SECTION A:	***QUALIFICATION DETAILS***													
QUALIFICATION DEVELOPER (S)	New Era College of Arts, Science and Technology													
TITLE	Bachelor of Engineering in Electrical and Electronics											***NCQF LEVEL***	***8***	
FIELD	Manufacturing, Engineering and Technology		***SUB-FIELD***		Electrical and Electronics							***CREDIT VALUE***	*600*	
New Qualification					Yes	*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:
1.1 Rationale for the Qualification:
The requirement for developing this qualification emanated from a labour market survey done by HRDC the nation's human resource development agency which identified the need for electrical and electronics engineers

who are able to provide solutions and services through analysis, design, evaluation, implementation, deployment and coordination of problems and services needed in the domain of electrical and electronics (Human Resource Development Council (HRDC) Top 20 Occupation report, 2016). The HRDC report highlighted electrical and electronics skills as needed in the following cross cutting industrial sectors: research and innovations sector (Energy Security and Electronics Systems), MMEWR sector (Integrated Energy Planning, Solar Systems, Electronics Engineer), Research and Innovation sector (Electronic Systems) and Manufacturing Sector (Electrical and Electronics Engineering). The Vision 2036 strategic report: Achieving Prosperity (2016) envisions a sustainable environment (Pillar 3) by declaring that "Botswana will be energy secure, with diversified safe and clean energy sources, and a net energy exporter" (pg24). These achievements can only be achieved through a through human resource capital development in Electrical and Electronics Engineering as advocated by Vision 2036 strategic report: Achieving Prosperity (2016). Botswana National Strategic Development Plans 9, 10 and 11 (NSDP) and the Vision 2036 plan informs on the need to establish the country's Electrical & Electronic infrastructure that should assist in developing **Botswana's sustainable plan for energy generation** hence assisting **economy diversification**.

a) The **National Development Plan strategic reports (9, 10 and 11**) advocate for Botswana to engage in research and development and determine clear strategic solutions for electrical power generation and skills required. Currently Botswana has a strong dependency on imported fuel such as oil and electricity. In 2012, the government spent about P5 billion from the Southern African Power Pool (SAAP) and SADC (The Botswana Gazette, 2017) and the article by Botswana Business Day reports that, Botswana Power Corporation has continuously made operating losses for years due to high electrical energy import costs, non-performing assets and operational inefficiency, hence the parasternal has relied on government subsidy and they have been forced to review energy tariffs (Botswana Business Day, 2018).

b) According to the report by **Botswana National Research Science and Technology**, there shall be electrical power shortage in the SADC region as from 2005 and respective country member states were advocated to find and research on renewable resources to cater for their power need in the future. In view of this recommendation, it is paramount for Botswana to develop qualification in Electrical and Electronics

and produce skills that can embark on researches to develop strategic plans for electrical power generation in Botswana and other strategies i.e. renewable energy (Botswana National Research, Science and Technology Plan Final Report, 2005). The report also urged for accelerating manpower development in Electrical and Electronics to escalate and fast track the rural areas electrification programme which has slackened pace due to lack of qualified electrical engineers in the Electrical & Electronics engineering industry (Botswana National Research, Science And Technology Plan Final Report, 2005),

c) Institutional consultation with the Electrical and Electronics industry, former and current students of the qualification identified the hard and soft skills needed in the industry. The industry needs graduates who have electrical and electronic skills in designing, maintenance, configuration deployment and testing of gadgets, plants and infrastructure. In addition, they also need soft skills in verbal and written communication skills, analytical and problem-solving skills, managerial skills, among others. Because technology is ever changing the graduates need to be lifelong learners who can combine technical expertise with context-sensitive soft skills in order to cope with complex situations in real life. The industry was represented by officials from Huawei Tech Botswana, Civil Aviation Authority of Botswana, Orange Botswana, Botswana Chamber of Mines, Botswana Telecommunications, Atlas COPCO, T3 Investments, Nashua, CAMUSAT, SOLAHART, Botswana Post, Botswana Chamber of Mines, BHC, CEDA and LEA. The industry representatives indicated that the electrical and electronic engineering qualification learning outcomes, modules in the course structure and the assessments approach are closely aligned and therefore should develop electrical and electronics graduates needed for the local, regional and global industry.

