BQA NCQF QUALIFICATION TEMPLATE

SECTION A:	QUALIFICATION DETAILS		
QUALIFICATION DEVELOPER (S)	Botswana International University of Science and Technology		
TITLE	Doctor of Philosophy in Telecommunications Engineering	**NCQF LEVEL**	10
STRANDS (where applicable)	1. N/A 2. 3. 4.		
FIELD	Manufacturing, Engineering and Technology	**CREDIT VALUE**	360
SUB FIELD	Engineering and Engineering Trades		

New Qualification		Legacy Qualification		Renewal Qualification	
				Registration Code	N/A

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 Telecommunications engineering doctorate qualification prepares learners for specialization in Telecommunications systems, real-time and embedded systems, data communications and networks, digital system design, image processing and multimedia, information systems, information systems security and intelligent systems. The qualification trains learners for careers in the

Telecommunications engineering field requiring advanced and specialised knowledge. In order to determine the viability of the Telecommunications engineering master's qualification in Botswana, a Market Needs Analysis was conducted (Appendix 1). The results from the market need analysis from prospective learners, and employers were positive, proving that stakeholders need the qualification; hence, it is sustainable. We also looked at the requirements for human capital development essential for achieving the VISION 2036 pillars: Pillar 1 and Pillar 2

Additionally, this qualification, PhD in Telecommunications Engineering, contributes to Vision 2036's realisation by equipping prospective graduates with the necessary skills and competencies for sustainable economic growth. The qualification equips the learners with the knowledge, skills, and competencies needed to create a knowledge-based economy in Botswana and achieve the vision.

The PhD Telecommunications Engineering qualification is developed to contribute vis a vis human capital development and to fulfil the demand gap as per HRDC 2019 report. It is against this background that this qualification has been developed to address the urgent need for adequately trained manpower to manage the area of Telecommunications Engineering in various sectors of the economy (HRDC 2019, Vision 2036, and National Development Plan 11). This qualification helps to build the human capital in the areas of:

- Designing advanced Telecommunications systems and control
- Designing Remote Control & Telemetry
- Designing advanced Telecommunications systems for communications systems for communication and mobile phone companies,
- Developing and writing software and firmware for Security & Encryption, and Network Management, analogue sensors, mixed signal circuit boards.
- Developing advanced Telecommunications systems, mobile applications and phones
- Designing intelligent distributed systems to serve their operations for banks and businesses,
- Designing advanced Telecommunications games for game companies

These are HRDC – Priority Skills and Employment Trends

Aims

Telecommunication engineers combine creativity and scientific knowledge for new ideas and innovations which can work with technology, networks and communication system design. Learners will have different options in the specialisation, such as network management, traffic engineering, and router internals, which can work with engineering trade-offs and design principles used in telecommunication networks. Telecommunication engineering developed with the latest changes in telecommunication systems and networks. Particularly Smart Grid techniques to transmit and distribute the power to the consumers by integrating renewable energy resources into the electrical grid. Electrical and Telecommunication networks are integral to modern power grid operations and are becoming increasingly critical as grid dynamics speed up and as more controls become closed loop in form. Existing operation and control (especially remote control) relies on communication between the power systems from generation, transmission, distribution and consumer. Intelligent power systems have become increasingly interdependent due to advances in sensor, network, and software technologies that enable more cost-effective means to interconnect grid devices.

Utilities are increasingly adopting data analytics in their operational systems to drive efficiency, reliability and more informed decisions. These analytics are enabled by the data-rich environments that the increasingly intelligent devices and sensors provide, which are needed by smart systems. This further emphasises the dependence on communication networks that provide these connections to the utility operational systems. In this view, it is important to obtain a Doctor of Philosophy (PhD) in Telecommunication Engineering qualification in the discipline of engineering.

The qualification allows the learners to cover all the basics of circuit analysis, digital signals and systems, wireless data network convergence, radio, broadband and optical networks, antennas and microwave components and telecommunications techniques and their applications. The qualified Ph.D. telecommunication Engineers will be ready to take up employment, conduct research and innovation in the telecommunication industry on antennas and microwave, wireless data networks, software-defined radio, optical networks, digital systems and signals and broadband networks to develop the economy and the scientific knowledge pool in Botswana and in the world[11].

