SECTION A:	QUALIFICATION DETAILS			

QUALIFICATION DEVELOPER (S)	Botswana International University of Science and Technology			

TITLE	Doctor of Philosophy in Mathematical Sciences		NCQF LEVEL	10

STRANDS (where applicable)	N/A				

FIELD	Natural, Mathematical and Life Sciences	SUB-FIELD	Mathematical 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:

Mathematics is a fundamental field of study that plays a pivotal role in the development of all branches of science, both pure and applied, as well as technology, especially information technology, business, and, even increasingly to social sciences. The study of mathematics

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develops the ability to think carefully, it sharpens analytical and problem-solving skills and trains the mind to reason logically and with precision. Mathematics provides powerful tools for explaining how the reality works. In our current world it is through an extensive use of mathematical tools and model analysis together with the power of computers in investigating complex and unpredictable problems that have contributed to the creation of new technologies in various areas of the economy.

Botswana Vision 2036 recognises education and skills development as the foundation for human resource development. The development of the human capital specialised in Mathematical Sciences is essential in achieving the Vision 2036 pillars mainly Pillar 1 (Sustainable Economic Development) and Pillar 2 (Human and Social Development). The two pillars emphasise transformation of Botswana's economy to a knowledge-based economy and producing a globally competitive human resource as a key strategy to drive economic growth and diversification.

According to the report by Human Resource Development Council 2016 (HRDC 2016) of Botswana, there is a need to fill top demand occupations such us   Data Analysts & Scientists, Financial & Investment Advisers, Finance Managers, Database and Network Professionals, Risk Management Specialists, University and Higher Education Teachers, Mathematical and related associate professionals, Science and Technology Researchers. The degree of Doctor of Philosophy (PhD) in Mathematical Sciences is thus designed to equip graduates with required competencies, knowledge and transferable skills to fill the shortage of gaps identified in the HRD 2016 report. This is in line with the national priorities as outlined in the Vision 2036 NDP 11.

The degree of PhD in Mathematical Sciences qualification is a research degree which trains scientists to a level where they are capable of planning and undertaking original research projects, and of working at the highest level in any scientific undertaking. This plays a great deal of the role in making informed decisions. Such qualified professionals can play major roles, particularly, in universities and research centers of the country or elsewhere. The PhD program also plays a role in technology transfer to support mathematical decision makings in the country.

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PURPOSE: (itemise exit level outcomes)

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

1. Plan and undertake original scholarly mathematical research projects in any scientific undertaking.
2. Contribute to scientific discourse through journal publications and other literary works.
3. Lecture and supervise research at higher educational institutions, industries and companies.
4. Contribute towards the development of knowledge and skills in the field of mathematical analysis through research and training.
5. Disseminate mathematical knowledge and understanding to diverse audiences through seminar presentations.

MINIMUM ENTRY REQUIREMENTS (including access and inclusion)

Entry into this qualification is through the following requirement:

Master's degree, NCQF level 9 in Mathematical Sciences or a related cognate field with provisions for exemptions, where applicable, in line with applicable Credit Accumulation and Transfer (CAT) and Recognition of Prior Learning (RPL) policies.

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SECTION B	QUALIFICATION SPECIFICATION
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
1. Apply the most advanced knowledge of Mathematical Sciences and/or modelling to critically analyse specific problems or issues and hypothesize new ideas using set criteria.	1.1 Synthesise and critically evaluate existing ideas, issues, and concepts in a specialized field of Mathematical Sciences to identify open problems. 1.2 Review existing literature on the problem and indicate possible research gaps for the problem under study. 1.3 Formulate the research question(s) in a standard that is appropriate to the specialization area. 1.4 Justify the relevance of the research problem. 1.5 Formulate a research proposal.
2. Conceptualize, design, and implement research to contribute to the existing body of knowledge in Mathematical Sciences.	2.1 Model solutions to scientific challenges that require the use of advance mathematical principles. 2.2 Assemble a theoretical base appropriate to explain the model designed. 2.3 Select appropriate research methods and associated research design.
3. Produce original research, or other advanced scholarship, of a quality to satisfy peer review, and to merit publication.	3.1 Apply analytical, critical, and creative thinking skills to solve problems. 3.2 Draw appropriate inferences and conclusions. 3.3 Generate new ideas or ways of viewing mathematical problems and their solution approaches. 3.4 Produce a substantial report giving an honest account of research undertaken.
4. Communicate scientific understanding orally and in writing using various forms of representation relevant to the target audience.	4.1 Produce written reports that communicate complex disciplinary and interdisciplinary ideas and information effectively for the intended audience and purpose.

