# BQA NCQF QUALIFICATION TEMPLATE

| SECTION A: | QUALIFICATION DETAILS | | | | | | | | | | | | | | | | | |
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| **QUALIFICATION DEVELOPER (S)** | Botswana International University of Science and Technology | | | | | | | | | | | | | | | | | |
| **TITLE** | Master of Engineering in Electronics Engineering | | | | | | | | | | | | **NCQF LEVEL** | | 9 | | | |
| **STRANDS (where applicable)** | 1. VLSI electronics<br>2. Applied electronics<br>3. Embedded systems<br>4. Digital system design<br>5. Advanced signal processing | | | | | | | | | | | | | | | | | |
| **FIELD** | Manufacturing, Engineering and Technology | | | | | | | | | | | | **CREDIT VALUE** | | 240 | | | |
| **SUB FIELD** | Engineering and Engineering Trades | | | | | | | | | | | | | | | | | |
| New Qualification | | | Legacy Qualification | | | Renewal Qualification | | | | | | | | | | | | |
| | | | | | | Registration Code | | | | | | | | | | | | |
| **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 the Global Innovation Index, Botswana is ranked 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 poor performance globally, the Government of Botswana has taken proactive steps for developing human capacity and infrastructure to drive sustainable economic diversification that leverages on research, science, technology, and innovation[2,3,4]. Vision 2036 advocates for sustainable economic development, together with human and social development that requires Batswana to attain the

necessary skills and competencies to advance their country[5]. National Development Plan (NDP) 11 Goal states the need to provide an adequate supply of qualified, productive, and competitive human resources policy frameworks[6]. Human Resource Development Council (HRDC) of Botswana has recognized '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)[6]. The future Jobs in the Global Market (Driven by Fourth Industrial Revolution) needs more Electronics & Telecommunications installers & Repair engineers (HRDC Priority Skills and Employment Report, 2019)[7].

It is to this effect that the M.Eng Electronics qualification is necessary. This is one of the vital engineering qualifications particularly in developing countries like Botswana[8,9]. The electronic engineers can have a strong analytical skill, problem solving skills, critical thinking, Dexterity, communication, interpersonal skills, and time management. It provides a strong theoretical foundation, practical skills, professional conduct, and critical thinking in Electronics Engineering[10,11].

Aims

The aim for the qualification is to develop an engineer with advanced abilities and level in the fields of electronic engineering, applied electronics, VLSI engineering, embedded systems for the design and synthesis, microwave and high-speed circuit design, signal processing, sensors technology and related principles to specific problems of society at large in the electronics engineering domain. One of the main objectives of this process is to develop an advanced capability to develop both analytical and design skills across the range of electronics subjects and conduct advanced electronics engineering research independently. It also promotes a lifelong learning approach. The aim of the course is to enable the develop graduated to develop solutions for the real-world problems in the electronics engineering by adapting the latest technologies through self-learning and to meet the demands in the industries and academia. 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. It is in this view that the discipline of Electronics Engineering is important to form the M.Eng Electronics Qualification.

The qualification allows the students to cover all the advanced applied electronics, advanced electronics engineering, advanced signal processing, digital system design, embedded systems, and VLSI design. The qualified Electronics Engineering postgraduates will be ready to take up employment, conduct research and innovation in the electronics industry on; advanced applied electronics, advanced electronics engineering, advanced signal processing, digital system design, embedded systems, and VLSI design 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 advanced knowledge, Skills, and competences to,

1. Apply advanced knowledge and understanding of advanced applied electronics, advanced electronics engineering, advanced signal processing, digital system design, embedded systems, and VLSI design.
2. Design complete and complex systems from the simulation steps to the final realization and able to propose innovative solutions to improve existing systems.
3. Adapt to multidisciplinary projects and environments.
4. Carry out engineering projects and develop products.
5. Carry out research in specialized discipline to contribute to advanced electronics.
6. Design systems to be used to solve related problems in Electronics Engineering.