PURPOSE:

1.2 Purpose of the Qualification:

The purpose of this qualification in electrical and electronics engineering is to produce

- Electrical Engineer,
- Electrical & Electronics Project Manager,
- Electronics Engineer
- Power Engineer

- Consultant
- Electrical & Electronics Lecturer
- Science and Technology Researcher
- Electrical and Electronics Lecturer
- Integrated Energy Planner
- Industrial Electronics Engineer
- Solar Systems Engineer

who possess:

- Critical thinking, problem solving and analytical skills to execute industrial tasks allied to analysis, design, implementation, deployment, and maintenance of electrical and electronics equipment, plants and infrastructure using techniques, theories and methodologies of electrical engineering.
- Specialised electrical and electronic engineering skills-sets in technical knowledge, skills, and competence for purposes of conducting applied research in electrical and electronic field, solve industrial and national problems.
- Capability of taking responsibility and accountability of work done in an electrical or multipurpose project.
- Lifelong learners skills as required in the field of electrical and electronic engineering
- Creative and innovative skill to originate electrical and electronic equipment, plants, and infrastructure to solve industrial problems and needs.
- System simulation, modelling, and technical documentation
- Track costs associated with project design and part procurement for Electrical/electronic system design.
- Interpersonal skills to work as a member of a project team.
- Talent for observing the ethical and professional codes of the electrical and electronic engineering industry.
- Cooperate with other engineers of various disciplines towards solving complex engineering issues.

ENTRY REQUIREMENTS (including access and inclusion)

Entry Requirements:

Normal Requirements

- Certificate IV (NCQF Level 4) or equivalent. best 6 subjects and passes in English, Mathematic and a Science subjects
- Certificate V (NCQF Level 5) or equivalent best 3 subjects and passes in English, Mathematic and a Science subject

Special Needs Students Requirements : Special Needs Requirements: Students with special needs are required to provide an official medical assessment report to determine the extent of the disability and compliance with demands of the qualifications program learning outcomes. Students who qualify shall be exempted from modules with high reliance areas reported as physical challenge. Such modules are replaced with others through which similar learning outcomes can be achieved.

Mature Entry: Mature student status may be granted to applicants who are over 19 years old and do not have at least NCQF level IV certificate. Mature entry admission is also based on the skills and experience acquired since leaving school. A mature entry student should also have working experience in the Electrical and Electronics Engineering industry for at least two years and supported with a reference letter from the employer.

SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
3.1. Critique reviews of a given electrical and electronic problem scenario and select appropriate analysis techniques for providing solutions. .	3.1.1 Examine electrical and electronic components with view to provide new solutions based on user and industrial requirements.

	3.1.2 Resolve snags in electrical and electronics domain by applying various techniques and technologies using software tools 3.1.3 Explain through presentation the feasibility of developing a given electrical and electronic components trouble suit and suggest parallel tradeoffs in selection of appropriate electrical and electronic components to solve the trouble suits. 3.1.4 Compile documents for purposes of records management. 3.1.5 Accept or reject compiled electrical and electronic feasibility project documentation based on principles in electrical and electronic components problem solving approaches
3.2.Analyse basic science, theories of circuits, electro-magnetic field, and control and apply them solutions to domestic and industrial electrical engineering problems.	3.2.1 Interpret a given problem scenario with view to establish electrical and electronic requirements for development of equipment, industrial plant or infrastructure set up based clientele requirements 3.2.2 Select relevant techniques for eliciting electrical and electronic requirements from domain stakeholders 3.2.3 Elicit equipment, industrial plant or infrastructure set up functional requirements using appropriate theories of interaction with clientele to derive electrical and electronic functional specifications. 3.2.4 Construct relevant diagrams representing functional specifications and models using relevant software modeling tools

