BQA NCQF QUALIFICATION TEMPLATE

SECTION A:	QUALIFICATION DETAILS																		
QUALIFICATION DEVELOPER (S)	Botswana International University of Science & Technology (BIUST)																		
TITLE	*Doctor of Philosophy in Industrial & Manufacturing Engineering*													**NCQF LEVEL**	10				
STRANDS (where applicable)	1. 2. N/A 3. 4.																		
FIELD	Manufacturing, Engineering & Technology													**CREDIT VALUE**	360				
SUB FIELD	Engineering & 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: Botswana's National Development Plan, NDP 11 notes that there is insufficient number of highly skilled doctoral graduates in the science, engineering, and mathematics (STEM) disciplines among which is Industrial & Manufacturing Engineering to meet national developmental needs [1, 2]. This sentiment is also reinforced in high-profile national reports on the state of education in Botswana which shows that no higher educational institution had graduated with a Doctor of Philosophy in Industrial & Manufacturing Engineering [14]. Furthermore, both NDP 11 [1] and Human Resource Development Council & Statistics Botswana [4] have indicated that intensive training of doctoral

students in STEM disciplines in Botswana remains a viable human resources development strategies to support economic growth of Botswana and transform it to knowledge-based economy. It was established recently that Botswana produces most doctoral graduates in the education and social sciences, with the headcount figure for these graduates being almost five times that for STEM disciplines [4]. Considering that about 80% of graduates were produced by the University of Botswana and other private [4], there is a critical to increase enrolment and graduation of PhD graduates in Industrial & Manufacturing Engineering in Botswana's first STEM University. BIUST has as part of her vision, mission, and strategic plan the training of a critical mass of highly skilled PhD graduates in Industrial & Manufacturing Engineering who are imbued with both practical knowledge for implementing and managing modern and environment-friendly manufacturing processes [3].

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

1. Contribute to the advancement of knowledge through original and scholarly research, disseminate findings and integrate them to formulate policies in the field of industrial and manufacturing engineering.
2. Analyse complex and challenging problems and recommend solutions within the context of industrial and manufacturing engineering.
3. Adhere to ethics when conducting research in the field of industrial and manufacturing engineering.

MINIMUM ENTRY REQUIREMENTS (including access and inclusion)

1. Master of Engineering degree, at NCQF Level 9, in Industrial & Manufacturing Engineering or related field(s) such as Mechanical Engineering, Metallurgical & Materials Engineering, Production Engineering, Industrial Engineering, or Manufacturing Engineering.
2. There is a provision for Recognition of Prior Learning (RPL), in accordance with institutional and national policies on RPL.

SECTION B	QUALIFICATION SPECIFICATION
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
1. Conduct original and scholarly research to solve problems dwelling on manufacturing, profitability, lead time, and materials utilisation in the field of industrial and manufacturing engineering.	*1.1* Identify and develop an approach to investigate a complex problem. *1.2* Review the state of the art of knowledge using high-level independent critical thinking ability. *1.3* Disseminate research findings through publications and conference presentations. *1.4* Integrate the research findings to inform policy development and improvement of manufacturing systems. *1.5* Adhere to applicable ethical standards and code of practice when handling research data.
2. Perform specialised design and synthesis of processes and products as innovative interventions to challenging problems within the context of industrial and manufacturing engineering.	2.1 Conduct a situational analysis of manufacturing systems in terms of products and processes. 2.2 Develop manufacturing systems based on the results of situational analysis. 2.3 Recommend manufacturing processing systems to improve the efficiency of industrial and manufacturing systems. 2.4 Simulate and commission the manufacturing processing systems. 2.5 Supervise the implementation of the improved manufacturing processing systems.

3. Use information technology, and modern engineering tools for prediction and modelling of solutions to determine the limitations, restrictions, premises, assumptions, and constraints of manufacturing processes.	3.1 Utilise discipline-specific tools, processes or procedures to predict limitations of manufacturing processes. 3.2 Use information communication technology (ICT) package software for computation and simulation of industrial and manufacturing processes. 3.3 Utilise computers and networks for data processing, handling, and storage.

