BQA NCQF QUALIFICATION TEMPLATE

SECTION A:	QUALIFICATION DETAILS		
QUALIFICATION DEVELOPER (S)	Botswana International University of Science and Technology		
TITLE	Doctor of Philosophy in Mechatronics and Industrial Instrumentation Engineering	**NCQF LEVEL**	10
STRANDS (where applicable)	N/A		
FIELD	Manufacturing, Engineering and Technology	**CREDIT VALUE**	360
SUB FIELD	Engineering and Engineering Trades		

New Qualification	✓	Legacy Qualification		Renewal Qualification	
				Registration Code	

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:

This qualification aims to produce graduates with knowledge and expertise across three different areas of study, namely, mechanical engineering, electrical engineering, computer science, and control systems. The interdisciplinary nature of this qualification can create a pool of experts that are necessary for the technological advancement of the country through locally developed technologies or as knowledge support to technologies of existing industries. The knowledge expertise produced from this qualification is a necessary element in creating a center of technological knowledge experts in the region, that will position Botswana as an important knowledge source that is nowhere found in the region. This can place Botswana on the world map as an important player in the advancement of technology throughout the world. The workforce demand in this area will profoundly increase when the necessary pool of knowledge experts is created will lead to the advancement of a knowledge-based economy in the country and become a strategic player in the regional production of knowledge and technology. This will place Botswana as an active contributor to the world's technological advancement.

This qualification aligns with Botswana HRDC key economic area in Information Communication and Technology (ICT), but is critical in all areas especially in Mining, Minerals, Energy and Water Resources, Agriculture, Health, etc. The qualification will set the standard for Doctoral learning and research qualification to be attained for award of the doctoral degree; as well be used as the criteria to recognise and compare graduates' performance at the end of learning and research; in determining whether they've attained competence that matches the standard set.

PURPOSE: (itemise exit level outcomes)

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

1. Undertake original, scholarly, and cutting-edge research of international standards to solve mechatronic, manufacturing and instrumentation problems.
2. Publish mechatronic, manufacturing and instrumentation research findings and knowledge in reputable journals and conferences

3. Produce designs incorporating mechanical, electronic and automation science for any sector of engineering and manufacturing. 4. Display professionalism and strategic leadership in mechatronic, industrial instrumentation, manufacturing, and associated systems design and implementation.
MINIMUM ENTRY REQUIREMENTS (including access and inclusion)
1. Masters degree, NCQF Level 9, in Mechatronics and Industrial Instrumentation and related field 2. There shall be provision for entry through RPL in line with ETP policies

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SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
1. Conduct original, scholarly, and cutting-edge research of international standard to solve mechatronics, manufacturing, and industrial instrumentation problems	1.1Access, analyze, and synthesize mechatronics, manufacturing and instrumentation information from an online database or printed scientific materials 1.2. Compare and contrast evaluated information from previous related work to be used for the proposed scientific solution or investigation. 1.3. Identify usefulness and discriminate irrelevant information, and prioritize information based on the impact on the current study.

	1.4 Undertake scientific investigation in real-world or simulated situations to solve mechatronics and industrial instrumentation problems. 1.5. Collect relevant data and extensively evaluate and analyse the results to inform solution generation. 1.6. Relate the findings and developed solutions to other related fields of investigations.
2. Generate new knowledge in mechatronics, manufacturing, and industrial instrumentation to be used in research, teaching, and solutions for industry and community problems	2.1. Propose novel contribution from investigation performed that contributes to the advancement of science and technology 2.2 Create new theories, equations, and results of investigations that show unique impact on the current state-of-the-art 2.3. Present novel ideas for peer review and approval
3. Publish original, scholarly, and cutting-edge research of international standard to solve mechatronics, manufacturing and instrumentation problems in reputable journals and conference publications	4.1. Undergo peer-review process to enhance clarity of presentation and improve on gaps found by the peer reviewers 4.2. Submit in reputable journals and conferences, preferably listed in Scopus or Web of Science, to enhance the quality of information dissemination 4.3. Use high-impact references and previous work with high-impact factors and credible citations that