	3.2.5 Create simulation models using relevant software tools and note any further correctional activities and changes. i.e. use of MATLAB / SIMULINK 3.2.5 Compile a typical Electrical and Electronic Specification Document for purposes of initiating a electrical and electronic project and secure agreement with user
3.3. 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	3.3.1 Create design plans of the approved identified electrical and electronics problems based on the Electrical and Electronic Specification Document using appropriate software tools and techniques 3.3.2 Derive specification of the plans based on the functional requirements and validate through quantitative methods data handling requirements. 3.3.3 Determine appropriate and relevant third party or middleware components of the development of equipment, industrial plant or infrastructure being developed. 3.3.4 Compose the equipment, industrial plant or infrastructure architectural layout based on the functionality of the problem defined 3.3.5 Derive the physical specification for implementing equipment, industrial plant or infrastructure based on the data model defined.
3.4. Formulate and provide effective solutions in electrical and electronics engineering through integrating people, knowledge, technologies, equipment and resources.	3.4.1 Create artifacts of the model in workshops and labs using the relevant material 3.4.2 Specify required materials using appropriate manufacturer reference manuals

	3.4.3 Recommend relevant substitution material based on specifications of the original terms when building an artifact. 3.4.4 Create the working models for created artifact based on the emergent and required properties 3.4.5 Present and defend formulated models and present to gathering or evaluators
3.5. Implement electrical or electronic projects in a multivendor oriented and joint project management	3.5.1 Use computer-assisted design software to draw a blueprint with product specifications, including calculations that lay out manufacturing and installation standards to ensure the product meets client specifications and electrical cum electronics standard manufacturing codes. 3.5.2 Manage and monitor prototype development and specify parts for actual build. 3.5.3 Present to the audience the functionality of the artifact and how it works. 3.5.4 Identify and resolve or seek for assistance through research or interaction with area experts to improve functionality. 3.5.5 Assessing the custom-built the final Electrical and electronic equipment project implements 3.5.6 Work as a team in multidisciplinary environment by representing all issues and matters pertaining to electrical and electronics implementations on projects
3.6. Evaluate derived models for Electrical & Electronics products by applying	3.6.1 Evaluate created electrical and electronic models and artifacts using appropriate software and tools.

complex numerical and engineering models using simulation tools	3.6.2 Record working functionalities for reproduction purposes and design modification with viability 3.6.3 Interact with relevant stakeholders in evaluating successful operation of the implemented artifact using relevant models and also other testing procedures. 3.6.4 Document operational features and factors of the implemented artifact as its test results and other emergent properties 3.6.5 Report with clear communication channels on test results and work status for clarity on all functions
3.7. Troubleshoot by applying appropriate electrical and electronics engineering theories and methodologies and perform data analysis and interpretation when designing solutions to unfamiliar problems	3.7.1 Investigate non-working equipment using appropriate and relevant tools and techniques. 3.7.2 Interpret manufacturer manual to install, trouble and repair any electrical and electronics equipment, plant or infrastructure. 3.7.3 Applying theories and methods of electrical and electronic s in troubleshooting non-working equipment 3.7.4 Documents none working equipment and its subsystem and reports empirically. 3.7.5 Repair non-working equipment by replacing with relevant and appropriate working parts based on manufacturer specifications. 3.7.6 Observe safety requirements when troubleshooting so as to protect equipment, oneself and other persons involved. 3.7.7 Identify and use appropriate protective clothing and accessories when working hazardous and

	dangerous equipment
3.8 Justify appropriate theory, practices, and tools for the specification, design, and implementation and evaluation of Electrical and Electronics Engineering solutions	3.8.1 Select appropriate and relevant tools for designing, analyzing and modelling electrical and electronic equipment. 3.8.2 Select tools based on the nature of repair and safety considerations. 3.8.3 Apply tools and use them based on manufacturer recommendations 3.8.4 Test working tools and also defend tools appropriateness and usability in the selected area.
3.9. Research using appropriate research methods, skills, tools and technological tools for effectively and critically adopting an engineering practice with intent to resolve problems and understanding their impact.	3.9.1 Approach problems and solve them through E&E engineering using appropriate and scientific technologies. 3.9.2 Apply relevant research methodologies in conducting E&E engineering research to produce publishable research documents. 3.9.3 Attend research conferences, workshops and seminars with a view to stay updated on latest technologies, theories and methodologies in E&E engineering and any other emerging technologies. 3.9.4 Publish research articles on existing and emerging issues in E&E engineering in order to create new knowledge and to provide solutions to running problems
3.10. Work effectively as part of project team in multi-purpose project	3.10.1 Work as part of a team during assigned tasks. 3.10.2 Communicate effectively through oral and presents during team work 3.10.3 Delegate and supervise assigned tasks.

