SECTION A: QUALIFICATION DETAILS																			
QUALIFICATION DEVELOPER (S)	New Era College of Arts, Science & Technology																		
TITLE	Bachelor of Engineering (Honours) in Telecommunications															**NCQF LEVEL**	8		
FIELD	Manufacturing, Engineering and Technology		**SUB-FIELD**	Telecommunications												**CREDIT**	600		
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

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 **Telecommunication Engineers** who are able to provide solutions and services for communication and networking infrastructure through analysis, design, evaluation, implementation, deployment and coordination of problems and services needed in the domain of Telecommunication (Human Resource Development Council (HRDC) Top 20 Occupation report, 2016). The Vision 2036 strategic report: Sustainable Economic Development (Pillar 1) calls for economic diversification through use of science, technology and as an enabling technology. CT through Telecommunications shall facilitate "efficient product and service delivery across all economic sectors including the delivery of government services" Vision 2036(pg27). These achievements can only be achieved through a thorough human resource capital development in Telecommunication skills set as advocated by Vision 2016 and 2036 strategic plans. Botswana National Strategic Development Plans 9, 10 and 11 (NSDP), Vision 2036 plan, Botswana's

Telecommunications Policy (1995) and Institutional Labour Markey Survey strongly support the development of these skills as argued in the following reports.

a) Telecommunication functional and efficient infrastructure is declared as a critical and important resource according to Botswana' Telecommunications Policy for Botswana (1995). The policy acknowledges the relevance of setting up and providing telecommunications infrastructure which involves terminal equipment, facsimile series, public telephony, data services, electronic mail services, cellular telephone, local area networks services with a view to support Botswana's national goals premised on economic growth, diversification of the economy to a knowledge-based economy and creation of Batswana Information Society. In this regard the policy also calls for creation of national telecommunication skill set in context of the ever growing and noted absence of local telecommunications skills to support and ensure sustenance and provision of these services within Botswana and with local manpower.

b) The National Development Plan 10 strategic plan reports "Telecommunications provides a much needed environment for the Botswana economy to prosper… Unfettered access and ease of flow of information through modern technology and will attract big companies into this country and the result will be job creation, income generation and asset base expansion" (Botswana Mid-Term Review NDP10, P.48 & P.49, 2013). Telecommunications skills will facilitates set up of public data communication infrastructure like, mobile communications networks, fibre optics network using appropriate platforms, digital radio and television set up, internet set composing Wide Area Networks, Metropolitan Area Networks, Local Area Networks and the general Public Switching Telephone Network. These infrastructures facilitate the transmission and reception of data to support modern business processes like electronic commerce, mobile commerce, social media, web site interactions and many more.

c) The National Development Plan strategic reports (9, 10 and 11) have strategized the implementation of advanced state of the art Telecommunications infrastructure. Currently Botswana's has seen the introduction of three mobile network operators (MNOs) – MASCOM Wireless (an affiliate of South Africa's MTN), Orange Botswana (backed by Orange Group) and beMobile (a subsidiary of the fixed-line incumbent BTC). These MNO have implemented the underdeveloped broadband sector with different strategies including 4G and 3G mobile, LTE, WiMAX, and bundling with fixed-line (DSL) services. BoFiNet completed two undersea fibre network expansion link costing BWP200 million. This infrastructure has been implemented what remains is

the human resource development to maintain and utilise this infrastructure and upgraded to latest observations.

d) Telecommunication skills were identified and justified by the Botswana industry as required as justified by the Human Resource Development Council (HRDC) top priority occupations for industry of Botswana. Telecommunication has been clearly stated as a Top 20 occupation of priority in the sector of Information and Communication Technology by the HRDC TOP OCCUPATIONS IN HIGH DEMAND report (December 2016).

