| SECTION A: | QUALIFICATION DETAILS | | | | |
|---|---|---|---|---|---|

| **QUALIFICATION DEVELOPER (S)** | Botswana International University of Science and Technology | | | | |
|---|---|---|---|---|---|
| **TITLE** | Bachelor of Engineering (Honours) in Computer and Telecommunication Engineering | | | **NCQF LEVEL** | 8 |
| **FIELD** | Manufacturing, Engineering and Technology | **SUB-FIELD** | Computer and Telecommunication Engineering | **CREDIT VALUE** | 630 |

| 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:

According to World GDP per Capita Ranking 2018, Botswana is ranked 79 out of 195 countries in the world[1]. Its GDP stands at 8,137.15 per capita[1]. 89th out of 131 countries and is classified as one of the top five economies in Sub-Saharan Africa[1].  In recognition of the country's need to grow, the Government of Botswana has taken proactive steps for developing human capacity and infrastructure to drive sustainable economic diversification that leverage on research, science, technology, and innovation[3,4,5]. Vision 2036 advocates for sustainable economic development; together with human and social development that requires Batswana to attain the necessary skills and competencies so as to advance their country[6]. National Development Plan (NDP) 11 Goal states the need to provide an adequate supply of qualified, productive and competitive human resources policy frameworks[7].

Human Resource Development Council (HRDC)[8] of Botswana has recognised 'Engineering and Technology' as one of the fields that are right now encountering deficiencies in the labour market (short term) and

occupations that show moderately solid business development (long term) (HRDC, 2016). The influence of the HRDC reports and the industrial survey makes the qualification viable, relevant, modern, needed and sustainable.

The top half of the countries have succeeded because of diversification of their economy by going into knowledge based economy. These countries include South Korea, Japan, Ethiopia, China and Singapore. To guarantee responsiveness of the capability to the economic needs of Botswana, the plan did not include only the technical side of Computer and Telecommunication Engineering modules but also includes the business management skills, life skills, research skills, and job and wealth creation. These modules consolidated get graduates ready for the universe of work, changes in their general surroundings, and life in general.

Aims

It is to this effect that the B.E in Computer and Telecommunication Engineering qualification is being developed to achieve HRDC, NDP 11, 2036 vision and Global Innovation Index requirements by equipping the participants with the knowledge, skills and competencies in line with the creation of a knowledge-based economy. The modern systems need both computer and telecommunication flowing together. Particularly areas such as Cybersecurity needs Networks design to continue advancing; Design automation needs Machine intelligence and Computer software; Embedded systems needs Internet of things (IoT) and 5G/6G development, Telegraph and telephone; Radio and television needs Satellite, Computer networks and the Internet, Optical fiber, Basic elements of a telecommunication system such as (Transmitter, Transmission medium, Receiver), Wired communication and Wireless communication once forcibly applied within the qualification will propel it to greater heights. It is in this view that the discipline of Computer Engineering and Telecommunications Engineering are being merged to form the B.Eng Computer and Telecommunications Qualification.

The qualification allows the students to cover all the basics of engineering mathematics, object-oriented programming, principles of communication engineering, computer communications networks engineering, computer architecture & design, signals & systems, data structures & algorithms, digital signal processing, microcontrollers, optical communications, digital system design, computational discrete mathematics, operating systems for engineers, parallel & distributed computing, AI & neural networks, reliability and maintainability, broadcasting engineering, telecommunications systems and network management, RF & microwave engineering, digital communications & networks, image & video signal processing, advanced communication engineering design, security & encryption, real-time systems, robotics modelling & simulation, mobile & wireless

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communications, remote control & telemetry, antennas and propagation, satellite communications. The qualified Computer and Telecommunication Engineering graduates will be ready to take up employment, conduct research and innovation in: Computer and Software design, Computer Hardware Management, Telecommunications area, Communications area, Information and Communication area, Computer & Telecommunications area, Information and Telecommunication area so as to develop the economy and the scientific knowledge pool in Botswana and in the world.

