with similar qualifications in Astrophysics. The qualification compares very well in terms of learning outcomes, the scope of content, level, and duration with: PhD in Astrophysics, University of Witwatersrand, South Africa; PhD in Astronomy and Astrophysics, University of Manchester, United Kingdom; PhD in Astronomy and Astrophysics, Australian National University, Australia; PhD in Astronomy, University of Canterbury, New Zealand. More specifically:

1. The Doctor of Philosophy in Astronomy and Astrophysics (**University of the Witwatersrand -** South Africa) is done through research only (no coursework) and requires a minimum of 2 years and a maximum duration of 4 years to complete the qualification.
2. The **PhD in Astronomy and Astrophysics** at the University of Manchester (United Kingdom) is done through research only (no coursework) and requires a minimum of 3 years and a maximum duration of 4 years to complete the qualification.
3. The **Australian National University** (Australia) offers a PhD in Astronomy and Astrophysics by dissertation, producing a piece of original research. The typical course of studies results in a 100,000-word thesis within 3 or 4 years of research under supervision by members of staff at the Research School of Astronomy and Astrophysics
4. The **University of Canterbury** (New Zealand**)** offers a PhD degree in Astrophysics. An initial 1-year period is probationary. A thesis based on original research must be published within a maximum of 2.5 years.

This qualification is comparable to the above qualifications offered at other universities in the region and around the world in terms of structure and research emphasis. Moreover, the PhD by research work is common in the SADC region (and in British-inspired systems) as offered by the University of the Witwatersrand in South Africa.

In conclusion, this qualification compares well regionally and internationally.

REVIEW PERIOD
5 Years in line with the NCQF.

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For Official Use Only:

CODE (ID)			
REGISTRATION STATUS	**BQA DECISION NO.**	**REGISTRATION START DATE**	**REGISTRATION END DATE**
LAST DATE FOR ENROLMENT		**LAST DATE FOR ACHIEVEMENT**	

REVISION DATE:		**NAME OF PROFESSIONAL BODIES/REGULATORY**	