PURPOSE: (itemise exit level outcomes)

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

1. Apply advanced understanding of digital signals and systems, including radio, broadband, optical networks, antennas, and microwave technologies, underpinned by strong professional ethics in telecommunication engineering.

2. Design and implement complex telecommunication systems from conceptualisation to realisation, exhibiting the ability to innovate and enhance existing technologies and infrastructures. 3. Contribute to multidisciplinary projects and environments, showcasing versatility and adaptability in the rapidly evolving field of telecommunication. 4. Conduct original scholarly research and engineering projects independently, contributing to developing novel products and solutions within the realm of Telecommunication Engineering.
MINIMUM ENTRY REQUIREMENTS (including access and inclusion)
i. Masters Degree, NCQF Level 9 in the same or related field. ii. Credit Accumulation and Transfer (CAT) and Recognition of Prior Learning (RPL) can be considered for entry according to ETP CAT and RPL policies.

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SECTION B	**QUALIFICATION SPECIFICATION**
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
1. Integrate and Innovate Engineering Knowledge: Synthesize and apply advanced principles of circuit analysis, electronics, computing, and telecommunication engineering to model, analyse, and address complex engineering problems, contributing innovative solutions and new knowledge to the field.	1.1 Assess learners' ability to integrate and apply advanced circuit analysis, electronics, computing, and telecommunication engineering principles to formulate solutions for complex engineering challenges. 1.2 Evaluate through project-based assessments that require innovative application of engineering knowledge to develop new methods or technologies.
2. Advanced Research and Synthesis: Demonstrate expertise in assessing, critically evaluating, and synthesising scientific information to inform research decisions, methodology development, and innovation in telecommunication engineering.	2.1 Measure the capability to assess, critically evaluate, and synthesise scientific and engineering information to support research and innovation in telecommunication engineering. 2.2 Assess through submitting research proposals, comprehensive literature reviews, and

	synthesising findings in research papers or dissertations.
3. Practical Engineering Competence: Design and implement advanced engineering solutions grounded in research findings, practical skills and competence in telecommunication applications.	3.1 Evaluate the application of practical skills and competencies in telecommunication engineering through the design and implementation of advanced engineering solutions. 3.2 Assess through practical projects, system simulations, and the development of prototypes or software, demonstrating the application of research findings to real-world problems.
4. Professional Communication: Communicate complex scientific and engineering concepts effectively in written, oral, and visual forms, catering to both professional audiences and the wider community, ensuring clarity, coherence, and technical accuracy.	4.1 Publish and disseminate complex engineering concepts and research findings effectively, in written, oral, and visual forms, to both technical and non-technical audiences. 4.2 Present technical reports, research publications, and visual aids that demonstrate clarity, coherence, and technical accuracy.
5. Research-Driven Engineering Design: Conduct rigorous engineering design and research projects that employ investigative research, analytical methodologies, and innovative problem-solving techniques to address real-world challenges in telecommunication engineering.	5.1 Evaluate the ability to conduct rigorous engineering design and research projects that utilize investigative research and analytical methodologies to solve engineering problems. 5.2 Assess through design documentation, research project reports, and the presentation of innovative solutions addressing real-world challenges in telecommunication engineering.
6. Ethical and Societal Impact: Evaluate and integrate considerations of ethical, societal, and environmental impacts in engineering projects and solutions, demonstrating a commitment to sustainable and responsible engineering practices.	6.1 Consider and integrate ethical, societal, and environmental considerations in engineering projects and solutions. 6.2 Evaluate through case studies, project reports, and ethical analyses that demonstrate a

	commitment to sustainable and responsible engineering practices, including the impact of engineering solutions on society and the environment.