**Purpose of the Qualification:**

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

- Design and model computer and telecommunications systems.
- Conduct experiments, design projects and develop prototypes for computer and telecommunications solutions.
- Apply interpersonal and transferable skills of teamwork, effective communication, time management, and adapt to new and different professional environments.
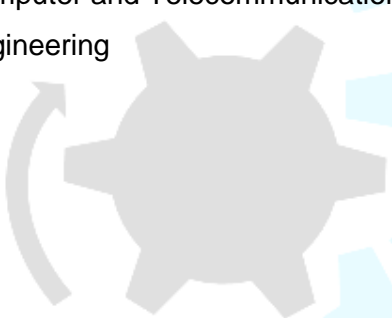- Innovate solutions for engineering problems through research conducted in teams or individually.

## ENTRY REQUIREMENTS (including access and inclusion)

**Entry Requirements**

The minimum entry qualification is:

1. Certificate IV, NCQF Level 4 (BGCSE or equivalent)
2. Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) would be considered for admission into this qualification according to the institutional RPL and CAT policies.
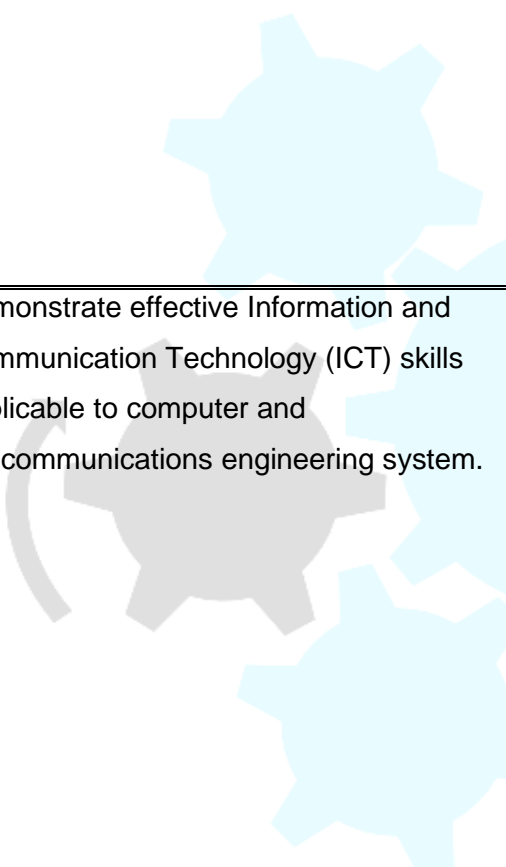
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| SECTION B | QUALIFICATION SPECIFICATION |
|---|---|
| **GRADUATE PROFILE (LEARNING OUTCOMES)** | **ASSESSMENT CRITERIA** |
| 1. Demonstrate highly specialized knowledge and understanding of fundamental concepts and principles of Computer and Telecommunications Engineering | 1.1 Apply core concepts and principles of computer and telecommunications engineering correctly.<br>1.2 Demonstrate the relationship among the core concepts and principles of computer and telecommunications engineering and communications<br>1.3 Discuss the range and limits of the applicability of the core concepts and principles of computer and telecommunications engineering with clients.<br>1.4 Appraise the limitations of basic techniques used in computer and telecommunications engineering. |
| 2. Access, evaluate and synthesize scientific information. | 2.1 Use the library, internet and other data storage and other facilities to access information.<br>2.2 Information from a variety of sources, which may be contradictory or divergent, is synthesised.<br>2.3 Appropriate procedures for generating relevant information are designed, selected and applied with due concern for bias and for any ethical or safety considerations.<br>2.4 Appropriate forms of enquiry are conducted by applying standard procedures within the discipline of computer and telecommunications engineering, such as theoretical, experimental, and computational techniques.<br>2.5 Data is collected and recorded accurately, truthfully and in appropriate formats. |