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		4.2 Produce oral presentations that communicate complex disciplinary and interdisciplinary ideas and information effectively for the intended audience and purpose.
		4.3 Present the result of the research work in workshops, seminars, or conference settings.
5.	Evaluate implications of applying knowledge to particular contexts.	5.1 Justify the use of Mathematical analysis in decision making and/or any other relevant fields.
		5.2 Analyse sensitivity of solutions to model assumptions.

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		Document No.	DNCQF.P01.GD02
	BQA NCQF QUALIFICATION TEMPLATE	Issue No.	01
		Effective Date	01.08.2022

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

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STRANDS/ SPECIALIZATION	Subjects/ Courses/ Modules/Units	Credits Per Relevant NCQF Level			Total Credits
		Level [ ]	Level [ ]	Level [ ]	
1.					
2.					

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	BQA NCQF QUALIFICATION TEMPLATE	Document No.	DNCQF.P01.GD02
		Issue No.	01
		Effective Date	01.08.2022

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)

Core Level 10 – 360 Credits

No electives.

The qualification requires a total of **360** credits of core component (supervised research) which can be evidenced through the submissions of concept note, research proposal, publications, and a final dissertation.

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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 aligned to the exit-level outcomes will be administered continuously throughout the learning period.
- Summative Assessment - Learners shall undergo a summative assessment which consists of a written thesis and a possible oral examination at the end of the learning period.

The formative assessment is intended to help learners advance their work, therefore not weighted. The outcome of this assessment does not contribute the final award of credit for the learner.

The summative assessment weighs 100%, is wholly dedicated to the evaluation of the research output, written PhD thesis, and final viva voce, both internally and externally.

MODERATION ARRANGEMENTS

The qualification shall be moderated internally and externally as a quality assurance measure.

RECOGNITION OF PRIOR LEARNING

Recognition of Prior Learning (RPL) will be considered in the award of the qualification in accordance with applicable RPL policy of the ETP which are aligned to BQA / National policies on the same.

CREDIT ACCUMULATION AND TRANSFER

This qualification is designed to allow award of credits towards through Credit Accumulation and Transfer, CAT in accordance with institutional CAT policies.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

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Learning Pathways

Horizontal Articulation

The qualification articulates horizontally with various local, regional and international Doctor of Philosophy degree in related areas. Qualifications of similar level at NCQF Level 10 include:

- Doctor of Philosophy in Applied Sciences
- Doctor of Philosophy in Statistics
- Doctor of Philosophy in Computer Science
- Doctor of Philosophy in Operations Research
- Doctor of Philosophy in Industrial Mathematics
- Doctor of Philosophy in Financial Mathematics

Vertical Articulation

Since the qualification provides a terminal degree there will be no vertical articulation beyond NCQF Level 10.

Employment Pathways

The graduates will be qualified to hold high-level managerial positions/roles such as:

- Mathematical Sciences Lecturer
- Research supervisor
- Science and Technology Researcher
- System analyst and developer
- Consulting manager

QUALIFICATION AWARD AND CERTIFICATION

Qualification award:

To obtain the **Doctor of Philosophy in Mathematical Sciences** the student must produce a thesis and accumulate 360 credits.

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Certification:

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

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

The qualification was compared with various institutions, regionally and internationally running a similar qualification in Mathematics. The qualification compares very well in terms of learning outcomes, scope of content, level and duration with:

(i) Doctor of Philosophy in Mathematical Sciences, Pan African University, Kenya

(ii) Doctor of Philosophy (Integrated) in Mathematical Sciences, University of Southampton, United Kingdom

(iii) Doctor of Philosophy in Mathematical Sciences, Brunel University, United Kingdom

(iv) Doctor of Philosophy in Mathematical Sciences, RMIT University, Australia

(v) Doctor of Philosophy in Mathematical Sciences, Sunway University, Malaysia

Since qualification titles, NQF levels and credit values are based on national standards of each country, the proposed qualification may differ in credit value and NQF level with some of the compared qualifications. However, as it is the highest level of qualification and is based on knowledge creation and contribution in advancement of a given subject area, the proposed qualification is similar to all of the compared qualifications in terms of the methods and weightings of assessments, and all other comparable areas. Even if the qualifications listed in (ii) and (v) require some taught courses, these are meant to assist learners in preparing them for the required research work. The qualification is assessed mainly by the PhD research output and the written PhD thesis.

Based on the above statements, all the five qualifications compare well with the proposed PhD qualification in Mathematical Sciences in terms of exit learning outcomes, topics covered and the research component.

REVIEW PERIOD

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Every five (5) years.

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