SECTION A:	***QUALIFICATION DETAILS***																	
QUALIFICATION DEVELOPER (S)	University of Botswana																	
TITLE	Master of Science in Civil Engineering														***NCQF LEVEL***		*9*	
FIELD	Manufacturing, Engineering and Technology		***SUB-FIELD***		Civil Engineering										***CREDIT VALUE***		288	
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:

Civil engineering is arguably the oldest engineering discipline that deals with the built environment. Civil engineering is a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including water supplies and waste management systems, highway and transportation networks, power, telecommunications and energy, sewerage systems, pipelines, flood controls and drainage systems, railroads, subway systems, airports, seaports and jetties, land protection

and reclamation, structural components of buildings and the infrastructure for a cleaner environment, to name just a few.

Engineering is a discipline and profession that serves the needs of society and the economy. The Master of Science degree in Civil Engineering qualification, with its broad fundamental base, is to enhance the career path in one of many areas of Civil Engineering specialization through structured development and lifelong learning. The broad base allows maximum flexibility and mobility for the holder to adjust to changing needs. Skills, knowledge, values and attitudes reflected in the qualification are building blocks for the development of candidate engineers towards becoming competent engineers to ultimately lead complex engineering activities and solve complex engineering problems, thus contributing to economic activity and national development.

The social and economic development of a nation depends solely on the growth and reliability of its infrastructure system which is determined by the quality of civil engineering professionals. Civil engineers have been providing the infrastructure of the societies since the very beginning of civilization. Civil engineers plan, design, supervise the construction of, operate, maintain, inspect, and manage many of the physical facilities and systems in both public and private sectors. Civil engineering touches us throughout our day.

In recent years, the civil engineering profession has seen an unprecedented shortage of experienced graduates, thereby making civil engineering graduates one of the most highly sought-after. The Human Resource Development Council (HRDC)'s 2016 Report ranked civil engineering among the top occupations in high demand in Mining, Minerals, Energy and Water Resources in Botswana. The expertise of civil engineers is also in high demand in transportation/highway, environmental and construction engineering industry which are major drivers of the nation's economy.

Hence, the MSc Civil Engineering qualification is designed to contribute towards the strategic role of meeting the country's development needs through advancing human resource development and developing research and innovation capacity (Towards a Knowledge Society. Tertiary Education Policy, 2010; Revised National Policy of Education 1994; Education and Training Sector Strategic Plan, 2015, National Development Plan 11, 2017). Furthermore, the qualification, through innovation and sustainability, is in alignment with three of the pillars of **Vision 2036** of producing (a) sustainable economic development, (b) human and social development, and (c) sustainable environment.

PURPOSE:

The purpose of the qualification is to:

- equip the prospective graduates with a broad and thorough education in civil engineering fundamentals, applications, design, construction, and maintenance that prepare them for the practice of civil engineering at the professional level with the confidence and skills necessary to meet the technical and social challenges of the future.
- build the necessary knowledge, understanding, abilities and skills required for further learning towards becoming a competent practicing engineer.
- provide graduates with a thorough grounding in mathematics, basic sciences, engineering sciences, engineering modelling, and engineering design together with the abilities to enable applications in fields of emerging knowledge.
- prepare graduates for careers in engineering and related areas, for achieving technical leadership and to contribute to the structural, environmental, socio-economic, and national development considerations which are designed to identify and address national, regional and global needs
- produce creative, competent, and motivated professional graduates who are capable of independent critical and innovative thinking for the development of the built environment through research, construction and entrepreneurship
- ensure that the holders of the qualification meet the global standards for continuing education for practicing engineering professionals, employment opportunities and attainment of higher education in preparation for career in academics
- prepare graduates with an educational requirement towards registration as a Professional Engineer with the Engineering Registration Board of Botswana and other relevant professional bodies as well as to allow the graduates to make careers in engineering and related fields.

ENTRY REQUIREMENTS (including access and inclusion)

Minimum entry requirement for this qualification is a:

Bachelor's degree (NCQF level 8) in Civil Engineering or Construction Engineering and Management or Bachelor **Honours** (NCQF level 8) in Material Science, Physics or Mathematics or equivalent.

Recognition of Prior Learning (RPL):

There will be access through Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) in accordance with the RPL and CAT National Policies.