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| | | 2.7 Data and scientific evidence are analysed and from such analysis valid arguments and conclusions are presented. |
|---|---|---|
| *3.* | Exhibit strong practical knowledge, skill and computer and telecommunications engineering applications. | 3.1 Combine the theoretical tools and the law controlling computer, telecommunications and electronic circuits to analyse critical quantities in such systems.<br><br>3.2 Apply Inductive (effect to cause or specific to general) and deductive (cause to effect or general to specific) reasoning.<br><br>3.4 Perform Hypothetic-deductive reasoning when developing engineering solutions.<br><br>3.5 reflect upon the thinking and reasoning process. |
| *4.* | Communicate effectively the scientific understanding applicable to solving computer and telecommunications engineering problems in writing, orally and using visual, symbolic and/or other forms of representation. | 4.1 Scientific and Engineering language is used correctly to produce clear and coherent written documents, which follow appropriate engineering conventions.<br><br>4.2 Scientific and engineering information is presented verbally in front of others.<br><br>4.3 Appropriate referencing conventions are used, plagiarism is avoided, and intellectual property is respected.<br><br>4.4 Non-verbal forms of representation are used correctly and appropriately. |
| *5.* | Conduct computer and telecommunications engineering design exercises involving investigative research, interviewing techniques and indirect methods of proof used to solve problems in computer and telecommunications engineering and related systems. | 5.1 Create the overall circuits correctly and select all components to meet given specifications using mathematical theory and simulation to realize prototypes and then the final circuit.<br><br>5.2 Formulate, analyse and solve complex problems, in familiar and unfamiliar contexts.<br><br>5.3 Appy the knowledge of theory to real-world and contexts, and particularly to problems in industry. |

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| | | |
|---|---|---|
| | | 5.4 Integrate knowledge from various disciples or modes of enquiry, in solving scientific and industrial problems. |
| | | 5.5 Control the validity of measurement results comparing them to the model and simulation results. |
| | | 5.6 Produce high quality scientific and technical reports based on the experimental data systematically checking all reports with anti-plagiarism tools. |
| *6.* | Demonstrate effective Information and Communication Technology (ICT) skills applicable to computer and telecommunications engineering system. | 6.1 Wire correctly basic and complex electronic circuits. |
| | | 6.2 Follow consistent steps to realize any system starting from theory and simulation to the final system. |
| | | 6.3 Perform tasks related to basic computer literacy skills correctly. |
| | | 6.4 Critically assess the validity of ICT solutions for problems posed by computer and telecommunications engineering as a discipline. |
| | | 6.5 Utilize ICT that is appropriate to computer and telecommunications engineering as a discipline for: computational applications; simulation applications; pattern recognition; automation and control; managing large volumes of data. |
| 7. | Apply highly specialized knowledge and demonstrate the impact of computer and telecommunications engineering activity on and around oneself. | 7.1 Take the precautions to protect oneself, colleagues and the work environment against computer and telecommunications engineering risks and the output of any invention. |
| | | 7.2 Identify Scientific knowledge that is relevant to current societal issues. |
| 8. | Work effectively as a member of a team or group in computer and telecommunications engineering projects or investigations. | 8.1 Contribute effectively to group tasks. |
| | | 8.2 Communicate the outcomes of engineering group work effectively and with respect for the contributions of each group member. |

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| | 8.3 Apply organisational skills in managing group work. |
|---|---|
| 9. Apply highly specialized knowledge in computer and telecommunications engineering principles and ways of thinking to societal and industrial issues, considering ethical and cultural considerations. | 9.1 Identify engineering knowledge that is relevant to current societal and industrial issues. <br> 9.2 Evaluated public information dealing with current engineering related issues. <br> 9.3 Make ethically and culturally sensitive decisions on the effects of engineering-based activities on society. <br> 9.4 Identified the socio-economic impact of engineering interventions in society and industry. <br> 9.5 Engineering knowledge is applied for the direct benefit of society and also to drive industry. |
| 10. Adhere to social, legal, ethical and professional issues in computer and telecommunications engineering decision making. | 11.1 Demonstrate understanding of the system of professional development. <br> 11.2 Acceptance of responsibility for own actions by individual is identified <br> 11.3 Judgment in decision making during problem solving and design issues is identified <br> 11.4 Limitation of decision making to area of current competence is identified. |
| 11. Undertake a computer and telecommunications engineering research project under supervision and demonstrate management skills. | 12.1 Develop and apply skills whilst integrating knowledge to complete a practical industry project in own area or a project related to any research institutions affiliated to Engineering. <br> 12.2 Perform Computer and Telecommunications Engineering research investigations which produce meaningful results. <br> 12.3 Conduct analysis of data and present results of scientific research appropriately. |

