SECTION A:	QUALIFICATION DETAILS																			
QUALIFICATION DEVELOPER (S)	UNIVERSITY OF BOTSWANA																			
TITLE	Master of Science in Electrical Engineering																**NCQF LEVEL**	9		
FIELD	Manufacturing, Engineering and Technology		**SUB-FIELD**		Engineering and Engineering Trades												**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 qualification is designed to meet the advanced Power Engineering (PE) and Electronic Engineering (EE) educational needs of recent undergraduate programmes graduates and practising engineers.

The Human Resource Development Council has ranked Electrical Engineering among the top occupations and most sought-after skills in Botswana. The qualification contributes 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, this qualification is commensurate with three of the pillars of Vision 2036 of producing 'sustainable economic development, human and social development and sustainable environment', as well as two key future imperatives of 'innovation and sustainability'. The role of the discipline in research and development, innovation, science, and technology, cannot be overemphasized in transforming Botswana into a creative, sustainable, and knowledge-based economy.

The Master of Science in Electrical Engineering qualification is designed to contribute to the objectives of National Development Plans through technology and innovation in the specialisation areas of Power Engineering and Electronic Systems Engineering. The qualification ensures that the students' education meets the global standards for continuing education, for practising engineering professionals, employment opportunities and attainment of higher education in preparation for careers in academia.

The qualification is intended to produce competent and motivated professional graduates who could engage in independent, critical, and innovative thinking, investigation and analysis, design, problem solving, management, leadership, research, and entrepreneurship, through the application of technological advances in electrical or electronic engineering.

PURPOSE:

The purpose of this qualification is to equip graduates with advanced specialised knowledge, skills, and competences to:

- Apply innovative solutions in engineering and technology disciplines of power engineering or electronic engineering.
- Apply advanced specialized knowledge of power engineering or electronic engineering to meet the needs of the industry through research, consultancy, contracting, advisory and other relevant services needed.
- Carry out research in power engineering or electronic engineering whose output extends or consolidates existing knowledge.

ENTRY REQUIREMENTS (including access and inclusion)

- The minimum entrance requirement shall be an NCQF Level 7 Bachelor's degree in Power Engineering or Electronic Engineering, or equivalent qualification from a recognized university or institution of higher learning.
- There is provision for entry through Recognition of prior learning and credit accumulation transfer in line with institutional and national policies.

SECTION B QUALIFICATION SPECIFICATION	
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
1. Formulate judgments with complete resourceful information for solving engineering problems in the business or community environment.	1.1 Design Engineering technologies in context of required specifications by clients. 1.2 Work in a composite project which would require Power Engineering and Electronic engineering solutions. 1.3 Install Power Engineering and Electronic equipment from multivendor to realize clientele requirements and specifications. 1.4 Deploy and commission power engineering/electronic engineering technologies for various functions. 1.5 Document commissioned power engineering/electronic engineering technologies for future reference and maintenance.
2 Create models for electrical networks and evaluate performance based on the underlying assumptions and limitations.	2.1 Apply appropriate design software (e.g. MATLAB, SIMULINK, ARISTO, AUTOCAD etc.) to create Engineering models for specified clientele requests. 2.2 Interpret power engineering drawings and electronic circuits and models to build the required engineering infrastructure. 2.3 Maintain and configure Power Engineering, telecommunications or Control infrastructure based on implemented model. 2.4 Modify and upgrade models based on new clientele Requirements. 2.5 Communicate and inform on needed Power Engineering/Electronic Engineering

	requirements using models.
3 Analyse Engineering network systems to optimize network operations using testing and measuring engineering network equipment.	3.1 Identify appropriate tools for analysis and maintenance of Electrical plant. 3.2 Calibrate Power Engineering or Electronic Engineering measuring, and testing upkeep equipment used for maintenance and configuration of equipment. 3.3 Monitor Power Engineering infrastructure operation and optimise its operation by adjusting and setting relevant operational parameters. 3.4 Compile a typical Power Engineering and Electronic Engineering Specification Document for purposes of initiating a power engineering and electronic engineering project and secure agreement with user.
4 Design models and plans of unfamiliar and ill-defined problems including the choice of appropriate and relevant Electrical and Electronic technologies in a multidiscipline project.	4.1 Create design plans of the approved identified power engineering and electronic engineering problems based on the Power Engineering and Electronic Engineering Specification Document using appropriate software tools and techniques. 4.2 Derive specification of the plans based on the functional requirements and validate through quantitative methods data handling requirements. 4.3 Determine appropriate and relevant third party or middleware components of the development of equipment, industrial plant or infrastructure being developed.
5 Research using appropriate research methods, skills, tools, and technological tools for effectively and critically adopting an engineering practice with intent to resolve	5.1 Solve problems using appropriate and scientific technologies. 5.2 Apply relevant research methodologies in conducting PE&EE research to produce publishable research