	3.10.4 Perform throughout the product development life cycle beginning from research level breadboards followed by functional prototypes to production equipment. 3.10.5 Respond to program critical path activities due to changing priorities. 3.10.6 Control activities and assigned tasks to accomplish agreed objectives
3.11. Communicate succinctly to a range of audiences about Electrical and Electronics engineering technical issues and their solutions	3.11.1 Communicate inter and intra personal during interaction with audience 3.11.2 Write research reports and defend raised criticism adequately. 3.11.3 Negotiate effectively during group activities and discussions 3.11.4 Convey project objectives and schedule along with updates to business teams 3.11.5 Express clearly the difference amongst tools for creating software project reports or documents.
3.12. Manage own learning and professional development for purposes of lifelong learning	3.12.1 Identify areas of weakness which need strengthening through staff development. 3.12.2 Participate in E&E engineering communities through social media platforms blog and present one's reflection and perception of issues related to E&E engineering 3.12.3 Collaborate with fellow E&E engineering experts from different organizations to share knowledge. 3.12.4 Subscribe to professional bodies of E&E engineering

3.13. Observe cultural, ethical, and professional matters that prevail and govern given environment in the best interest of working with all stakeholders in developing electrical and electronics solutions	3.13.1 Practice professional ethics in discipline and register 3.13.2 Create conscience in ethical practice and liaise with subordinates. 3.13.3 Apply principles of ethical and professional practice in conducting E&E engineering activities in particularly when dealing with different clients 3.13.4 Sensitize and respect cultural norms of various ecosystems related to area of occupation and location 3.13.5 Abide by legal statutes to guide the operations and conduct of E&E engineering duties in any given context. 3.13.6 Respect and honour working relationships od subordinates and superiors to maintain good working relationships in any give working environment

SECTION C	***QUALIFICATION STRUCTURE***					
COMPONENT	***TITLE***	***Credits Per Relevant NCQF Level***				***Total (Per** Subject/ Course/ Module/ Units)*
		Level [5]	***Level [6]***	***Level [7]***	***Level [8]***	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/Units*	End User Computing	10				10
	Engineering Mathematics	20	20	10		50
	Engineering Science	10	10			20
	Introduction to Programming Principles	10				10
	Professional Communication & Skills for Engineers	10				10
	Engineering Ethics	10				10
	Engineering Drawing		10			10
	Industry Based Learning			50		50
	Research Methodology in Engineering			10		10

	Entrepreneurship and Economic development				10	10
	Project Management for Engineers			**10**		**10**
	Electrical and Electronics Workshop		15			15
CORE COMPONENT *Subjects/Courses/ Modules/Units*	Fundamentals of Electrical Engineering		15			15
	Digital Electronic Systems		15			15
	Circuit Theory (DC +AC) Principles		15			15
	Electronic Devices		15			15
	Introduction to Python Programming		15			15
	Analogue Circuit Design			15		15
	C++ Programming		15			15
	Electricity and Magnetism		*10*			*10*
	Digital System Design			*15*		*15*
	Electromagnetic Theory			*15*		*15*
	Measurement Systems			10		10

	Control Theory			*20*		*20*
	Electrical Machines			*15*		*15*
	Signal & Systems		*15*			*15*
	Microprocessor & Microcontrollers			*15*		*15*
	Digital Signal Processing			15		15
	Embedded Systems Design				**15**	15
	Transmissions and Distributions				**10**	10
	Power Electronics & Drives				**15**	15
	Individual Project I				**15**	15
	Linear Integrated Circuits				**10**	10
	Individual Project II				**15**	15
	Introduction to Power systems			10		10
	Renewable Energy Technology				**10**	10
	Group Project			15		15
	Artificial Intelligence				10	10

	Power System Design & Analysis				*10*	*10*
ELECTIVE/ OPTIONAL COMPONENT *Subjects/Courses/ Modules/Units* **Choose TWO**	Distributed Computing				*10*	*20*
	Power Plant Engineering				*10*	
	Network Planning and Optimization				*10*	
	Computer Security and cryptography				10	
	Optical Communication				10	
	Process and Instrumentation				10	
	Software Engineering				10	
	Machine Learning				10	
	ICT Systems and Integration				10	

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	***Credit Value***
Level - 5	***70***
Level - 6	***170***
Level - 7	***225***
Level - 8	***135***
TOTAL CREDITS	***600***

Rules of Combination:

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

Rules of the Qualification

The qualification rules constitute a combination of:

(a) Elective modules (**Learner will choose two electives**)
(b) Core modules which are compulsory
(c) Fundamental modules which are also compulsory
(d) To graduate a candidate should have completed 600 credits.