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

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

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)**	
The learner shall be required to achieve 360 credits at level 10 through the submission of thesis and associated requirements.	

ASSESSMENT ARRANGEMENTS

Formative Assessment: There are no credits allocated to formative assessment. All credits are attained at the completion of the qualification.

Summative Assessment (100% Weighting)

- Thesis Assessment: It should demonstrate how a learner achieves exit-level outcomes via the developed doctoral thesis in fulfilment of the award of the PhD in Industrial & Manufacturing Engineering. The PhD thesis should clearly demonstrate evidence of original work that contribute to the knowledge of and insight into the field of study.
- Publications: Publication of at least three data-based manuscripts in reputable international peer-reviewed journal (in approved databases) with a known impact factor is mandatory.
- Oral Examination: Oral Examination is mandatory for Doctor of Philosophy in Industrial & Manufacturing Engineering, and it shall be held in English. Assessment shall be carried out by Botswana Qualifications Authority registered and accredited assessors.

MODERATION ARRANGEMENTS

There shall be internal and external moderation as a quality assurance measure. The moderation must be conducted by BQA registered and accredited moderators.

RECOGNITION OF PRIOR LEARNING

Recognition of Prior Learning (RPL) will be considered for award of credits towards this qualification.

CREDIT ACCUMULATION AND TRANSFER

Credit Accumulation and Transfer (CAT) will be considered for award of credits towards this qualification.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal Articulation: The PhD in Industrial & Manufacturing Engineering is comparable to other Doctor of Philosophy qualifications offered at the same level nationally, regionally and worldwide (e.g. PhD in Manufacturing Engineering, PhD in Industrial Engineering, PhD in Production Engineering, PhD in Mechanical Engineering.

Vertical Articulation: PhD in Industrial & Manufacturing Engineering is at the highest qualification and there is no possible vertical articulation. Graduates of the programme can access post -doctoral studies to expand their knowledge in research.

Employment Pathways

- Teaching instructors, lecturers and/or research scholars
- Industrial and manufacturing researchers
- Manufacturer
- Manufacturing Manager
- Product Designer
- Manufacturing Process Modeler
- Manufacturing Systems Modeler
- Industrial & Manufacturing Consultants.

QUALIFICATION AWARD AND CERTIFICATION

Minimum standards of achievement for the award of the qualification:

For a candidate to be awarded a PhD in Industrial & Manufacturing Engineering, they must have acquired a minimum of 360 credits.

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

- Titles: The proposed qualification is titled Doctor of Philosophy in Industrial and Manufacturing Engineering, but the United Kingdom, UK and United States of America, USA qualifications are titled Doctor of Philosophy in Manufacturing Engineering, while that of South Africa is Doctor of Philosophy in Industrial Engineering. Meanwhile, all the qualifications have both Industrial and Manufacturing Engineering components, therefore, they are similar.
- National Qualification Framework, NQF Level: The NQF levels differ according to the NQF systems for each country, however, they are similar because each of this qualification is on the highest level of each NQF and have similar level descriptors of the most advanced knowledge, at the frontier of the discipline. Meanwhile, USA does not have NQFs.
- Credits: The NQF credits differ according to the NQF systems for each country, however, they are similar because they translate to the same duration of three years full time minimum.
- Duration: All the qualifications have minimum duration of three years.
- Main exit outcomes: The main exit outcomes of the compared qualifications to Doctor of Philosophy in Industrial and Manufacturing Engineering are similar.

- Modules: All of the qualifications compared are similar to this qualification as they have no course work or module to be taught.
- Assessment: All the qualifications require successful completion of PhD research thesis.

REVIEW PERIOD
The qualification will be reviewed every 5 years as per the NCQF Regulations.

For Official Use Only:

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