SECTION A:	QUALIFICATION DETAILS																	
QUALIFICATION DEVELOPER (S)	Botswana International University of Science and Technology																	
TITLE	Master of Science in Computer Science													**NCQF LEVEL**	9			
STRANDS (where applicable)	1. Data Science 2. Cybersecurity 3. Artificial Intelligence 4. Machine Learning 5. Computer Networks 6. Network Security 7. Internet of Things																	
FIELD	Information and Communication Technology			**SUB-FIELD**	Information technology									**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																		

RATIONALE:

An MSc in CS degree focuses on advancing learners' research competencies pertaining to the theoretical foundations of Computer Science which could also be aligned with specific domains within CS (such as Data Science, Cybersecurity, Artificial Intelligence, Machine Learning, Computer Networks, Network Security, Internet of Things, etc.) depending on the availability of supervisors with relevant expertise. Master of Science in Computer Science is considered as a transitional degree to PhD programmes. The entry requirements for this programme are higher than for a taught MSc, and the admission criteria include the ability of candidates to demonstrate their research potential through a research proposal and an interview with a prospective supervisor.

Botswana Vision 2036 recognises education and skills development as the foundation for human resource development. The development of the human capital specialised in Computer Science is essential in achieving the Vision 2036 pillars mainly Pillar 1 (Sustainable Economic Development) and Pillar 2 (Human and Social Development) (Vision 2036 Presidential Task Team, 2016). 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. The achievement of Botswana Vision 2036 goals is impossible without producing Batswana with graduate degrees, those who are also able to be competitive in the global academic jobs market.

According to the report by Human Resource Development Council of Botswana (Human Resource Development Council of Botswana, 2017), there is a need to fill top demand occupations such us Data Analysts and Scientists, Database and Network Professionals, University and Higher Education Teachers, Science and Technology Researchers. The degree of MSc in CS is thus designed to produce graduates who can, if they choose not to pursue further studies, either fill the shortage of qualifications identified in the HRDC report or help to prepare specialists in required qualifications at the university level (undergraduate and postgraduate) as teaching instructors/lecturers. This is in line with the national priorities as outlined in the Vision 2036 and NDP 11 (Vision 2036 Presidential Task Team, 2016), (Government of Botswana, 2017)

The degree of MSc in CS qualification is a degree which trains scientists to a level where they are capable, under supervision, of planning and undertaking original research projects. After successful completion of this programme, qualifying candidates can join PhD programmes in universities and research centres of Botswana or globally.

An MSc in CS degree helps, to a certain extent, advance Computer Science as an academic discipline. Research output at the master's level is expected to be more significant for the discipline than that of a bachelor's degree. It also has the potential to be more effective in communicating the distinctive contributions and importance of the discipline. This is particularly valuable in communicating the value and the identity of the CS discipline to prospective employers who might still not have a clear understanding of what modern Computer Science programmes can offer. High-performing MSc graduates and a well-defined integrated understanding of the key elements of Computer Science as an academic discipline can have a significant impact on stakeholders' perception of CS and willingness to employ CS programmes graduates.

PURPOSE: (itemise exit level outcomes)

The purpose of the qualification is to produce graduates with highly specialised knowledge, skills, and competences to

- plan and undertake original research, including that at the PhD level, if qualify for admission,
- make research contributions to the body of knowledge of Computer Science,
- develop and apply new techniques, and possess skills in solving social, economic, organisational, and other problems,
- to possess mastery of the latest and advanced Computer Science methods and techniques in scholarly research to solve socio-economic problems of the country, as per Vision 2036, NDP 11 agendas and other national agendas which will follow,
- effectively disseminating advanced CS knowledge and understanding through publications, seminars, classroom teaching, or other means.

MINIMUM ENTRY REQUIREMENTS (including access and inclusion)

To be admitted to the Master of Science in Computer Science qualification, an applicant shall have:

- NCQF Level 7, Bachelor of Science in Computer Science, or its equivalent

  or
- Entry through Recognition of Prior Learning in line with institutional and national policies where necessary

SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
ELO-1 Possess advanced knowledge at the frontier of Computer Science, specifically theories, models, methods, and techniques from the existing body of knowledge of Computer Science to critically analyse and interpret information to make propositions and judgements.	1.1 Critically evaluate existing ideas, issues, and concepts in a specialised field of Computer Science to identify open problems and their possible solutions. 1.2 Produce a proposal identifying the research problem and proposing the solution to this problem potentially contributing to the body of knowledge of Computer Science. 1.3 Produce a thesis incorporating advanced knowledge (theories, models, methods, techniques, etc.) at the frontier of Computer Science and contributing to the body of knowledge of Computer Science.
ELO-2 Understand contemporary theories, principles, and concepts in the area of Computer Science that can form the basis for academic research and carry out research, critical evaluation and synthesis of ideas, issues and concepts as applies to the chosen research topic and identified research problem.	2.1 Produce a literature review using a critical analysis of literature and proper use of citation within arguments. 2.2 Identify strengths and weaknesses of existing relevant studies, as well as gaps to be addressed by proposed research. 2.3 Apply analytical, critical, and creative thinking skills to solve problems in a range of professional contexts. 2.4 Critically analyse and evaluate the existing knowledge to draw appropriate inferences and conclusions. 2.5 Generate new ideas or ways of viewing problems in Computer Science field and their solution approaches.
ELO-3 Exercise autonomy, initiative and authority while conducting research and take responsibility and accountability for the research output.	3.1 Working under supervision, produce a high-quality concept paper, a research proposal, research progress reports and, finally, a thesis. 3.2 Produce comprehensive written reports that communicate complex disciplinary and interdisciplinary ideas and information effectively for the intended audience and purpose. 3.3 Produce oral presentations that effectively communicate complex disciplinary and

	interdisciplinary ideas and information effectively for the intended audience and purpose. 3.4 Present the results of the research work in workshops, seminars, or conference settings. 3.5 Publish the results of the research work in reputable peer-review journals.
ELO-4 Possess mastery of professional practice in the area of Computer Science.	4.1 Identify user requirements. 4.2 Design software/a system/an application. 4.3 Create a prototype of software/a system/an application. 4.4 Implement software/a system/an application. 4.5 Test software/a system/an application.
ELO-5 Identify and solve complex and unpredictable problems within the area of Computer Science.	5.1 Select a complex and unpredictable research problem (under guidance) and present it in a form of a concept paper. 5.2 Carry out a literature review to formulate and refine a research problem and present it in a form of a research proposal. 5.3 Formulate the research questions and/or hypotheses in a standard way appropriate to the specialisation area. 5.4 Justify the relevance of the research problem. 5.5 Select appropriate research design and research methods to solve the identified research problem.

SECTION C	***QUALIFICATION STRUCTURE***				
COMPONENT	***TITLE***	***Credits Per Relevant NCQF Level***			***Total Credits***
		Level [ ]	***Level [ ]***	***Level [ ]***	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/Units*	***N/A***				
CORE COMPONENT *Subjects/Courses/ Modules/Units*	Research Proposal in Computer Science			60	60
	Master's Thesis in Computer Science			180	180
STRANDS/ SPECIALIZATION	*Subjects/ Courses/ Modules/Units*	***Credits Per Relevant NCQF Level***			***Total Credits***
		Level [ ]	***Level [ ]***	***Level [ ]***	

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 has 240 credits. The credit combination for the qualification is 60 credits from a research proposal and 180 credits from a thesis.	

ASSESSMENT ARRANGEMENTS
1) All assessments leading to the award of credits in this qualification shall be based on the qualification exit-level outcomes. 2) Formative Assessment in this programme is done through presentations, progress reports and research papers. Formative assessment does not contribute to the final mark but is used for providing feedback to the students and informing the department and supervisor(s) about student's progress. 3) Summative Assessment − Learners shall undergo a summative assessment which includes a research proposal and a written thesis. Examination of research proposals and theses should be undertaken according to the postgraduate rules, regulations and procedures established by the university. Summative Assessment contributes 100% to the final grade while Formative Assessment is not graded and only is used to track students' progress and provide them with feedback.
MODERATION ARRANGEMENTS
Assessments contributing towards the award of credits in this qualification are examinations of a research proposal and a thesis by appointed examiners. The exit level assessment is the examination of the thesis and the tools for thesis examination shall be moderated by an External Moderator to ensure that assessments are aligned with exit level outcomes. Qualified external moderators shall be appointed from an accredited Education and Training Providers (ETPs).
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
Credit transfer will be awarded in accordance with applicable ETP CAT policies and guidelines 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 a horizontal articulation pathway, nationally, regionally, and internationally. **Horizontal Articulation**

Qualifications of similar level at NCQF Level 9 include:

- MSc in Computer Science,
- MSc in Software Engineering,
- MSc in Cyber Security,
- MSc in Data Science,
- MSc in Artificial Intelligence.

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 a PhD in Computer Science programme.

