SECTION A:	***QUALIFICATION DETAILS***																	
QUALIFICATION DEVELOPER (S)	University of Botswana																	
TITLE	Master of Science in Mechanical Engineering														***NCQF LEVEL***		*9*	
FIELD	Manufacturing, Engineering and Technology		***SUB-FIELD***		Mechanical Engineering										***CREDIT VALUE***		*240*	
New Qualification														*Review of Existing 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 purpose of the MSc in Mechanical Engineering qualification is to educate and train learners to contribute to the development of knowledge at an advanced level in the field of mechanical engineering. Graduates of this qualification will be competent to contribute to the body of knowledge in the discipline of mechanical engineering and conduct research under minimal supervision. Qualifying learners will be able to deal with complex issues systematically and creatively, design and critically evaluate analytical writing, make sound judgements using data and information at their disposal, communicate conclusions clearly to both specialist and non-specialist

audiences, demonstrate self-direction and originality in tackling and solving problems, and continue to advance their knowledge and skills, critically reflecting on application of theory.

The need for the qualification is driven by identified need for systems analysts, researchers, consultants, policy makers and advisors, and business development specialists in key strategic economic sectors characterized by rapid changes in technology. These sectors include research, innovation, science and technology, Energy Management and manufacturing as identified by the Human Resource Development Council (Priority Occupations List, 2019) which requires a high demand of manpower to transform Botswana into a knowledge-based economy. The Master of Science in Mechanical Engineering qualification was developed in the context of the outcome-based learning framework. The qualification contributes towards the strategic goal of meeting the country's development needs through advancing human resource development and developing research and innovation capacity (Education and Training Sector Strategic Plan, 2015; National Development Plan 11, 2017). The design of the Master of Science in Mechanical Engineering qualification is also considered to be in line with three pillars of Vision 2036 of producing sustainable economic development, human and social development and sustainable environment, as well as key future imperatives of innovation and sustainability. The qualification is closely comparable to similar local, regional and international qualifications selected for bench marking.

PURPOSE:

The purpose of the Master of Science in Mechanical Engineering is to equip learners with the required disciplinary knowledge, practice-oriented skills, and research capacity to meet acceptable academic and professional standards. The qualification will equip learners with in-depth knowledge and understanding of the discipline, including critical awareness of current issues and developments in the field of mechanical engineering. The Master of Science in Mechanical Engineering qualification will enable graduates to apply integrated technical knowledge, advanced skills, advanced analysis and problem-solving to the discipline of Mechanical Engineering. Learners will be equipped with analytical skills and technical competences to:

- Evaluate and interpret information to make propositions and judgments in engineering management.
- Analyze existing engineering professional practice and put issues and ideas in perspective.
- Develop new skills and techniques to identify and solve complex engineering problems in a range of professional contexts.
- Work independently and make informed decisions with professional authority.

- Apply advanced research methods and tools to contribute to professional knowledge and practice.

ENTRY REQUIREMENTS (including access and inclusion)

- Minimum of Bachelor of Engineering or Bachelor of Science, NCQF Levels 7.

- Recognized prior learning (RPL), work experience, and transfer of credits (CAT) from comparable institutions in areas covered by the qualification will be considered but will not outweigh formal academic qualifications.

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SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
1. Apply specialist knowledge to solve engineering problems.	1. 1 Formulate the engineering problem 1. 2 Apply skills in a specialization of the mechanical engineering field. 1. 3 Lead in solving advanced engineering problems 1. 4 Work in a team, making individual contribution to solutions. 1. 5 Work independently with professional responsibility in a specialized engineering field. 1. 6 Communicate solutions effectively to the understanding of both specialist and non-specialist audiences. 1. 7 Responsibility in a specialized engineering field.
2. Develop problem solving techniques in mechanical engineering contexts.	2.1 Select the most appropriate specialized approaches to problem solving. 2.2 Develop the most appropriate specialized techniques to problem solving. 2.3 Integrate knowledge across the various streams of mechanical engineering. 2.4 Apply specialist knowledge to develop appropriate solutions to problems, recognizing wide-ranging factors including management, financial, environmental, health and technological aspects.
3. Apply specialized engineering tools and techniques to investigate and solve	3.1 Develop the most appropriate specialized techniques for investigation and data collection.