(Note: Please use Arial 11 font for completing the template)

SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
• Demonstrate competence to identify, assess, formulate, and solve convergent and divergent civil engineering problems creatively and innovatively.	• Analyse and define the problem and identify the criteria for an acceptable solution. • Identify necessary information and applicable engineering and other knowledge and skills. • Generate and formulate possible approaches to solution of problem. • Model and analyse possible solution(s). • Evaluate possible solutions and select best solution. • Formulate and present the solution in an appropriate form.
• Apply knowledge of mathematics, basic science, and engineering sciences from first principles to solve engineering problems.	• Bring mathematical, numerical analysis and statistical knowledge and methods to bear on engineering problems by using an appropriate combination of theoretical analytical investigation, field and laboratory experimental studies, numerical modelling and simulation, and probabilistic and statistical analysis. • Use the theories, principles, and knowledge the physical, chemical, and mathematical sciences as a basis for the engineering sciences and the solution of engineering problems. • Use the techniques, principles, and laws of engineering science at a fundamental level to identify and solve open-ended engineering

	problems, pursue engineering applications, and work across engineering disciplinary boundaries.
• Analyse and conduct creative, procedural, and non-procedural design and synthesis of components, systems, engineering works, products, or processes.	• Identify and formulate the design problem to satisfy user needs, applicable standards, codes of practice and legislation. • Plan and manage the design process, address critical issues, and apply relevant principles that recognise and deal with constraints. • Acquire and evaluate the requisite knowledge, information, and resources: apply correct principles, evaluate, and use relevant design tools. • Perform design tasks including analysis, modelling and optimisation. • Evaluate alternatives and preferred solution using critical judgment, implementability testing and relevant techno-economic analyses. • Assess the impacts and benefits of the design on social, legal, health, safety, and environmental factors. • Communicate the design logic and information to other professional partners for implementation.
• Apply analytical competence to design and conduct investigations and experiments.	• Plan and conduct investigations and experiments. • Conduct a literature search and critically evaluate material. • Perform necessary analysis. • Select and use appropriate equipment or software.

	• Analyse, interpret, extract, and deduce useful information from data. • Draw conclusions based on verifiable facts or evidence. • Communicate the purpose, process, and outcomes in a technical report.
• Demonstrate competence to use appropriate discipline-specific engineering methods, skills, and tools, including ICT-based methods to engineering problems.	• Use method, skill, or tool effectively by, selecting and assessing the applicability and limitations of the method, skill, tool, process, or procedure, properly applying the method, skill, or tool, critically testing and assessing the end-results produced by the method, skill or tool. • Create computer applications as required by the discipline. • Apply basic techniques from economics, business management, and health, safety, and environmental protection.
• Demonstrate competence to communicate effectively, both orally and in writing, with engineering audiences and the community at large.	• Use appropriate structure, style and language for purpose and audience. • Use effective graphical support and visual materials. • Apply methods of providing information for use by others involved in engineering activity. • Meet the requirements of the target audience through effective delivery.
• Apply the critical knowledge of the impact of engineering activity and operations on social, industrial, and physical environment.	• Identify and deal with an appropriate combination of issues in the impact of technology on society.

	• Identify and deal with an appropriate combination of issues in Occupational and public health and safety. • Identify and deal with an appropriate combination of issues in Environmental impact assessment. • Identify and deal with an appropriate combination of issues in the personal, social, cultural values and requirements of those affected by engineering activity.
• Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments.	• Demonstrate effective individual work by identifying and focusing on objectives, working strategically, executing tasks effectively and timely delivery of completed work. • Demonstrate effective teamwork by making individual contribution to team activity, performing critical functions, enhancing work of fellow team members, benefiting from support of team members, communicating effectively with team members and timely delivery of completed work. • Demonstrate inter- or multidisciplinary work by acquiring a working knowledge of co-workers' discipline, using a systems approach and communicating across disciplinary boundaries.
• Evaluate information and apply requisite knowledge to engage in independent learning through well-developed learning skills.	• Reflect on own learning and determine learning requirements and strategies. • Source and evaluate information. • Access, comprehend and apply knowledge acquired outside formal instruction.

	• Critically challenge assumptions and embrace new thinking.
• Appreciate and apply professional ethics to exercise appropriate engineering judgment and take responsibility within own limits of competence.	• Demonstrate thorough understanding of the system of professional development. • Accept responsibility for own actions. • Display judgment in decision making during problem solving and design. • Reason about and make judgment on ethical aspects in case study context. • Discern boundaries of competence in problem solving and design.