Institutional consultations with the Telecommunication industry, former and current students of the qualification identified the hard and soft skills needed in the industry. The industry needs telecommunication graduates' 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 above show that there is need for Botswana's institutions of learning to develop telecommunication engineering qualifications that are closely aligned to local, regional and global industry needs

PURPOSE:

Purpose of the Qualification:

The purpose of this qualification is to produce graduates with specialized telecommunications engineering knowledge, skills and competences to:

- Solve telecommunication problems in the industry and community through analysis, design, implementation, deployment and maintenance of telecommunication equipment, plants and infrastructure by applying techniques, theories and methodologies of telecommunication engineering.
- Conduct basic applied research in telecommunication domain and solve industrial and national problems.
- Participate and take responsibility and accountability of work done in a telecommunication or multipurpose project.
- Simulate, model, and correctly document Telecommunication systems.
- Track costs associated with project design and part procurement for telecommunication project or multi-purpose project.

ENTRY REQUIREMENTS (including access and inclusion)
Entry Requirements: Minimum entry qualifications • Certificate IV, NCQF Level 4 (BGCSE or equivalent). • Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) shall be considered for access and inclusion using the relevant policies in line with national RPL and CAT policies.

SECTION B	3.0 QUALIFICATION SPECIFICATION
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
3.1 **Integrate** people, knowledge, telecommunication technologies, equipment, and resources and formulate judgments with complete resourceful information for solving telecommunication problems in business/community environment. . .	3.1.1 Design telecommunication technologies in context of required communications requirements by clients. 3.1.2 Work in a composite project which would require telecommunication engineering solutions. 3.1.3 Install telecommunication structure using telecommunication equipment from multivendor to realize clientele requirements and specifications. 3.1.4 Deploy and commission telecommunication technologies for various functions. 3.1.5 Document commissioned telecommunications technologies for future reference and maintenance
3.2 **Create** models for telecommunications network to evaluate performance with proper regard given to the underlying assumptions and limitations.	3.2.1 Apply appropriate design software (MATLAB, SIMULINK) to create telecommunications models for specified clientele requests. 3.2.2 Interpret telecommunication models to build the required telecommunication infrastructure. 3.2.3 Maintain and configure a telecommunication infrastructure

	based on telecommunication model. 3.2.4 Modify and upgrade telecommunications models based on new clientele requirements. 3.2.5 Communicate and inform on needed telecommunication requirements using models.
3.3 **Analyse** telecommunications network systems to optimize network operations using testing and measuring telecommunication network equipment	3.3.1 Identify appropriate tools for analysis and maintenance of telecommunications plant. 3.3.2 Calibrate telecommunication measuring and testing upkeep equipment used for maintenance and configuration of telecommunication equipment. 3.3.3 Monitor telecommunication infrastructure operation and optimise its operation by adjusting and setting relevant operational parameters. 3.3.4 Compute statistical functional elements of a telecommunication infrastructure and report on operational status and recommend any modifications. 3.3.5 Simulate functional operation of deployed telecommunication infrastructure and note discrepancies for purposes of maintenance and calibration
3.4 **Apply** hardware and software tools to solve telecommunications technical and management problems in any business organization**.**	3.4.1 Create software codes or software patches to upgrade functionality of telecommunication devices which are programmable. 3.4.2 Upgrade installed software in telecommunication devices for enhanced functionality. 3.4.3 Install and configure using software all telecommunication devices that are from different vendors or the same manufacturer. 3.4.4 Troubleshoot complex telecommunication infrastructure using intelligent devices. 3.4.5 Interpret and maintain complex telecommunication

