SECTION A:	QUALIFICATION DETAILS			

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

TITLE	Master of Science in Mathematical Sciences		**NCQF LEVEL**	9

STRANDS *(where applicable)*	*NOT APPLICABLE*

FIELD	Natural, Mathematical and Life Sciences	**SUB-FIELD**	Mathematics and Statistics	**CREDIT VALUE**	240

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

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RATIONALE:

Botswana has identified the need to transform the economy from one that depends largely on revenue mineral resources to a knowledge-based economy. The intention on how to transform the economy is stipulated in Botswana's Vision 2036 which recognizes that progress for the transformation must be driven by innovation and research. Some of the key pillars of focus in Vision 2036 include Pillar 1 (Sustainable economic development), Pillar 2 (Human and social development) and Pillar 3 (Sustainable environment). Furthermore, to propel the economy to a higher level, the use of Science and Technology is crucial. Soft and technical skills in mathematics have been identified as being essential in several in-demand areas of specialization such as Radiography, Biomedical Engineering, Pharmacy, irrigation specialization (HRDC report, 2019) among others. Mathematical skills also form a strong foundation for computational, qualitative, and quantitative analysis specialities including but not limited to cyber security, data mining and data science which are important in industry, governance, and the health sector. The proposed advanced skills training for a qualification in a Master of Science Mathematical Sciences is in line with the skill set needed to realise Botswana's Vision 2036.

Mathematical scientists, or mathematicians, use the science of numbers to solve problems and conduct research in a number of different fields including engineering, technology, logistics, health, and economics and finance. This qualification is therefore designed to develop and refine learner's logical, analytical, and creative problem-solving skills and further the growth of mathematical theory and its applications and dealing with abstract concepts at an advanced level

PURPOSE: (itemise exit level outcomes)

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

- Apply and develop an advanced level of mathematical knowledge and practical skills relevant to problem-solving in diverse, real-world contexts and also for those that wish to develop their specialised understanding and appreciation of a fundamental branch of

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mathematics.

- Analyse complex situations and information, identify the problem, and determine a range of possible solutions using advanced mathematical and computational techniques.

- Demonstrate a higher level of skills in the planning, execution, and completion of a piece of original research or creative scholarly work in all areas of mathematical sciences.

MINIMUM ENTRY REQUIREMENTS (including access and inclusion)

- The minimum entry requirement to the Master of Science in Mathematical Sciences Degree qualification is a bachelor's degree (NCQF level 7) in the same or a cognate field of study.

- Applicants who do not meet the above criteria but possess relevant industry experience may be considered through Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) institutional policies in line with National RPL and CAT Policies for access.

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SECTION B	QUALIFICATION SPECIFICATION

GRADUATE PROFILE (LEARNING OUTCOMES)	ASSESSMENT CRITERIA
1. Demonstrate mastery of the core mathematical concepts in at least four areas of Mathematics, including Geometry, Algebra, Analysis and Applied Mathematics.	a) Prove mastery of the relevant mathematical methods in proving key results in Geometry, Advanced Algebra, Advanced Analysis and Applications b) Evaluate the validity and correctness of new results in Geometry, Advanced Algebra, Advanced Analysis and Applied Mathematics. c) Develop and adapt mathematical methods to new contexts.
2. Solve complex problems in Mathematics and propose solutions applying research-based knowledge/approach.	a) Identify, formulate complex and challenging problems in Mathematics. b) Analyse complex problems of other fields of science and technology and plan strategies for their resolution. c) Apply notions and methods of pure and applied mathematics to solve complex problems in science and technology. d) Test the validity and effectiveness of solutions using real world data.
3. Conduct advanced research in one of the areas of Mathematical Sciences.	a) Plan and conduct research in Mathematics on an appropriate topic.

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	b) Perform individual and group research and draw relevant conclusions.
	c) Present research findings in the prescribed thesis format.
	d) Uphold ethical research practices and adhere to societal expectations from scientific research.
4. Communicate mathematical ideas and results effectively and professionally in written and oral form.	a) Write a mathematical document according to the conventions of the sub discipline.
	b) Structure an oral presentation and adapt it to the audience level of mathematical knowledge.
	c) Produce written reports that communicate disciplinary and interdisciplinary ideas and information effectively for the intended audience and purpose.