(Note: Please use Arial 11 font for completing the template)

SECTION C	***QUALIFICATION STRUCTURE***				
COMPONENT	***TITLE***	***Credits Per Relevant NCQF Level***			***Total Credits***
		Level [7]	***Level [8]***	***Level [9]***	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/Units*	Mathematical Methods for Engineers			***18***	***18***
	Introduction to Project Management			***18***	***18***
CORE COMPONENT *Subjects/Courses/ Modules/Units*	Research Methodologies			***18***	***18***
	MSc Dissertation			***144***	***144***
ELECTIVE/ OPTIONAL COMPONENT *Subjects/Courses/ Modules/Units*	**Set 1: *Geotechnical Engineering Stream* (Compulsory Courses)**				
	Advanced Soil Mechanics			***18***	***18***
	Site Investigation and Soil Testing			***18***	***18***

	Analysis and Design of Shallow and Deep Foundations (**Choose any two courses from the list below**)			***18***	***18***
	Slope Stability and Design of Earth & Rock fill Dams Clay Mineralogy and Expansive Soils Earth Pressure and Earth Retaining Structures Pavement Design Highway Engineering Materials Finite Element Analysis			***18***	***36***
	Set 2: ***Construction Management Stream*** **Compulsory Courses**				
	Construction Finance and Economics			***18***	***18***
	Construction Planning Techniques & Cost Control			***18***	***18***
	Human Resource Management			***18***	***18***
	(**Choose any two courses from the list below**) Total Quality Management			***18***	***36***

	Information Management in Construction Strategic Management for Construction Alternative Dispute Resolution **Set 3:** ***Transportation Engineering Stream*** **Compulsory Courses**				
	Advanced Soil Mechanics			***18***	***18***
	Pavement Design			***18***	***18***
	Highway Engineering Materials			***18***	***18***
	(**Choose any two courses from the list below**) Construction Technology & Equipment Highway Rehabilitation & Maintenance Transportation Planning Transportation Systems Management & Safety			***18***	***36***
	Set 4:				

	Water Resources and Environmental Engineering Stream **Compulsory Courses**				
	Water Quality Management and Modelling			***18***	***18***
	Environmental Engineering Systems			***18***	***18***
	Integrated Catchment Management			***18***	***18***
	(**Choose any two courses from the list below**) Water and Wastewater Treatment Water Services Management Solid and Hazardous Waste Management Water Supply and Pipeline Engineering Integrated Water Resources Management Hydrology and Water Resources			***18***	***36***
	Set 5: **Structural *Engineering Stream*** **Compulsory Courses**				

	Advanced Structural Analysis			***18***	***18***
	Reinforced Concrete Design			***18***	***18***
	Design of Steel Structures			***18***	***18***
	(**Choose any two courses from the list below**) Prestressed Concrete Design Finite Element Analysis Structural Masonry Design Structural Dynamics Site Investigation and Soil Testing Earth Pressure & Earth Retaining Structures			***18***	***36***

(Note: Please use Arial 11 font for completing the template)

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	***Credit Value***
Level 9	***288***
TOTAL CREDITS	***288***

Rules of Combination:

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

Rules of Combination and Credit Distribution

Candidates will have to complete 36 credits from the Fundamental component 162 credits from core courses and 90 credits from the electives. There are five sets of electives provided. Candidates are expected to select 1 set and complete 3 courses (54 credits) from the compulsory section of the set then add any 2 courses (36 credits) from the optional section of the set. The total number of credits to be completed will add up to 288 credits.

Fundamental component contributes 36 credits

Core component contributes 162 credits

Elective component contributes 90 credits

Total: 288 credits.

(Note: Please use Arial 11 font for completing the template)

ASSESSMENT ARRANGEMENTS

Assessment Arrangements

There will be two types of assessments:

- *Formative assessment (continuous assessment), and*
- *Summative assessment (final assessment)*

Formative assessment (continuous assessment)

In line with the Outcome Based Education principle, the weighting of formative assessment shall be **40%,**

Summative assessment (final assessment)

The summative assessment shall carry **60%** weighting.

The only exception is the MSc Research that does not require written examinations, but the student must pass all the components of the dissertation from proposal defence to final assessment of dissertation by independent internal and external examiners. All assessments shall be carried out by BQA accredited assessors.

MODERATION ARRANGEMENTS

There is a commitment to have all examinations moderated both internally and externally, and

This will be done in accordance with institutional policy and in line with national policy.