Employment Pathways

As the graduates of the Master of Science in Computer Science qualification will have high level problem-solving skills, this qualification can be a steppingstone to a wide and diverse career. Graduates of the MSc in CS qualification will be sought after by universities and research centres, industries and consultancies, central and local government departments, due to their scientific training, critical thinking skills and problem-solving abilities.

The graduates will have the requisite competencies and attributes to work in the following sectors:

- Research and innovation,
- IT companies,
- Banks and financial companies, and
- Various business companies.

They could also start their own IT companies thus contributing to the diversification of Botswana's economy and creating jobs for university graduates with CS degrees.

The graduates will be qualified to hold high-level managerial positions/roles such as (World Economic Forum, 2020), (Human Resource Development Council of Botswana, 2017):

- Junior researchers in universities and academic research centres,
- Researchers in industries focusing on innovation, data collection, analysis, and documentation, monitoring and evaluation, critical thinking, and analysis,
- IT project managers,

- IT consulting managers,
- IT strategic advisors,
- Heads of IT departments/chief information officers (CIO),
- Technopreneurs.

QUALIFICATION AWARD AND CERTIFICATION

Minimum standards of achievement for the award of the qualification

Candidates will be awarded the degree of Master of Science in Computer Science after attaining the stipulated minimum credits of 240, inclusive of 60 credits from Research Proposal and 180 credits from Dissertation. No student will be allowed to graduate unless their dissertations are successfully examined. The examination of MSc dissertation is according to the rules and standards established by School of Postgraduate Studies.

Certification

A certificate will be awarded to graduates.

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

Benchmarking has been done against a sample of similar types and levels qualifications and/or programmes offered within the region and beyond to appreciate international trends and practices in relation to exit level descriptors and scope of content covered and ascertain regional and international comparability and articulation of the proposed qualification. The outcomes of this process are highlighted below.

Summary of Similarities and Differences Observed

The preliminary analysis has revealed that Master's by research qualifications are mostly found in the UK, Australia and South Africa while, for example, in the US most Master's degrees are either taught or contain a significant taught component. All the 14 reviewed qualifications compare well with the proposed MSc in CS qualification relative to the duration, exit learning outcomes, entry requirements, NQF level, and research areas covered. All reviewed qualifications could be considered either as degrees of their own merit or a transitional stage to a PhD qualification. However, only the following nine qualifications are done by with the main emphasis

on research in a form of a dissertation/thesis, and, therefore, fully compare with the proposed qualification. The summary of exit learning outcomes and research areas covered in these qualifications is provided below.

S/N	Qualification/University	Exit Level Outcomes	Research Areas
1.	Master of Science in Computer Science (developed)	1) Possess advanced knowledge at the frontier of Computer Science, specifically theories, models, methods, and techniques from the existing body of knowledge of Computer Science to critically analyse and interpret information to make propositions and judgements 2) Understand contemporary theories, principles and concepts in the area of Computer Science that can form the basis for academic research and carry out research, critical evaluation and synthesis of ideas, issues and concepts as applies to the chosen research topic and identified research problem 3) Exercise autonomy, initiative and authority while conducting research and take responsibility and accountability for the research output 4) Possess mastery of professional practice in the area of Computer Science 5) Identify and solve complex and unpredictable problems within the area of Computer Science 6) Apply a range of advanced Computer Science knowledge and skills with a sense of responsibility for the integrity of research	Data Science, Cybersecurity, Artificial Intelligence, Machine Learning, Computer Networks, Network Security, Internet of Things