engineering problems.	*3.2* Use specialised software for simulation and data processing. *3.3* Verify the solutions developed. 3.4 Validate the solutions developed.
4. Conduct research and develop new methods in the discipline of mechanical engineering.	4.1 Formulate an appropriate research topic that addresses an identified mechanical problem. 4.2 Formulate a problem statement for the research topic. 4.3 State appropriate objectives. 4.2 Review all relevant literature. 4.5 Design appropriate methods and instruments to achieve stated objectives. 4.6 Collect relevant data. 4.7 Use appropriate software to process data 4.8 Interpret the results.
5. Design engineering components, systems, products or processes.	5.1 Identify a need from a relevant industry for new designs of components, systems, products, or processes. 5. 2 Plan the engineering design process for identified needs. 5. 3 Perform the engineering design of components, systems, products, or processes to fill the need identified in industrial applications. 5. 4 Perform economic analyses of the design.

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SECTION C	***QUALIFICATION STRUCTURE***				
COMPONENT	***TITLE***	***Credits Per Relevant NCQF Level***			***Total (Per** Subject/ Course/ Module/ Units)*
		Level [8]	***Level [9]***	***Level [10]***	
CORE COMPONENT *Subjects/ Courses/ Modules/Units*	Numerical Analysis for Engineers		*15*		*15*
	Experimentation and Measurements		*15*		*15*
	Research Methods		*15*		*15*
	Supervised Research and Dissertation		**108**		***108***
ELECTIVE/ OPTIONAL COMPONENT *Subjects/Courses/ Modules/Units* *"Learners are required to select*	Advanced Topics in Manufacturing Methods		*15 (Choose one)*		*15*
	Renewable Energy I				
	Advanced Thermodynamics				
	Modelling and Control				
	Advanced Engineering				

one Stream from Streams 1 to 5 comprising of 54 credits and one module from the last stream worth 18 credits".	Management theories				
	Advanced Manufacturing Systems		*54* *(Stream 1)*		*54* *(Choose one stream)*
	Reliability and Maintainability				
	Manufacturing Productivity				
	Clean Energy Technologies		*54* *(Stream 2)*		
	Energy Sustainability				
	Energy Management & the Environment				
	Advanced Power Generation		54 *(Stream 3)*		
	Numerical Thermal Flow				
	Advanced Heat & Mass Transfer				
	Simulation and Software Engineering		54 *(Stream 4)*		
	Signal Processing and Estimation				
	Non-linear Systems, Adaptive, Self-tuning and				

	Optimal Control				
	Reliability and Maintainability		54 *(Stream 5)*		
	Project Administration Procedures				
	Operations Research				
	Logistics and Supply Chain Management		18 (Choose one)		*18*
	Renewable Energy II				
	Advanced Fluid Mechanics				
	State Space and Multivariable Systems				

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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)

The Master of Science degree in Mechanical Engineering is composed of course work and a dissertation. To attain this qualification, students should fulfil the requisite learning outcomes for courses and dissertation**.**

Level 9 consists of 240 credits

Total Credits = 240

The credit combination for this qualification consists of 153 Core credits and 87 Elective credits, giving a total of 240 credits for the qualification.

Learners are required to select one Stream from Streams 1 to 5 comprising of 54 credits and one module worth 18 credits from the last Stream under the Electives/ Optional Component.