problems and understanding their impact.	documents. 5.3 Participate in research conferences, workshops and seminars with a view to stay updated on latest technologies, theories, and methodologies in PE&EE and any other emerging technologies. 5.4 Publish research articles on existing and emerging issues in PE&EE to create new knowledge and to provide solutions to running problems.
6 Communicate succinctly to a range of audiences about Electrical and Electronics engineering technical issues and their solutions.	6.1 Communicate inter and intrapersonal during interaction with audience. 6.2 Write research reports and dissertation and defend raised criticism adequately. 6.3 Negotiate effectively during group activities and Discussions. 6.4 Convey project objectives and schedule along with updates to business teams. 6.5 Express clearly the difference amongst tools for creating software project reports or documents.
7 Manage own learning and professional development for purposes of lifelong learning.	7.1 Identify areas of weakness which need strengthening through staff development. 7.2 Participate in PE&EE communities through social media platforms blog and present one's Reflection and perception of issues related to E&E engineering. 7.3 Collaborate with fellow PE&EE experts from different organizations to share knowledge.

SECTION C	QUALIFICATION STRUCTURE				
COMPONENT	**TITLE**	**Credits Per Relevant NCQF Level**			**Total (Per** Subject/ Course/ Module/ Units)
		Level [7]	**Level [8]**	**Level [9]**	
FUNDAMENTAL COMPONENT Subjects/ Courses/ Modules/Units	Mathematical Methods for Engineers.			√	15
	Research Methodology.			√	15
CORE COMPONENT Subjects/Courses/ Modules/Units	Computer Control Systems.			√	15
	MSc Dissertation.			√	120
ELECTIVE/ OPTIONAL COMPONENT Subjects/Courses/ Modules/Units	Electric Power System Analysis, High Voltage Transmission, Electrical Machines and Drives and other 2 from Stream1 (Power Engineering). **OR** Digital Systems Design Using PLDs, Digital Signal Processing, Digital Communication and other 2 from Stream2 (Electronic Engineering).				
	Stream1 (Power Engineering)				

	Electric Power Systems Analysis.			√	15
	Electrical Measurements and Control Engineering.			√	15
	High Voltage Transmission.			√	15
	High Voltage Transmission.			√	15
	Electrical Machines and Drives.			√	15
	Power Systems Economics and Management.			√	15
	Power Distribution Systems.			√	15
	Electric Power System Operation.			√	15
	Stream2 (Electronic Engineering)				
	Digital Systems Design Using PLDs.			√	15
	Electrical Measurements and Control Engineering.			√	15
	Digital Signal Processing.			√	15
	Digital Communication.			√	15
	Image Processing.			√	15

	VLSI Circuits Design.			√	15
	Mobile and Wireless Communications.			√	15
	Optical and Broadband Communications.			√	15

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)

QUALIFICATION COMPOSITION AND RULES

A learner shall take courses of specified credits as shown in the components:

Type of Course	No.	Credits
Fundamental Component	2	**30**
Core Component	2	**135**
Elective Component	5	**75**
Total	9	**240**

- Programme shall consist of 120 notional credits from 8 courses plus 120 notional credits from the dissertation, resulting in 240 credits for the Master of Science in Electrical Engineering qualification.
- The courses shall consist of 2 fundamental courses, 2 core courses and 5 elective courses
- The elective courses must be selected as per the areas of specialization:
- Courses shall be done over 2 semesters (full time) or 4 semesters (part time).
- Research (Dissertation) shall also be done over 2 semesters (full time) or 4 semesters (part time).

ASSESSMENT ARRANGEMENTS

- Assessors and moderators of the Master of Science in Electrical Engineering qualification shall be individuals in possession of qualification at the NCQF Level 10 (PhD), or equivalent professional qualifications.
- Assessment and moderation shall be done by registered and accredited assessors and moderators.

ASSESSMENT STRATEGIES, REQUIREMENTS AND WEIGHTINGS

Formative Assessment

- For examinable courses: The contribution of formative assessment to the final grade shall be **50%**.

Summative Assessment

- For examinable courses: The contribution of summative assessment to the final grade shall be **50%**.

Pass mark for each course is **55%**

Research Dissertation shall be assessed on a **Pass/Fail** final grade

MODERATION ARRANGEMENTS

Both internal and external moderation shall be conducted by qualified personnel who are registered and accredited.

RECOGNITION OF PRIOR LEARNING

Recognition of Prior Learning for the award of this qualification will be in line with the institutional and national policies.

CREDIT ACCUMULATION AND TRANSFER

Credit Accumulation Transfer for the award of this qualification will be in line with the institutional and national policies.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

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

- MSc/Meng in Electrical and Electronic Engineering
- MSc/Meng in Telecommunications Engineering
- MSc/Meng in Renewable Energy
- MSc/Meng in Power Systems Engineering
- MSc/Meng in Systems

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

- Doctor of Philosophy (PhD) in Power Engineering
- Doctor of Philosophy (PhD) in Electronic Engineering

Employment Pathways (related qualifications of similar level that graduates may consider)

Holder of a Master of Science in Electrical Engineering qualification may be employed in various areas of Power Engineering/Electronic Engineering practice, including but not limited to:

- Power Systems Engineer
- Distribution Engineer
- Transmission Engineer
- Energy Auditor
- Facilities Manager
- Lecturer / Educator
- Researcher

- Consultant
- Contractor
- Electrical Designer Engineer
- Engineering Project Manager
- Telecommunications Engineer
- Systems Engineer
- Programmer / Analyst

QUALIFICATION AWARD AND CERTIFICATION

Minimum standards of achievement for the award of the Master of Science in Electrical Engineering qualification

The candidate must have met the following requirements:

i) Acquired a minimum of **240** notional credits resulting from the completion of all the qualification requirements.

ii) Passed **all** the Fundamental, Core and 5 Elective modules.