2.	MRes and MPhil in Computing Science, University of Glasgow (the UK)	1) Contribute to culture and society 2) Become leaders in a global environment	Cyber Security, Healthcare Technologies, Media and Data Science, Programming Languages, Understandable Autonomous System
3.	MPhil in Computer Science and Informatics, Cardiff University School of Computer Science (the UK)	1) Possess deep understanding and broad knowledge concerning contemporary Computer Science from a research and development perspective 2) Build the computing systems of the future	Data Privacy and Cybersecurity, Distributed and Parallel Systems, Human Factors Technology, Knowledge Representation and Reasoning, Social Computing, Text and Data Mining, and Quantum Technologies and Engineering
4.	MPhil in Computer Science, University College London (the UK)	1) Conduct research, with initial research results, 2) Plan for completion of the work and writing of the thesis 3) Understand the current questions which face industry 4) Have the skills and the experience to market innovative solutions	Bioinformatics, Financial Computing, Human Centred Systems, Information Security, Intelligent systems, Media Futures, Networks, Programming Principles, Verification and Logic, Software Systems Engineering, Virtual Environments, and Vision and Imaging Science
5.	MSc by Research in Computer Science, University of Bristol (the UK)	Produce ground-breaking research that makes an impact on society at local, national, and international levels	Cryptography, Interaction, Intelligent Systems, Computational Neuroscience, Robotics, Programming Languages, Algorithms and Complexity, Visual Information, Trustworthy Systems, Cyber Security, High Performance Computing
6.	MPhil Computer Science, University of Manchester (the UK)	1) Demonstrate the capacity to pursue research and scholarship 2) Represent original work that is appropriately located by the candidate within a wider field of knowledge and investigation	Artificial Intelligence, Data Science, Future Computing Systems, Human Centred Computing, Software and E-Infrastructure, Theory and Foundations
7.	Master of Philosophy (Engineering, with specialisation in Computer Science, the University of Sydney (Australia)	1) Succeed in research, 2) Build a professional network,	Complex Systems, Data Science, Internet of Things, and

		3) Possess multidisciplinary knowledge while working with students and researchers from a broad range of backgrounds, 4) Have a robust set of skills sought-after by employers, for a career in academia or industry	Robotics and Intelligent Systems
8.	Master of Science (Research) in Computing Sciences, University of Technology Sydney (Australia)	Have deep and extended knowledge of a specialised area of computing	Quantum Computation and Intelligent Systems, Innovation in IT Services and Applications, Human Centred Technology Design
9.	Master's by dissertation in Computer Science, School of IT, University of Cape Town (South Africa)	1) Possess a thorough understanding of the scientific principles underlying the research and an appropriate acquaintance with the relevant literature, 2) Present their research results according to the standards of the department and faculty, 3) Undertake a substantial and informed piece of research, and 4) Collect, organise and analyse material	Artificial Intelligence, ICT for Development, Collaborative Visual Computing, Digital Libraries, High Performance Computing, Human-Computer Interaction, Network and Information Security, Networking for Development.
10.	MSc in Computer Science, University of Pretoria (South Africa)	Plan, initiate, carry out and report on a scientific investigation	Artificial intelligence, Computer and Information Security, Digital Forensics, Computer Science Education Didactics and Applications, System Specifications and Formal Methods, Software Engineering and Software Architecture.

The five remaining qualifications include a significant number of credits obtained through taught modules, and this is the main difference between them and the proposed qualification.

Comparability and articulation of the proposed qualification with the ones examined

Available learning and employment opportunities for the developed qualification were benchmarked against a selected set of 14 qualifications to determine the competitiveness of the graduates of the developed qualification against those of other qualifications. The summary of horizontal and vertical articulation, as well as of employment pathways, is shown below.

S/N	Programme/University	Horizontal and Vertical Articulation	Employment Pathways
1.	Master of Science in Computer Science (developed)	MSc in Computer Science, MSc in Software Engineering, MSc in Cyber Security, MSc in Data Science, MSc in Artificial Intelligence, PhD in Computer Science, PhD in Software Engineering, PhD in Cyber Security, PhD in Data Science, PhD in Artificial Intelligence	Junior researchers in universities and academic research centres, Researchers in industries focusing on innovation, data collection, analysis, and documentation, monitoring and evaluation, critical thinking, and analysis, IT project managers, IT consulting managers, IT strategic advisors, Heads of IT departments/chief information officers (CIO), Technopreneurs
2.	MRes and MPhil in Computing Science, University of Glasgow (the UK)	MLitt/MRes/MPhil in Information Studies MRes/MPhil in Autonomous Systems and Connectivity PhD in Computing Science (direct transfer) PhD in Information Studies PhD in Autonomous Systems and Connectivity (available within the same university)	Various posts in industry and academia
3.	MPhil in Computer Science and Informatics, Cardiff University School of Computer Science (the UK)	MPhil in Social Computing MPhil in Text and Data Mining MPhil in Distributed and Parallel Systems MPhil in Data Privacy and Cyber Security MPhil in Knowledge Representation and Reasoning MPhil in Quantum Technology and Engineering MPhil in Visual Computing	Software Developer, Lecturer, Web Developer, Software Engineer, Software Architect, Technical Consultant, IT Specialist, and Support Analyst