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| 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 | Pre-Calculus | 12 | | | | 12 |
| | General Chemistry I | 12 | | | | 12 |
| | Introductory Physics I | 12 | | | | 12 |
| | Programming Logic | 12 | | | | 12 |
| | Engineering Graphics | 12 | | | | 12 |
| | Introduction to Technical Communication & Academic Literacy | 6 | | | | 6 |
| | Introduction to calculus | 12 | | | | 12 |
| | General Chemistry II | 12 | | | | 12 |
| | Introductory Physics II | 12 | | | | 12 |
| | Introduction to Statistics | 12 | | | | 12 |
| | Introduction to Engineering | 6 | | | | 6 |
| | Measurements and instrumentation | 12 | | | | 12 |
| | Engineering Mathematics I | 12 | | | | 12 |
| | Procedural Programming | 12 | | | | 12 |
| | Fundamentals of Electrical Engineering I | 12 | | | | 12 |
| | Technical and Professional Communication | 6 | | | | 6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Applied Mechanics I (Statics) | 12 | | | | 12 |
| | Materials Science | 12 | | | | 12 |
| | Engineering Mathematics II | 12 | | | | 12 |
| | Object-Oriented Programming | 12 | | | | 12 |
| | Fundamental of Electrical Engineering II | 12 | | | | 12 |
| | Computer Networks | 12 | | | | 12 |
| | Software Engineering | 6 | | | | 6 |
| | Engineering Design | 12 | | | | 12 |
| | Winter School | 12 | | | | 12 |
| ***CORE*** ***COMPONENT*** *Subjects/Courses/ Modules/Units* | Engineering Mathematics III | | 12 | | | 12 |
| | Data Structures & Algorithms | | 6 | | | 6 |
| | Electric Circuits Theory | | 12 | | | 12 |
| | Computer and Telecommunications Design 1 | | 12 | | | 12 |
| | Digital Electronics | | 12 | | | 12 |
| | Principles of Communication Engineering | | 12 | | | 12 |
| | Engineering Mathematics IV | | 12 | | | 12 |
| | Computer and Telecommunications Design 2 | | 12 | | | 12 |
| | Electronic Circuit Analysis and Design | | 12 | | | 12 |
| | Electromagnetic Field Theory | | 6 | | | 6 |
| | Control Systems | | 12 | | | 12 |
| | Computer Architecture & Design | | 12 | | | 12 |
| | Economics, Business & Entrepreneurship | | | 6 | | 6 |

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| | | | | | | |
|---|---|---|---|---|---|---|
| | AI & Neural Networks | | | 12 | | 12 |
| | Computer and Telecommunications Design 3 | | | 12 | | 12 |
| | Digital Signal Processing | | | 12 | | 12 |
| | Microcontrollers | | | 12 | | 12 |
| | Industrial Training | | | 36 | | 36 |
| | Electrical, Computer & Telecommunications Engineering Project I | | | | 24 | 24 |
| | Research Methods for Engineering and Technology | | | | 12 | 12 |
| | Optical Communications | | | | 12 | 12 |
| | Advanced Digital System Design | | | | 12 | 12 |
| | Electrical, Computer & Telecommunications Engineering Project II | | | | 24 | 24 |
| | Engineering Business and Society | | | | 12 | 12 |
| | Image & Video signal Processing | | | | 12 | 12 |
| | Advanced Communication Engineering Design | | | | 12 | 12 |
| | Security & Encryption | | | | 12 | 12 |
| **ELECTIVE/ OPTIONAL COMPONENT** *Subjects/Courses/ Modules/Units* | Computational Discrete Mathematics | | | | 12 | 12 |
| | Linear Optimization | | | | 12 | 12 |
| | Operating Systems for Engineers | | | | 12 | 12 |