**MINIMUM ENTRY REQUIREMENTS (including access and inclusion)**

i) Bachelor/ Bachelor Honours Degree (Level 8 on the NCQF).

ii) The qualification may also build on extensive professional experience of an appropriate kind through Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) policies for access.

| SECTION B | QUALIFICATION SPECIFICATION |
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| ***GRADUATE PROFILE (LEARNING OUTCOMES)*** | ***ASSESSMENT CRITERIA*** |
| 1. Demonstrate highly specialised Knowledge and understanding of advanced concepts of Electronics engineering. | 1.1 Identify core concepts and principles of electronics are identified, described, and explained in industry and in research institutes.<br>1.2 Apply advanced knowledge to real world application through comprehension questions and problem analytical skills.<br>1.3 Demonstrate the relationship among the core concepts and principles of electronics.<br>1.4 Discuss the range and limits of the applicability of the core concepts and principles of electronics.<br>1.5 Apply the core concepts and principles of electronics engineering and how they are applied to solve practical societal problems as well as problems in industry.<br>1.6 Identify the changes in specialised knowledge for electronics.<br>1.7 Appraise the limitations of advanced techniques used in electronics.<br>1.8 Recognise the significance of contested scientific knowledge in a contemporary context.<br>1.9 Interpret how scientific information and ideas become generally accepted.<br>1.10 Apply the fundamental concepts and principles of Electronics to the solution of complex engineering problems. |
| 2. Access, evaluate and synthesize scientific information. | 2.1 Access information by using the library, internet and other data storage and other facilities.<br>2.2 Evaluate the quality of information using the scientific reasoning.<br>2.3 Information from a variety of sources, which may be contradictory or divergent, is synthesized.<br>2.4 Appropriate procedures for generating relevant information are designed, selected, and applied |

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| | with due concern for bias and for any ethical or safety considerations.<br>2.5 Appropriate forms of enquiry are conducted by applying standard procedures within the discipline of Electronics Engineering, such as theoretical, experimental, and computational techniques.<br>2.6 Appropriate formats used for the data collection and recording.<br>2.7 Use valid arguments and conclusions from the collected data with the scientific evidence.<br>2.8 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using engineering sciences to develop and improve the new advanced electronics products. |
| 3. Exhibit strong advanced practical knowledge, skill, and competence in electronics applications. | 3.1 Capacity of students to combine the theoretical tools and the law controlling advanced electronics circuits to analyse critical quantities in electronics systems.<br>3.2 Demonstrate the logical thinking with naive and flawed scientific reasoning.<br>3.3 Inductive (effect to cause or specific to general) and deductive (cause to effect or general to specific) reasoning can be discriminated.<br>3.4 Hypothetical-deductive reasoning can be performed.<br>3.5 Cause-effect relations can be discerned in the face of some level of uncertainty or gap in available information.<br>3.6 The self-conscious capacity to judge when understanding has been achieved or a problem has been adequately solved is demonstrated.<br>3.7 Independently or in a team, provide technical support, design and testing system and management. |
| 4. Communicate professional and technical scientific understanding in writing, orally and using visual, symbolic and/or other forms of representation. | 4.1 Apply Scientific and Engineering language correctly to produce clear and coherent written documents, which follow appropriate engineering conventions.<br>4.2 Demonstrate Scientific and engineering information is verbally in front of others. |

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| | 4.3 Appropriate referencing conventions are used, plagiarism is avoided, and intellectual property is respected.<br>4.4 Non-verbal forms of representation are used correctly and appropriately.<br>4.5 Write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| 5. Conduct engineering design exercises involving investigative research, interviewing techniques and indirect methods of proof used to solve problems. | 5.1 Create overall circuit correctly and sizing all components to meet given specifications using mathematical theory and simulation to realize prototypes and then the final circuit.<br>5.2 Concrete and abstract problems, in familiar and unfamiliar contexts, are formulated, analysed, and solved.<br>5.3 The knowledge of theory is applied to real-world and contexts, and particular to problems in industry.<br>5.4 Integrate Knowledge from various disciples or modes of enquiry, in solving scientific and industrial problems.<br>5.5 Capacity to control the validity of measurement results comparing them to the model and simulation results.<br>5.6 Produce high quality scientific and technical reports based on the experimental data systematically checking all reports with anti-plagiarism tools.<br>5.7 Use research-based knowledge and research methods including prediction and modelling to complex engineering activities with an understanding of the limitations. |
| 6. Demonstrate engineering methods, skills, and tools in Information and Communication Technology (ICT). | 6.1 Wire correctly basic and complex Electronics circuits.<br>6.2 Capacity to follow consistent steps to realize any system starting from theory and simulation to the final system.<br>6.3 Tasks related to basic computer literacy skills are performed.<br>6.4 The validity of ICT solutions for problems posed by Electronics Engineering as a discipline are critically assessed. |