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SECTION C	QUALIFICATION STRUCTURE				
COMPONENT	**TITLE**	**Credits Per Relevant NCQF Level**			**Total Credits**
		Level [8]	**Level [9]**	**Level [ ]**	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/Units*	N/A				
CORE COMPONENT *Subjects/Courses/ Modules/Units*	Measure Theory and Integration		*12*		*12*
	Advanced Algebra		*12*		*12*
	Functional Analysis		*12*		*12*
	Dissertation for MSc. in Mathematical Sciences		*120*		*120*
ELECTIVE/ OPTIONAL COMPONENT *Subjects/Courses/*	*Subjects/ Courses/ Modules/Units. Electives modules: Choose seven Modules (84 credits) from the following list.*	**Credits Per Relevant NCQF Level**			**Total Credits**
		Level [8]	**Level [9]**	**Level [ ]**	

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Modules/Units					
	Selected Topics in Geometry		*12*		*12*
	Axiomatic Set Theory		*12*		*12*
	Selected Topics in Algebra		*12*		*12*
	Applied Algebraic Topology		*12*		*12*
	Selected Topics in Analysis		*12*		*12*
	Advanced Numerical Analysis		*12*		*12*
	Mathematical Biology		*12*		*12*
	Neural Networks		*12*		*12*
	Fourier and Wavelet Analysis		*12*		*12*
	Dynamical Systems		*12*		*12*

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SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	*Credit Value*
9	*240*
TOTAL CREDITS	*240*

Rules of Combination:

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

- This qualification will have 240 credits. The credit combination for the qualification is 156 credits of core component and 84 credits of elective components.

- For the Elective Component, choose at least 84 credits from the list of elective modules.

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ASSESSMENT ARRANGEMENTS

All assessments, formative and summative, leading to the award of credits in this qualification shall be based on module learning outcomes, and the qualification exit-level outcomes.

- **Formative Assessment** - A formative assessment aligned to the module learning outcomes and exit-level outcomes will be administered continuously throughout the learning period in each module. The recommended weights of the formative assessment should be at least 50% and should not exceed 60% of the final marks for that module.
- **Summative Assessment** - Learners shall undergo a summative assessment which may include a written examination at the end of the learning period in each module. The recommended weights of the summative assessment will vary from 50% to 40% of the final marks for that module. All summative practical assessments must, as far as possible, be conducted in real-work settings.

MODERATION ARRANGEMENTS

Pre-assessment moderation will be carried out before administering assessments that contribute towards the award of credits in this qualification and post-assessment moderation will be carried out after the assessment tasks have been marked.

- **Internal Moderation** - Assessment instruments shall be subjected to internal moderation by BQA registered and accredited Assessors and Moderators before administering to ensure fairness, validity, reliability, and consistency of assessments.
- **External Moderation** - Exit level assessment instruments shall be moderated by Internal and External Moderators to ensure fairness, validity, reliability, and consistency of assessments. Qualified external moderators shall be appointed from an accredited Education Training Provider (ETP).

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.

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CREDIT ACCUMULATION AND TRANSFER

Credit Accumulation and Transfer (CAT) will be considered in the award of the qualification in accordance with applicable CAT policy of the ETP which are aligned to BQA/National policies on the same.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

LEARNING PATHWAYS

This qualification is intended to provide learners with both horizontal and vertical articulation pathways, nationally, regionally, and internationally:

Horizontal Articulation

The qualification articulates horizontally with various local, regional, and international Master of Science Degrees in related areas. Qualifications of similar level at NCQF Level 9 include:

- Master of Science in Industrial Mathematics.
- Master of Science in Statistics.
- Master of Science in Actuarial Science.
- Master of Science in Financial Mathematics.
- Master of Science in Operations Research.

Vertical Articulation

The qualification provides vertical articulation to higher level qualifications at NCQF level 10. The graduate of this qualification can thus progress to enrol to PhD in Mathematical Sciences.

EMPLOYMENT PATHWAYS

Mathematical Sciences graduates apply their problem-solving skills to a wide variety of fields and upon successful completion of the degree, graduates qualify to work in the following sectors:

- Data analyst in any field including climate change, public health,
- Agriculture and natural resources scientist in government and private institutions,
- Research scientist in academic and research institutions,

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- Researchers in public and private institutions,
- Consultant in educational institutions and industries.

QUALIFICATION AWARD AND CERTIFICATION

Minimum standards of achievement for the award of the qualification

Candidate(s) will be awarded the degree of Master's in Mathematical Sciences after attaining the stipulated minimum credits of 248, inclusive of 8 credits from fundamental module, 156 credits from core modules and 84 credits from elective modules as specified in the rules of combination.

Certification

Candidates meeting prescribed requirements will be awarded the qualification in accordance with standards prescribed for the award of the qualification and applicable policies. A certificate of the award of the degree of Master's in Mathematical Sciences will be given upon successful completion of the qualification. Candidates who do not meet the prescribed minimum standards may, where applicable, be considered for appropriate exit awards in accordance with applicable policies.