	infrastructure using auto generated reports from intelligent monitoring devices
3.5 **Derive** telecommunications network hardware and software for designing and implementing various network topologies specific to clientele needs.	3.5.1 Apply computer network skills relating to design of network topologies for telecommunication implementation. 3.5.2 Select appropriate and relevant network devices for selected network topologies for designing purposes. 3.5.3 Evaluate and inform on relevant computer hardware and software needed for telecommunication infrastructure. 3.5.4 Specify computer hardware and software specifications for implemented telecommunication infrastructure. 3.5.5 Install and configure computer hardware and software to facilitate telecommunication operations
3.6 **Evaluate** derived models for telecommunication products by applying complex numerical and engineering models using simulation tools	3.6.1 Apply key functional skills in electronics and electrical engineering to test and measure telecommunication equipment. 3.6.2 Interpret electronic and electrical values in measuring and measurement of telecommunication equipment. 3.6.3 Service telecommunication equipment using electronic and electrical datasheets for replacement of components and devices. 3.6.4 Establish test fixtures for telecommunication systems production along with development work. 3.6.5 Record and Report precisely on test results and work status in verbal and writing
3.7 **Troubleshoot** telecommunication equipment by applying grounding theories in Telecommunications engineering and perform data analysis and interpretation	3.7.1 Investigate none working equipment using appropriate and relevant tools and techniques. 3.7.2 Interpret manufacturer manual to install, trouble and repair any telecommunications equipment, plant or infrastructure. 3.7.3 Applying theories and methods of electrical and electronic s in troubleshooting none working equipment

when designing solutions to unfamiliar problems	3.7.4 Documents none working equipment and its subsystem and report empirically. 3.7.5 Repair none 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 Telecommunications Engineering solutions	3.8.1 Select appropriate and relevant tools for designing, analysing 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 defend tools appropriateness and usability in the selected area.
3.9 **Work** effectively as part of project team in multi-purpose project	3.10.1 Work as team during assigned tasks. 3.10.2 Communicate effectively through oral and presents during teamwork. 3.10.3 Delegate and supervise assigned tasks. 3.10.4 Perform throughout product development life cycle beginning from research level breadboards followed by functional prototypes to production equipment. 3.10.5 Respond to project activities within program critical path and react suitably to changing priorities. 3.10.6 Control activities and assigned tasks to accomplish agreed objectives
3.10 **Communicate** succinctly to a	3.10.1 Communicate inter and intrapersonal during interaction with

range of audiences about Telecommunications engineering technical issues and their solutions	audience. 3.10.2 Write research reports and defend. 3.10.3 Work in group by practicing all facets of communication like negotiation, listening and presenting skills. 3.10.4 Convey project objectives and schedule along with updates to business teams. 3.10.5 Express clearly the difference amongst tools for creating software project reports or documents
3.11 **Research** through application of numerical and statistical knowledge for testing and improving the quality of developed software**.**	3.11.1 Approach problems and solve them through researching using appropriate and scientific technologies. 3.11.2 Apply relevant research methodologies in conducting software engineering research to produce publishable research documents 3.11.3 Attend research conferences, workshop and seminars with a view to stay updated on latest technologies, theories and methodologies in software engineering and any other emerging technologies 3.11.4 Publish research articles on existing and emerging issues in software engineering in order to create new knowledge and to provide solutions to running problems
3.12 **Manage** 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	3.13.1 Practice professional ethics in discipline and register 3.13.2 Create conscience in ethical practice and liaise with

prevail and govern given environment in the best interest of working with all stakeholders in developing Telecommunications solutions	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 eco systems related to area of occupation and location 3.13.5 Abide to legal statues to guide the operations and conduct telecommunications 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	Engineering Mathematics I,II, III, IV, V	20	20	10		50
	Engineering Science I, II	20				20
	End User Computing		10			10

Subjects/ Courses/ Modules/Units	Professional Communication Skills for Engineers	10				10
	Introduction to Python Programming		15			15
	Introduction to Programming Principles	10				10
	Engineering Drawing		10			10
	Industrial Attachment			50		50
	Electromagnetic Theory			10		10
	Project Management for Engineers			10		10
	Network Fundamentals		15			15
	Entrepreneurship and Economic development				10	10
	Electricity and Magnetism	10				10
	Research Methods in Engineering			10		10
CORE COMPONENT *Subjects/Courses/ Modules/Units*	Electronics and Communications Workshop		15			15
	Group Project			15		15
	Electronic Devices			15		15
	Telecommunication Principles			15		15
	Circuit Theory		15			15
	Signal & Systems		15			15
	Analogue Circuit Design			15		15
	Digital System Design		15			15
	C++ Programming		15			15
	Digital Electronics System		15			15
	Structured Programming using C			15		15
	Digital Communications			15		15
	Antenna & Propagation			10		10
	Digital Signal Processing			15		15
	Optical Communications				10	10
	Microprocessor & Microcontrollers Theory			15		15
	Mobile Communication				10	10
	Network Engineering				15	15
	Individual Project I				15	15