	will help establish good reputation to scientific community
5. Utilize computational software, develop simulation, and develop own software tool to evaluate proposed mechatronic, manufacturing and instrumentation problem solutions	5.1. Evaluate, simulate, and test research investigations using available software, preferably freeware, or own-developed software tools 5.2. Verify proposed methods or algorithms before any hardware implementation, and test them to allow visualization of the physical system in a virtual world. 5.3. Iterate as many results as possible to the satisfaction of the investigator, and improve on methods according to the showed results 5.4. Show numerical computations through software tools, graphical results, and visualization for analysis and synthesis of the methods or algorithms of the proposed solutions.
6. Implement hardware of chosen investigation platform when solving mechatronics, manufacturing, and instrumentation problem	6.1. Design and develop a hardware platform according to the experimental design of the mechatronics solution. 6.2. Design and develop control software to command the hardware and focus to investigate theoretical principles tested through simulation or computational evaluation 6.3. Test and evaluate the robustness and reliability of the created hardware

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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					
	Research Thesis			360	360

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

Electives					

BOTSWANA Qualifications Authority

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)

This qualification has research thesis at NCQF level 10 with a total of 360 credits. There are no fundamentals and electives.

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ASSESSMENT ARRANGEMENTS
Summative assessment (thesis) carries 100%. Formative assessment is encouraged but not graded. Assessment must be conducted by persons with a minimum of a doctoral degree in mechatronics engineering or related in line with ETP policies.
MODERATION ARRANGEMENTS
There shall be provision for internal and external moderation by suitably qualified persons preferably with a minimum of doctoral degree in mechatronics in line with ETP policies.
RECOGNITION OF PRIOR LEARNING
There shall be provision for award of credits towards this qualification through RPL in line ETP policies.
CREDIT ACCUMULATION AND TRANSFER
There shall be provision for award of credits towards this qualification through CAT in line ETP policies.
PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)
Horizontal • Doctor of Philosophy in Mechanical and Energy Engineering • Doctor of Philosophy in Biomedical Engineering • Doctor of Philosophy in Artificial Intelligence Employment Pathways • Mechatronics Engineering Researcher • Mechatronics and Industrial Instrumentation Lecturer

QUALIFICATION AWARD AND CERTIFICATION

Candidates must attain 360 credits through research to be awarded Doctor of Philosophy in Mechatronics and Industrial Instrumentation.

The graduate will be issued a certificate and record of learning/transcript for the Doctor of Philosophy in Mechatronics and Industrial Instrumentation.

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

Regional comparability: Doctor of Philosophy in Mechatronic Engineering - Stellenbosch University (South Africa)
International Comparability: Doctor of Philosophy in Mechatronics Systems Engineering - University of Denver (United States of America)

Titles: The developed qualification and the benchmarks have the same qualification type and qualifier (Ph. D. in Mechatronics) which makes them similar. The developed qualification titles has a designator (Industrial Instrumentation) to define the area of focus within the broad area of mechatronics.
NQF Levels and Credits: The developed qualification is on NCQF Level 10 while the regional benchmark is on NQF level 10 both with 360 credits, making them similar. A slight difference is that USA does not have an NQF and NQF based credits system. Nonetheless, the credit value can be inferred from the duration of three (3) years.
Main Exit Level Outcomes: All the qualifications aim to produce graduates the most advanced knowledge, skills and competence at the frontier of mechatronics, capable of conducting independent, original and scholarly research to contribute new knowledge in the mechatronic field. The slight difference is the explicit focus on industrial instrumentation for the developed qualification.

Main Modules / Domains: The developed qualifications and the benchmarks are similar in the sense that they mainly focus on independent research thesis with oral defence and no coursework. None of the qualifications explicitly allocates assessment weighting to formative assessments.
Assessment arrangements and weightings: The developed qualifications allocates 100% to summative assessment of the research thesis. While formative assessments will be conducted to

aid progress, their grades will not contribute to the final grade or the 360 credits. The benchmarks do not explicitly state the assessment weightings, but rather strategies such as oral exams, thesis defence and examinations.

Rules of combinations: The developed qualification and the benchmarks demand submission of a research thesis and oral defence as minimum requirement for award making all qualifications similar.

In summary, the proposed qualification is aligned and almost identical to existing qualifications within the region and around the world. All the qualifications are the apex of the hierarchy of qualifications for the respective countries, therefore, do not have vertical progression pathways. Graduates may undertake post-doctoral studies in related fields. All the qualifications present graduates with similar career opportunities as researchers in mechatronics field

REVIEW PERIOD
5 years

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