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ASSESSMENT ARRANGEMENTS

Formative assessment

Formative assessment or continuous assessment will contribute 50% towards the final grade. The contribution of formative assessment to the final grade is 50%

Summative assessment

The contribution of summative assessment to the final grade is 50%

MODERATION ARRANGEMENTS

Both internal and external moderation shall be done in accordance with applicable policies and regulations and shall be carried out by BQA registered and accredited moderators.

RECOGNITION OF PRIOR LEARNING

Recognized prior learning (RPL), work experience, and transfer of credits (CAT) from comparable institutions in areas covered by the qualification will be considered but will not outweigh formal academic qualifications.

CREDIT ACCUMULATION AND TRANSFER

There will be provision of awarding this qualification through Credit accumulation and Transfer in line with BQA RPL policy and the ETP RPL Policy.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

A. Learning Pathways:

1. Horizontal Articulation (related qualifications of similar level that graduates may consider):

Master of Business Administration (NCQF Level 9)

Master's in Project Management (NCQF Level 9)

Master of Philosophy in Information Systems (NCQF Level 9)

Master of Science in Manufacturing Engineering (NCQF Level 9)

Master of Science in Production Engineering (NCQF Level 9)

Master of Science in Systems Engineering (NCQF Level 9)

Master of Science in Renewable Energy (NCQF Level 9)

2. Vertical Articulation (qualifications to which the holder may progress to)

Doctor of Philosophy (PhD) in Mechanical Engineering (NCQF Level 10)

Doctor of Philosophy (PhD) in Business Administration (NCQF Level 10)

Doctor of Philosophy (PhD) in Project Management (NCQF Level 10)

Doctor of Philosophy (PhD) in Information Systems (NCQF Level 10)

Doctor of Philosophy (PhD) in Manufacturing Engineering (NCQF Level 10)

Doctor of Philosophy (PhD) in Production Engineering (NCQF Level 10)

Doctor of Philosophy (PhD) in Systems Engineering (NCQF Level 10)

Doctor of Philosophy (PhD) in Renewable Energy (NCQF Level 10)

B. Employment Pathways:

Possible jobs or employment which the holder of this qualification may take up include the following:

Researchers,

Consultants,

Policy makers and advisors,

Systems analysts,

Business development specialists,

Academics, etc.

QUALIFICATION AWARD AND CERTIFICATION

1. Minimum standards of achievement for the award of the qualification

The candidate must have met the following requirements:

i) Satisfy all exit level outcomes
ii) Achieve minimum credit requirements of 240 credits

2. Certification

Upon successful completion of the programme, a candidate will be awarded a Master of Science in Mechanical Engineering degree.

REGIONAL AND INTERNATIONAL COMPARABILITY

This qualification was compared with three qualifications (one in the region and two internationally), which were used for benchmarking purpose to aid the development of the qualification.

It was compared with the Master of Engineering Structured Mechanical Engineering from Stellenbosch University in South Africa. It was also compared with the Master of Engineering Mechanical Engineering from University College Dublin in Ireland as well as with Master of Engineering (Mechanical Engineering) from University of Sydney in Australia.

The similarities and differences among the qualifications benchmarked are as follows:

Similarities

- All three qualifications are at level 9
- Common exit level outcomes/ graduate attributes include problem solving and critical thinking,
- Assessment strategies are largely similar, though with minor variations, largely due to unclear captions in the University handbooks and /or web pages.
- Graduates from all qualifications will be eligible to become fully qualified professional engineers,

Differences

- Total credits are different for all qualifications, that is; 72, 120, and 180 for the Universities of Sydney, Dublin, and Stellenbosch respectively. Our qualification has 48 credits (240 BQA credits).
- The qualification durations vary from 1 year to 2 years for full time study and 2 to 3 years for part-time study. This qualification is of 2 years duration.
- Domains covered are all different, possible to address local needs.

The current qualification has been compared with the benchmarked regional and international qualifications. It has adopted the best components of the regional and international qualification and therefore, its graduates will be more versatile.

REVIEW PERIOD

Review will be done after 5 years.

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