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| | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | Parallel & Distributed Computing | | | | | 12 | 12 |
| | AI & Neural Networks | | | | | 12 | 12 |
| | Reliability and Maintainability | | | | | 12 | 12 |
| | Broadcasting Engineering | | | | | 12 | 12 |
| | Telecommunications Systems and Network Management | | | | | 12 | 12 |
| | RF & Microwave Engineering | | | | | 12 | 12 |
| | Digital Communications & Networks | | | | | 12 | 12 |
| | Selected Topics in Computer Engineering | | | | | 12 | 12 |
| | Real-time Systems | | | | | 12 | 12 |
| | Robotics Modelling & Simulation | | | | | 12 | 12 |
| | Mobile & Wireless Communications | | | | | 12 | 12 |
| | Remote Control & Telemetry | | | | | 12 | 12 |
| | Antennas and Propagation | | | | | 12 | 12 |
| | Electromagnetic Interference/Compatibility | | | | | 12 | 12 |
| | Satellite Communications | | | | | 12 | 12 |

| SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL | | |
| --- | --- | --- |
| TOTAL CREDITS PER NCQF LEVEL | | |
| Description | NCQF Level | Credit Value |
| Fundamentals | Level 5 | 138 |
| Core | Level 5 | 150 |
| Core | Level 6 | 108 |

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| Core | Level 7 | 90 |
|---|---|---|
| Core | Level 8 | 96 |
| Electives | Level 8 | 48 |
| **TOTAL CREDITS** | | 630 |

| **Rules of Combination:** |
|---|
| ***(Please Indicate combinations for the different constituent components of the qualification)*** |
| All the fundamentals and core modules are compulsory (582 Credits). Students have to choose 4 electives worth 48 credits to earn 630 credits needed for award of this qualification. |

| *ASSESSMENT ARRANGEMENTS* |
|---|
| **Assessment arrangement** <br> **Formative assessments:** The types of assessments used in this Qualification is 40% of Continuous Assessment. Continuous assessment calculation: <br><br> **Summative assessments:** The type of assessment used here is a final examination, which is 60%. Continuous assessment and final exam are combined using the following formula: <br><br> Assessment will be done by suitably qualified persons registered with BQA as assessors or recognized authority or registered with a relevant professional body. |

| *MODERATION ARRANGEMENTS* |
|---|
| **Moderation arrangements** <br> • There is provision for internal and external moderation as a quality assurance measure. <br> • Moderation must be done by suitably qualified persons registered with BQA or relevant professional body. |

| *RECOGNITION OF PRIOR LEARNING* |
|---|
| Recognition of Prior Learning (RPL) will be considered for award of credits this qualification or part qualifications. |

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Candidates may apply for recognition of prior learning whether such learning has been gained through formal study, through workplace learning, or through any other formal or informal means. Any candidate applying for Recognition of Prior Learning (RPL) will be expected to provide evidence of such learning that must be relevant, sufficient, valid, verifiable, and authentic. In addition, the candidate may be interviewed by a member of staff or have to take a formal test, which may include a live demonstration of skills and competencies, to assess competence.

## CREDIT ACCUMULATION AND TRANSFER

Credit Accumulation and Transfer will be considered for award of qualification as per applicable provider policies in line with the relevant national policies.

## PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Learning Pathway: Those who have achieved the qualification can progress as mentioned below

**Horizontal Learning Pathways (NCQF Level 8):**

A Bachelor in Computer and Telecommunications candidate could continue to pursue Bachelor's qualification in any other university in the Computer and Telecommunications specialized disciplines such as;

- Bachelor of Engineering (Honours) in Electronics and Instrumentation
- Bachelor of Engineering (Honours) in Computer networks and systems
- Bachelor of Engineering (Honours) in Information and Telecommunication
- Bachelor of Engineering (Honours) in Satellite Communications
- Bachelor of Engineering (Honours) in Telecommunication

**Vertical Learning Pathways (NCQF Level 9):**

Completion of a Bachelor's in Computer and Telecommunication Engineering meets the requirement for admission to a Master's Degree, Postgraduate Diploma or Postgraduate certificate in the same or related field such as:

- Master of Engineering in Electronics and Instrumentation Engineering
- Master of Engineering in Computer networks and systems Engineering

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- Master of Engineering in Information and Telecommunication Engineering
- Master of Engineering in Satellite Communications Engineering
- Master of Engineering in Telecommunication Engineering

**Employment Pathway:**

The qualification will produce graduates trainable for the following positions:

Computer Engineer

Software Engineer

Computer Hardware Manager

Telecommunications Engineer

Communications Engineer

Information and Communication Engineer

Computer & Telecommunications Engineer

Information and Telecommunication Engineer

## *QUALIFICATION AWARD AND CERTIFICATION*

The learner will be awarded a **Bachelor of Engineering in Computer and Telecommunication Engineering** after attaining 630 credits as specified in the rules of combination and credit distribution. If the student does not need the prescribed minimum standards of the qualification the learner will exit with a transcript. Certificate will be awarded to the candidates who have met the qualification requirements.