Qualification Combination Rules Based on Module Status per NCQF designation of: Fundamental, Core & Electives

- Core modules have 365 credits.

- Fundamental modules have 215 credits.
- Elective modules have 20 credits

Qualification Rule of Credit Distribution Based on NCQF Levels from Level 5 to Level 8 is given below.

- NCQF Level 5 Modules: 70 Credits
- NCQF Level 6 Modules: 170 Credits
- NCQF Level 7 Modules: **225** Credits
- NCQF Level 8 Modules: **135** Credits

ASSESSMENT ARRANGEMENTS
All assessments, formative and summative, leading/contributing to the award of credits or a qualification should be based on learning outcomes and/or sub-outcomes. **Summative assessment** The Final Examination contributes to **60%** of the final grade. **Formative assessment** Formative assessments contribute to **40%** of the final grade.
MODERATION ARRANGEMENTS
Assessment and moderation shall be carried as per ETP's policies, which are aligned to BQA/ National policies. The ETP will engage only BQA accredited assessors and moderators to carry out assessment and moderation.
RECOGNITION OF PRIOR LEARNING
There will be provision for awarding of the qualification through RPL mode which will be in line with the national RPL Policy.
CREDIT ACCUMULATION AND TRANSFER

There will also be provision of awarding credits to the learner in a case where they do not complete the qualification or transfer to another institution.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal articulation of the qualification

- Level 8 qualifications in BEng. (Hons) Electronics Engineering
- Level 8 qualifications in BEng. (Hons) Telecommunications Engineering
- Level 8 qualifications in BEng. (Hons) Computer Engineering
- Level 8 qualifications in BEng. (Hons) Networking Engineering
- Level 8 qualifications in BEng. (Hons) Software Engineering

Vertical articulation of the qualification

- Level 9 qualifications in BEng. (Hons) Electronics Engineering
- Level 9 qualifications in BEng. (Hons) Telecommunications Engineering
- Level 9 qualifications in BEng. (Hons) Computer Engineering
- Level 9 qualifications in BEng. (Hons) Networking Engineering
- Level 9 qualifications in BEng. (Hons) Software Engineering

Employment Pathways

Graduates of the course may find employment in a range of public and private organisations for the following posts.

Typical roles include in Electrical and Electronics domains and those related as

- Electrical Engineer,
- Electrical & Electronics Project Manager,
- Electronics Engineer
- Power Engineer
- Consultant
- Electrical & Electronics Lecturer

- Science and Technology Researcher
- Electrical and Electronics Lecturer
- Integrated Energy Planner
- Industrial Electronics Engineer
- Solar Systems Engineer

QUALIFICATION AWARD AND CERTIFICATION

The learner will be awarded **Bachelor of Engineering (Honors) in Electrical and Electronic** after attaining 600 credit values. The qualification will be awarded after attaining minimum credits. If the candidate does not meet the prescribed minimum standards of the qualification, the learner will exit with a transcript. There will be provision of certificate when awarding the qualification

REGIONAL AND INTERNATIONAL COMPARABILITY

The qualification is regionally and internationally compatible and transferable on the strength of 95% to 100% similar learning domains in the qualification **Bachelor of Engineering (Honors) in Electrical and Electronic**. It covers most of the telecommunications domain being broadcasting technologies, optical communications, wireless and wired networking technologies, networking and security and electives that deal with 4th industry revolution technologies like cloud commuting, Internet of Things, Artificial Intelligence etc. The qualification does share the same national qualification level with a majority of the qualifications. The assessment strategies all emphasize workplace (Internship) and embrace drill down on practice of the trade. Refer to the regional and international qualification comparability matrix.

REVIEW PERIOD

Every five (5) years