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SECTION C	QUALIFICATION STRUCTURE				
COMPONENT	TITLE	Credits Per Relevant NCQF Level			Total Credits
		Level []	Level [ ]	Level [10]	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/Units*	Telecommunications engineering Ph.D - Concept Note			10	0
	Telecommunications engineering Ph.D - Proposal			10	0
	Telecommunications engineering Ph.D Progress report- Research Phase			10	0
	Telecommunications engineering Ph.D Dissertation Progress report- Submission Phase			10	0
CORE COMPONENT *Subjects/Courses/ Modules/Units*	Doctoral Thesis in Telecommunication Engineering			360	360

STRANDS/ SPECIALIZATION	*Subjects/ Courses/ Modules/Units*	***Credits Per Relevant NCQF Level***			***Total Credits***
		Level [6]	***Level [7]***	***Level [8]***	
1.					
2.					
Electives					

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	***Credit Value***
Core - 10	360
TOTAL CREDITS	**360**

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

The credit allocation for the qualification is as follows:

- **Fundamentals Level 10**: 0 Credits
    - The qualification assumes entry-level candidates have already acquired fundamental knowledge through previous academic pursuits, particularly at the Master's level.
- **Core Level 10**: 360 Credits
    - The entirety of the qualification credits is allocated to core components, which encompass advanced coursework, research methodologies, and the dissertation. This comprehensive allocation reflects the qualification's focus on deep specialisation and research excellence in Telecommunication Engineering.
- **Electives**: No Electives
    - There are no elective courses. All learners are required to engage in core research and thesis that are pivotal to the field of Telecommunication Engineering.
- **Total**: 360 Credits

To graduate, learners must successfully complete the specified 360 credits, which are entirely constituted by core research and study over the designated three-year period.

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ASSESSMENT ARRANGEMENTS

The PhD qualification in Telecommunication Engineering is designed to comprehensively evaluate learners' knowledge, skills, and competencies aligned with the qualification's exit-level outcomes. The assessment strategy encompasses formative and summative assessments, each serving a distinct purpose in the learning and evaluation process.

Formative Assessment: 0%

- **Purpose**: Formative assessments are conducted continuously throughout the qualification to monitor learners' progress, provide feedback, and support the development of research skills and knowledge application. These assessments include research proposals, literature reviews, progress reports, presentations, and peer reviews.
- **Weighting**: While formative assessments are critical for learning and development, they are not directly weighted in the final qualification award. Instead, they serve as a developmental tool to guide learners towards achieving the required competencies and readiness for the summative assessment.

Summative Assessment: 100%

- **Purpose**: The summative assessment is the capstone of the PhD qualification, evaluating the student's cumulative knowledge and research capabilities. It comprises the submission of a written thesis and the defence of this thesis in an oral examination. This assessment tests the student's ability to independently conduct significant research, contribute to the body of knowledge in Telecommunication Engineering, and articulate and defend their findings.

Weighting: The summative assessment is the primary determinant of the student's eligibility for graduation and is, therefore, heavily weighted in the final qualification award. The written thesis and oral defence collectively account for 100% of the final assessment, reflecting the qualification's emphasis on research excellence and contribution to the field.

MODERATION ARRANGEMENTS

Appointment of Internal Examiners

The Ph.D. in Telecommunication Engineering incorporates robust moderation processes to ensure the quality and integrity of student assessments, aligning with the qualification's commitment to academic excellence. The moderation framework includes both internal and external components, designed to validate the alignment of assessments with the qualification's exit-level outcomes and uphold rigorous academic standards.

- **Internal Moderation**: Internal examiners play a pivotal role in the assessment process, particularly in evaluating the written dissertation and conducting the Viva Voce oral presentation. The selection of internal examiners and the moderation of assessment instruments are governed by the postgraduate regulations of the hosting institution. This process ensures that all assessments are conducted fairly and in accordance with the established academic criteria.
- **External Moderation**: To further enhance the credibility and impartiality of the assessment process, external moderators are engaged from accredited Education and Training Providers. These Moderators review the assessment instruments, specifically the dissertation/thesis and the oral presentation, to ensure consistency with the qualification's exit-level outcomes. The appointment of external moderators and the moderation process adhere to the quality assurance standards of the respective ETPs, ensuring an objective and comprehensive evaluation of student work.

Quality Assurance Measures:

- The qualification RPL and CAT will be considered for award of Qualification. recognizes the importance of early and continuous engagement with academic research, requiring learners to present a viable research concept shortly after their initial registration. This early milestone ensures that learners are on a clear path toward their research objectives.
- The outcome of the dissertation/thesis examination is subject to a range of possible recommendations, from acceptance with minor corrections to the requirement for major revisions or resubmission, ensuring that the final submission meets the qualification's high standards.
- Special considerations are in place for cases where there is significant divergence in examiner evaluations or outright rejection, with the Postgraduate Examination Committee playing a central role in resolving such discrepancies.