	Network Planning & Optimisation				10	10
	Embedded System Design				15	15
	Microwave & Satellite Communications				10	10
	Individual Project II				15	15
	Multimedia Compression Technique			10		10
	Artificial Intelligence				10	10
	Radio transmission Management		10			10
ELECTIVE/ OPTIONAL COMPONENT *Subjects/Courses / Modules/Units*	Software Engineering			10		10
	Distributed Computing			10		10
	ICT System and Integration			10		10
	TOTAL	**70**	**170**	**240**	**120**	**600**

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	***240***
Level- 8	***120***
TOTAL CREDITS	***600***
Rules of Combination: ***(Please Indicate combinations for the different constituent components of the qualification)***	

Rules of the Qualification

Fundamental	Level 5	70 Credits
Fundamental	Level 6	70 Credits
Fundamental	Level 7	90 Credits
Fundamental	Level 8	10 Credits
Core	Level 6	100 Credits
Core	Level 7	140 Credits
Core	Level 8	110 Credits
Elective	Level 7	10 Credits (Learners choose 1 module)
Total		600 Credits

ASSESSMENT ARRANGEMENTS

Formative assessment

Formative assessments contribute to **40%** of the final grade which include Test, Assignment, presentation, discussion forum, quiz, role play, etc. depending on the nature of the module.

Summative assessment

The Final Examination contributes to **60%** of the final grade.

Assessment must be conducted by suitably qualified person(s) in the field of Telecommunications Engineering.

MODERATION ARRANGEMENTS

There shall be internal and external moderation of the qualification as a quality assurance measure.

Moderation must be conducted by suitably qualified person(s) in the field of Telecommunications Engineering.

RECOGNITION OF PRIOR LEARNING

RPL will be applicable for award of credits towards components of this qualifications according to the relevant

institutional policies in line with the national RPL Policy.

CREDIT ACCUMULATION AND TRANSFER

CAT will be applicable for award of credits towards components of this qualifications according to the relevant institutional policies in line with the national RPL Policy.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal articulation of the qualification (NCQF Level 8)

- Bachelor of Engineering in Electronics Engineering
- Bachelor of Engineering in Computer Engineering
- Bachelor of Engineering in Networking Engineering
- Bachelor of Engineering in Software Engineering

Vertical articulation of the qualification (NCQF Level 9)

- Master of Engineering in Electronics Engineering
- Master of Engineering in Telecommunications Engineering
- Master of Engineering in Computer Engineering
- Master of Engineering in Networking Engineering
- Master of Engineering in 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 Telecommunications domains and those related as

- Telecommunication Engineer,
- Telecommunication Technician,
- Telecommunication Network Designer,

- Telecommunication Network Developer,
- Telecommunication Architect,
- Telecommunication Manager,
- Telecommunication Analyst
- Security Analyst
- Telecommunication Salesperson
- Telecommunication Consultant
- Project Manager
- Telecommunication Network Engineer
- Telecommunication Help Desk
- Telecommunication Business Analyst
- Telecommunication Quality Assurance Expert
- Mobile/Telecommunications Operators
- RF & Microwave Industries
- Optical Fibre Industries
- Consulting Engineering Firms
- Information Technology firms
- Engineering Sales
- Research & Development
- IT Project Manager
- Systems engineer
- IT Expert
- Information Technology firms
- Systems engineer

QUALIFICATION AWARD AND CERTIFICATION

The learner will be awarded **Bachelor of Engineering in Telecommunications** after attaining a minimum of 600 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 BEng Telecommunications Engineering. 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 which 7 with a majority of the qualifications. The assessment strategies all emphasis workplace (Internship) and embrace drilldown on practice of the trade. Refer to the regional and international qualification comparability matrix.
REVIEW PERIOD
After 5 years in line with the NCQF