Learners who complete the minimum requirement for a Master of Science in Mathematical Sciences will be awarded a Master of Science degree in Mathematical Sciences at NCQF level 9.

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

The qualification was compared with various institutions regionally and internationally running the Mathematical Sciences qualifications. The qualification compares very well in terms of learning outcomes, scope of content, level, and duration with:

- Master of Science in Mathematical Sciences, Pan African University, Kenya,
- Master of Science in Mathematical Sciences, Australian National University, Australia,
- Master of Science (MSc) in Mathematical Sciences, Norwegian University of Science and Technology, Norway,
- Master of Science in Mathematics (MSc), University of Lethbridge, Canada,
- Master of Mathematical Sciences, University of York, United Kingdom,
- Master of Mathematical Sciences, University of Bristol, United Kingdom.

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The Pan African University, Kenya, offers a Master of Science qualification in Mathematical Sciences. The duration of the qualification is between two and four years. The qualification includes a 14-course unit that includes an essay and a thesis. The entry requirement is a bachelor's degree with Honours in Mathematical Sciences, Mathematics and Statistics, Mathematics and Computer Sciences, Financial Mathematics or a related field. Topics covered include Analysis, Dynamical System, Topology and Differential geometry, Mathematical Physics, Numerical Linear Algebra, Financial Mathematics and Statistics.

The Australian National University, Australia, offers a two-year Master of Science qualification in Mathematical Sciences worth 96 units in the Australian Qualifications Framework at Level 9. The entry requirement is an ordinary BSc in Mathematical Sciences. The research component is worth 24 units (equivalent to 60 credits in the NCQF). Topics covered include Algebra, Analysis, Geometry, Topology and Applied Mathematics.

The Norwegian University of Science and Technology, Norway, offers a two-year MSc in Mathematical Sciences qualifications worth 120 ECTS. It comprises 75 credits of coursework and 45 credits for a thesis. The entry requirement is an ordinary Bachelor of Science degree. Topics covered include Algebra, Analysis, Topology, Applied Mathematics and Statistics.

The University of Lethbridge, Canada, offers a two-year MSc qualification in Mathematics worth 60 credits. The course work includes modules in Analysis, Algebra and Number Theory followed by a dissertation.

York University, United Kingdom, offers a one-year MSc qualification in Mathematical Sciences which comprises coursework and a research project. The entry requirement is a BSc Honours qualification in Mathematics. It is worth 180 credits including 60 credits of a dissertation.

The University of Bristol, United Kingdom, offers a one-year MSc qualification in Mathematical Sciences worth 180 credits with a taught component of 120 credits and a dissertation with 60 credits. The entry requirement is a BSc Honours qualification.

All the five qualifications compare well with the proposed MSc qualification in Mathematical Sciences relative to exit learning outcomes, topics covered and the research component. However, the proposed qualification is

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closer to those qualifications of which the duration is two years, and the entry requirement is an ordinary BSc qualification in Mathematical Sciences.

Graduates in Master of Mathematical Sciences from Australia National University, Australia has job opportunities in areas requiring computational techniques. These include quantitative applications analysts and lecturing positions (Macquarie Group; Kellogg School of Management). Areas such as biological sciences and computational sciences are becoming increasingly reliant on advanced techniques from the mathematical sciences. The Master of Mathematical Science will equip you with quantitative skills in these areas, as well as act as a pathway to a PhD.

Graduates with master's degrees in mathematical sciences from Norwegian University of Science and Technology, Norway are in demand on the job market in sectors ranging from energy to finance, research, and teaching and information technology.

Graduates with Master of Science in Mathematics from University of Lathbridge, Canada has an opportunity as Researcher, Cryptologist, Statistician, Actuary, Economist, Investment Banker, Computer Scientist, Systems Analyst, Software Developer, Physicist, Geologist, Meteorologist, Astronomer, Ecologist, Epidemiologist, Biomathematician, Biostatistician, Operations Research Analyst, Sales Manager.

Graduates with MSc in mathematical sciences, York University, UK has an opportunity to work at Banking and financial services, Computing and IT Engineering, Public Administration and Logistic Research.

Graduates with MSc in mathematical sciences, University of Bristol, UK provides a graduate with skills in quantitative research, reasoning and problem solving that will be valuable in your future career. Mathematics graduates often go on to PhD or find employment in finance, accountancy, research, teaching, or management.

REVIEW PERIOD

The qualification will be reviewed after 5 years.

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