General Policy:

- The specific procedures for internal and external moderation are guided by the overarching assessment and moderation policies of the individual ETPs. This approach allows for flexibility and adaptability to the diverse standards and practices of different institutions, while maintaining a consistent framework for quality assurance across the qualification.

RECOGNITION OF PRIOR LEARNING

Clear structures through which understudies can collect learning credits and transfer such qualities toward suitable capabilities approves and perceive learning increased through formal and casual methods, gives adaptability to understudies, and enables understudies to advance generally flawlessly through their long-lasting learning venture.

Learners may apply for acknowledgment of earlier realizing whether such learning has been increased through formal investigation, through working environment learning, or through some other formal or casual methods. Any competitor applying for Recognition of Prior Learning (RPL) will be relied upon to give proof of such discovery that must be significant, adequate, substantial, irrefutable, and true. What's more, the hopeful might be met by an individual from staff or need to step through a formal examination, which may incorporate a live showing of abilities and capabilities, to evaluate fitness.

CREDIT ACCUMULATION AND TRANSFER

RPL and CAT will be considered for award of Qualification.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal:

A Doctor of Philosophy in Telecommunication Engineering candidate could continue to pursue a Doctor of Philosophy qualification in any other university in the Electrical and Communications specialized disciplines such as;

- Doctor of Philosophy in Electronics Engineering
- Doctor of Philosophy in Electrical Engineering
- Doctor of Philosophy in Computer Engineering

Employment Pathway:

- Research Engineer
- Line Installers Engineer
- Telecommunication System Manager
- Radio and Antennae Engineer
- Circuit Designer
- Project Manager
- Lecturers
- Research Supervisors

QUALIFICATION AWARD AND CERTIFICATION

The learner will be awarded a **"Doctor of Philosophy in Telecommunication Engineering"** after attaining 360 credits as specified in the rules of combination and credit distribution. Certificate will be awarded to the candidates who have met the qualification requirements.

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

Three qualifications were compared with the qualification as follows:

The qualification was compared with various institutions, locally, regionally and internationally running the Ph.D in Telecommunication Engineering qualifications. The qualification compares very well in terms of learning outcomes, scope of content, level and duration with:

- PhD Telecommunications Engineering, The University of Johannesburg, RSA, NCQF Level 10
- PhD Telecommunication Engineering, University of Cape Town, NCQF Level 10
- PhD Telecommunication Engineering, King's College London University of London, FHEQ level 8

Summary of Similarities

The comparison has revealed that the proposed Ph.D Telecommunications Engineering has similar level, credits total, scope of course specialisations, strategies of delivery and common approach to assessment comprising completion of research seminar and dissertation successfully.

All the three (3) institutions cover the domains of the research domain of Telecommunications Engineering, and they all have the outcome of a final research project. There is a strong similarity in

terms of exit level outcomes, these include application of scientific and engineering knowledge**,** problem solving, use of ICT, practical skills etc. All the qualifications from the three (3) institutions articulate to a Ph.D degree.

Summary of differences

The only difference found is that in the EU, the highest level for Ph.D is level 8, but yet equivalent to the local level 10 in terms of level descriptors. Another notable difference is that the proposed qualification adopts also a viva voce form of integrated summative assessment done by internal and external panel of examiners. The University of Cape Town qualification is offered at a minimum of two years for full-time and five years part-time which is similar to the University of Johannesburg, RSA, whereas the University of London, UK qualification is offered at a minimum of three years for full time and six years part-time.

The assessment strategies for the University of Cape Town and the University of Johannesburg, RSA are on the outcome of the research component as well as the required coursework in a case where a module was requested to support the project. A professional doctorate is assessed on the outcome of the research Component. At the University of London, the learners are assessed through tutorials, tests, assignments, and a final-year examination scheduled at the end of every semester. The individual project module is continuously assessed in the summer period and concludes with the submission of a final project report, as well as an oral assessment based upon the practical demonstration of the proposed engineering design/solution.

REVIEW PERIOD
5 years in line with the NCQF

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