Certification

Upon completion of the above in (i) and (ii) above, the candidate will be awarded a Master of Science in Electrical Engineering.

A certificate and transcript will be issued at award.

REGIONAL AND INTERNATIONAL COMPARABILITY

The proposed Master of Science in Electrical Engineering qualification is in line with comparable qualifications offered at notable Universities such as University of Pretoria, University of Stellenbosch, and University of Cape Town. Elsewhere in the world, the qualification is offered in many universities such as at University of Surrey in United Kingdom and Concordia University in Canada.

University of Pretoria offers 3 related masters' qualifications. Information to these masters' qualifications can be found at:
https://up.ac.za/chair-in-electronic-defence-researchcedr/article/2189277/mengelectricalelectrniccomputer-engineering
University of Stellenbosch offers 3 related Masters qualifications. Information to these Masters qualifications can be found at: http://www.sun.ac.za/english/pgstudies/Pages/Engineering/Electrical-Electronic-Engineering.aspx
University of Cape Town offers 1 related qualification. Information can be found at:
http://www.ee.uct.ac.za/master-science-engineering-specialising-electrical-engineering
University of Surrey offers 1 related qualification. Information can be found at:
https://www.surrey.ac.uk/postgraduate/electronic-engineering-msc
Concordia University offers 1 related qualification. Information can be found at
https://www.concordia.ca/academics/graduate/electrical-engineering-masc.html#structure

UNIVERSITY OF PRETORIA (South Africa)

Similarities

- Both qualifications are at level 9.
- Both qualifications are structured with 1 year for course work and 1 year for research.
- Both qualifications are assessed through course work and research.
- Similar upgrade to PhD and employment possibilities.

Differences

- The streams of specialization are different.
- Have an oral defence presentation for the thesis work.
- The learner must first complete an Honours degree to do the research. But the course work is simply the Honours degree.

UNIVERSITY OF STELLENBOSCH (South Africa)

Similarities

- Both qualifications are at level 9
- Both qualifications are assessed through course work and research.
- Similar upgrade to PhD and employment possibilities

Differences

- The streams of specialization are different.
- Have an oral defence presentation for the thesis work.
- Stellenbosch's Research Meng assessment is completely on the thesis work and not course work, while for UB, assessment is based on both coursework and thesis.

UNIVERSITY OF CAPE TOWN (South Africa)

Similarities

- Both qualifications are at level 9.
- Both qualifications are structured with 1 year for course work and 1 year for research.
- Both qualifications are assessed through course work and research.
- Similar upgrade to PhD and employment possibilities

Differences

- The streams of specialization are different.
- Have an oral proposal defence presentation for the thesis work.

UNIVERSITY OF SURREY (United Kingdom)

Similarities

- Both qualifications are at level 9.

- Similar upgrade to PhD and employment possibilities.
- Both qualifications are assessed through course work and research/project.
- Both qualifications are structured with 1 year for course work.

Differences

- The streams of specialization are different.
- The learners must first complete an honours degree to get entry into the qualification or work experience is considered for University of Surrey.
- In the second year, there is an extended project, potentially leading to substantial research contributions, along with two modules on engineering and professional studies to enhance your professional skills for University of Surrey, while the proposed program only has a research thesis in the second year.

CONCORDIA UNIVERSITY (Canada)

Similarities

- Both qualifications are at level NCQF 9.
- Similar upgrade to PhD and employment possibilities.
- Both qualifications are assessed through course work and research.
- Both qualifications are structured with 1 year for course work and 1 year of applied research and Thesis.
- Both qualifications combine Power Engineering and Electronic Engineering, and learners select areas of specialization based on course choices.

Differences

- The learner must maintain a minimum CGPA of 2.70 (out of 5) to graduate.
- The learner must defend a thesis.
- In the second year, there is an extended advanced research project, potentially leading to substantial research contributions, with a thesis, while the proposed qualification only has a research thesis in the second year.

In summary:

The proposed Master of Science in Electrical Engineering qualification when benchmarked with similar qualifications regionally and internationally demonstrates more similarities and very few minor differences. The qualification is at the same level as all other MSc qualifications and similarly knowledge based. It is assessed through a combination of course work and research dissertation and the learners have similar career employment possibilities and offers a path to pursuing PhD. The key difference with some of the other benchmarked universities is the requirement for an oral defence which is not a requirement for this proposed qualification. The other key difference is that some universities have specialized qualifications while the proposed and Concordia qualifications allow learners to select courses from a pool as per area of specialization. As such, after the benchmarking exercise, the Master of Science in Electrical Engineering qualification proposed here is found to be at par with other similar qualifications regionally and internationally.

REVIEW PERIOD

The programme will be reviewed every 5 years.