		PhD in Computer Science and Informatics (direct transfer) PhD in Social Computing PhD in Text and Data Mining PhD in Distributed and Parallel Systems PhD in Data Privacy and Cyber Security PhD in Knowledge Representation and Reasoning PhD in Quantum Technology and Engineering PhD in Visual Computing (available within the same school)	
4.	MPhil in Computer Science, University College London (the UK)	MPhil in Cybersecurity, MPhil/MRes in Medical Imaging MPhil/MRes in Foundational Artificial Intelligence MPhil in Theoretical Neuroscience and Machine Learning PhD in Computer Science (direct transfer) PhD in Cybersecurity, PhD in Medical Imaging PhD in Foundational Artificial Intelligence PhD in Theoretical Neuroscience and Machine Learning *(available within the same college)*	Applications developers, information systems managers, IT consultants, multimedia programmers, software engineers and systems analysts
5.	MSc by Research in Computer Science, University of Bristol (the UK)	MSc in Immersive Technologies (Virtual and Augmented Reality) MSc in Cyber Security (Infrastructures Security) MSc in Digital Health MSc in Data Science MSc in Financial Technology with Data Science	Commercial or academic careers

		PhD Computer Science (direct transfer) PhD Interactive Artificial Intelligence PhD Computational Statistics and Data Science PhD Robotics and Autonomous Systems PhD Cybersecurity PhD Digital Health and Care *(available within the same university)*	
6.	MPhil Computer Science, University of Manchester (the UK)	MPhil in Bioinformatics MPhil in Health Informatics PhD in Computer Science (direct transfer) PhD in Bioinformatics PhD in Health Informatics *(available within the same university)*	Commercial or academic careers
7.	Master of Philosophy (Engineering, with specialisation in Computer Science), the University of Sydney (Australia)	Master of Philosophy in Engineering (Cybersecurity) Master of Philosophy in Engineering (Data Science) Master of Philosophy in Engineering (Digital Health and Data Science) Master of Information Technology Master of Information Technology Management PhD in Engineering with specialisation in Computer Science (direct transfer) *(available within the same faculty)*	Careers in industry, academia and research organisations
8.	Master of Science (Research) in Computing Sciences, University of Technology Sydney (Australia)	Master of Science by Research in Analytics PhD in Computer Science (direct transfer) PhD in Artificial Intelligence	Positions in universities and other institutions undertaking research or other academic work, including teaching

		PhD in Information Systems, Software Engineering and Analytics *(available within the university)*	
9.	Master's by dissertation in Computer Science, School of IT, University of Cape Town (South Africa)	Master's in Information Technology Master's in Data Science MSc/MPhil in Artificial Intelligence Master's of Commerce in Information Systems PhD in Computer Science (direct transfer) PhD in Information Systems *(available within the same school)* MSc in Machine Learning and Artificial Intelligence MSc in Artificial Intelligence MSc in Data Science Master's in Applied Data Science Master's in Information Systems MEng in Computer Engineering MSc in Computing MSc in Informatics PhD in Computer Science PhD in Artificial Intelligence PhD in Data Science PhD in Information Systems PhD in Informatics (*available through National Articulation Policy*)	Careers in academia and industry
10.	MSc in Computer Science, University of Pretoria (South Africa)	Master's in Information Technology PhD in Computer Science (direct transfer) *(available within the same school)*	Careers in industry and academia

		MSc in Machine Learning and Artificial Intelligence MSc in Artificial Intelligence MSc in Data Science Master's in Applied Data Science Master's in Information Systems MEng in Computer Engineering MSc in Computing MSc in Informatics PhD in Computer Science PhD in Artificial Intelligence PhD in Data Science PhD in Information Systems PhD in Informatics (*available through National Articulation Policy*)	

The developed qualification aims to produce graduates who will be qualified to take various positions in academia and industry which compares well with the reviewed qualifications regionally and globally.

Only South Africa has provisions for the horizontal and vertical articulation nationally. The degree articulation in South Africa is ensured by the SANQF and National Articulation Policy. Although there are the Frameworks for Higher Education Qualifications of UK Degree-Awarding Bodies (FHEQ) for qualifications awarded by bodies across the United Kingdom with degree-awarding powers, there is no provision for the horizontal and vertical articulation. The Australia Qualification Framework (AQF) comprises 10 levels, ranging from certificates to doctoral degrees, with MSc degree being at Level 9. However, no nation-wide articulation policy is found in Australia.

Therefore, for qualifications in the UK and Australia it could only be assumed that there is a horizontal and vertical articulation within the same school/college or university.

Therefore, in terms of the horizontal and vertical articulation the developed qualification compares better with those in South Africa.

REVIEW PERIOD

Every five (5) years.