RECOGNITION OF PRIOR LEARNING

The qualification embraces the developers, Credit Accumulation and Transfer and Recognition of Prior Learning Policy and Procedures and in line with national policy. Recognition of prior learning will be applicable for award of credits to contribute to the award of the qualification.

CREDIT ACCUMULATION AND TRANSFER

Credit accumulation and transfer will be applicable for award of credits to contribute to the award of the qualification and in line with national policy.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

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

- Master of Science in Water Resources & Environmental Engineering
- Master of Science in Geotechnical Engineering
- Master of Science in Structural Engineering
- Master of Science in Bridge Engineering
- Master of Science in Transportation Engineering
- Master of Applied Science Civil Engineering
- Master of Applied Science Water Resources & Environmental Engineering
- Master of Applied Science Geotechnical Engineering
- Master of Applied Science Structural Engineering
- Master of Applied Science Bridge Engineering
- Master of Technology Geotechnical Engineering
- Master of Technology Structural Engineering
- Master of Technology Bridge Engineering
- Master of Technology Transportation Engineering
- Master of Technology Construction Management.

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

Holder of an MSc (Civil Engineering) qualification may apply for a:

- Doctor of Philosophy Civil Engineering
- Doctor of Philosophy Water Resources & Environmental Engineering
- Doctor of Philosophy Geotechnical Engineering
- Doctor of Philosophy Structural Engineering
- Doctor of Philosophy Bridge Engineering
- Doctor of Philosophy Transportation Engineering
- Doctor of Philosophy Construction Management

- **Employment Pathways**

Holder of an MSc (Civil Engineering) qualification may be employed in several areas of Civil Engineering practice:

- Civil Engineer
- Construction Engineer
- Construction Project Manager
- Design Engineer
- Engineering manager
- Environmental Engineer
- Field Engineer
- Geotechnical Engineer
- Mechanical Engineer
- Project Manager
- Site Engineer
- Structural Engineer
- Water Resources Engineer

A graduate of MSc (Civil Engineering) interested in teaching and research may wish to pursue a career path in academia, research institutes, standards regulatory and professional organizations.

QUALIFICATION AWARD AND CERTIFICATION

Qualification Award

To be awarded Master of Science in Civil Engineering qualification, a candidate is required to achieve a minimum of **288** Credits. The Candidate should pass all the **Fundamental, Core and 5 Elective** modules.

Certification Award

Candidates meeting prescribed requirements will be awarded **Master of Science in Civil Engineering** and will be issued a certificate and an official transcript.

REGIONAL AND INTERNATIONAL COMPARABILITY

The proposed qualification was compared with a total of three similar qualifications in the region and internationally. The detailed courses/modules from three universities: University of Pretoria (South Africa), Florida Atlantic University (USA) and University of Newcastle (Australia) are attached as an appendix to the comparability matrix.

Summary

The comparison found that the proposed qualification is largely comparable with the qualifications from the three universities namely, University of Pretoria- UP (South Africa), Florida Atlantic University - FAU (USA) and University of Newcastle - UoN (Australia).

Similarities

In all these qualifications, the courses are common, and the structures are largely similar in course component structure and begin with fundamental courses. The qualifications have both the taught courses and dissertation components. The award of MSc Civil Engineering qualification is based on successful completion of a well-planned, rigorous set of coursework and major research/design dissertation experience. The learning outcomes are largely similar as well as pathways for further study and career growth. The proposed qualification compares very favourably with others from around the continent and the world and, additionally, it is unique as it is the only qualification that offers both the taught coursework and comprehensive dissertation in Civil Engineering. This presents advantages in relation to the exit level outcomes for the graduate and hopefully places them at an advantage in their career pathways.

Differences

Although all the qualifications offer options for streams of specialization, the specializations vary from three at FAU, four at UP and five at UoN. After the successfully completing the taught coursework, UP has a provision for early exit qualification with an award of Bachelor of Engineering (honours) degree (BEng (Hons). The pass mark for taught course is 50% at UP, while it is 55% at UB. UoN offers a general MSc in Civil Engineering qualification in which students have general knowledge in all area's specializations, while only four

fundamental component which accounts for 165 credits out of the 240 credits are common. UP and FAU also offer specialized qualifications like to the proposed, but slightly different from UoN's.
REVIEW PERIOD
The qualification shall be reviewed every five years.

(Note: Please use Arial 11 font for completing the template)