## *REGIONAL AND INTERNATIONAL COMPARABILITY*

**MEng Electronics and Computer Engineering, The University of Sheffield, QAA FHEQ Level 8**

This qualification seeks to produce graduates with scarce skills needed by industry. Industries require the two skills of hardware and software programming including robotics, autonomous vehicles, the Internet of Things (IoT) and big data Artificial Intelligence (AI). These are growth industries and require graduates with these skill sets to drive them forward. An example of this is the focus on hardware accelerators for applications ranging from big data analytics to mining Bitcoins. In first year students are taught programming in C as this has a

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fundamental connection with hardware. Studying Electronics and Computer Engineering will allow graduates to enter a variety of industries including manufacturing and IT with future facing companies.

### BSc Computer Engineering, University of KwaZulu Natal, NQF level 8

This qualification is designed to prepare students for a career in the fast growing field of computer engineering, where computer systems are applied to the management, control and dissemination of information and the control and management of systems of all forms. The programme is based heavily on the Electronic Engineering programme with different specialization subjects being offered in the 2nd, 3rd and 4th years of study. The specialization starts in 2nd year with a course on Data Structures and Algorithms, which complements the two standard Computer Methods programming courses. In the third year of study, further specialist courses in Software Engineering, Advanced Programming and Discrete Mathematics are taken along with two Computer Engineering Design courses. Students also do a course on Engineering Management and Labour Practices in preparation for industry employment and an Environmental Engineering course to ensure sensitivity to this important aspect of any engineering activity

### BEng Electrical and Computer Engineering, University of Cape Town, NQF level 8

This is qualification is an interdisciplinary branch of engineering which combines a fundamental study in electrical engineering with computing. Many universities and other institutions world-wide are now offering courses or degrees in Electrical and Computer engineering, and it is recognized that the combination of electrical engineering and computer studies equips graduates with an excellent basis upon which valuable engineering roles in modern industry can be built. Apart from receiving a thorough grounding in both electrical engineering and computing, the Electrical and Computer Engineering student gains a foundation of understanding in physical science, advanced engineering mathematics, microcomputer technology and systematic engineering design. Electrical and Computer engineers in industry generally possess expertise across a broad range of engineering disciplines, and are especially well-suited to a career in network engineering, control & instrumentation, power systems or telecommunications. Electrical and Computer engineers may also become involved in diverse fields such as bio-medical engineering, machine vision, power electronics and machines, or signal and image processing.

### BEng Computer and Telecommunications Engineering, BIUST, NQF level 8

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| | BQA NCQF QUALIFICATION TEMPLATE | Document No. | DNCQF.QIDD.GD02 |
|---|---|---|---|
| | | Issue No. | 01 |
| | | Effective Date | 04/02/2020 |

This qualification has been created to nourish this employment growth with job ready graduates. To guarantee responsiveness of the capability to the economic needs of Botswana, the plan of the capability not just included the technical side of Computer and Telecommunication Engineering modules but also includes the business management skills, life skills, research skills, and job and wealth creation. These modules consolidated get ready graduates of this capability for the universe of work, changes in their general surroundings, and life in general. To make the graduates effective practitioner in their fields requires the skills to know the technology up-to-date with the rapidly changing technologies and competence to apply this knowledge effectively. Graduates for this qualification may pursue MEng degrees in Mechatronics & industrial instrumentation, mechanical & energy, computer & telecommunications and, electrical & electronics at NCQF Level 9. Graduates may work as computer engineers, telecommunication engineers, robotics engineers, software engineers, automation engineers, control systems engineers, instrumentation engineers, maintenance engineers, reliability engineers, asset management engineers, data scientist / big data analyst, electronics design engineer, electrical design engineer, consulting engineers and researchers.

### *REVIEW PERIOD*

5 years in line with the NCQF

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