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| | 6.5 ICT that is appropriate to Electronics Engineering as a discipline is used for: mathematical model construction; simulation applications; power electronics and drives control; automation and control; managing and controlling the system.<br>6.6 Creates, select, and apply appropriate techniques, resources and modern electronics engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. |
| 7. Develop professional engineering solutions for sustainable development. | 7.1 Follow all the precautions to protect oneself, colleagues and the work environment against Electronics risks and the output of any invention.<br>7.2 Scientific knowledge that is relevant to current societal issues is identified.<br>7.3 Understands the impact of professional engineering solutions in the society and demonstrates the knowledge of and need for sustainable development. |
| 8. Work effectively as a member of a team or group in scientific project or investigations. | 8.1 Evidence of successful and effective contributions in group work is provided.<br>8.2 The outcomes of engineering group work are communicated effectively and with respect for the contributions of each group member.<br>8.3 Organisational skills in managing group work are applied.<br>8.4 Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings. |
| 9. Apply engineering knowledge and ways of thinking to societal and industrial issues, considering ethical and cultural considerations. | 9.1 Engineering knowledge that is relevant to current societal and industrial issues is identified.<br>9.2 Public information dealing with current engineering related issues is critically evaluated. |

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| | 9.3 Ethically and culturally sensitive decisions on the effects of engineering-based activities on society are made.<br>9.4 The socio-economic impact of engineering interventions in society and industry is identified.<br>9.5 Engineering knowledge is applied for the direct benefit of society and also to drive industry.<br>9.6 Applies ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| 10. Manage and organise Independent lifelong learning ability | 10.1 Appropriate study skills are demonstrated (learning from text, note-taking, summarising, analysis, and synthesis).<br>10.2 Effective learning strategies which suite personal needs and context are developed and used.<br>10.3 Demonstrate effective time management.<br>10.4 The graduate recognizes the need for and has the preparation and ability to engage independent and lifelong learning in the broadest context of technological change. |
| 11. Apply social, legal, ethical, and professional issues in engineering decision making. | 11.1 Maintain continued competence and to keep abreast of up-to-date tools and techniques are identified.<br>11.2 Understanding of the system of professional development is demonstrated.<br>11.3 Acceptance of responsibility for own actions by individual is identified.<br>11.4 Judgment in decision making during problem solving and design issues is identified.<br>11.5 Limitation of decision making to area of current competence is identified.<br>11.6 Appy reasoning informed by the contextual knowledge to access societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice. |

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| 12. Conduct research and the developments of new methods within the broad field of advanced electronics engineering and recognizing the roles in innovation process. | 12.1 Identify the research topic and formulate the specific research problem.<br>12.2 Develop and apply skills to formulate the research questions to carry out the research project and construct a logical argument for the need of the project.<br>12.3 Construct the hypothesis, literature review based on the review collected.<br>12.4 Interpret the theories, models, methods, and the validated results exiting for the research.<br>12.5 Select the appropriate research tools, methods, simulation software and hardware components to carry out the research.<br>12.6 Present the research finding and recommendations. |



| ***SECTION C*** | ***QUALIFICATION STRUCTURE*** | | | | |
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| ***COMPONENT*** | ***TITLE*** | ***Credits Per Relevant NCQF Level*** | | | ***Total Credits*** |
| | | ***Level [9 ]*** | ***Level [ ]*** | ***Level [ ]*** | |
| | ***N/A*** | | | | |

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| ***FUNDAMENTAL COMPONENT***<br>*Subjects/ Courses/ Modules/Units* | | | | | |
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| ***CORE COMPONENT***<br>*Subjects/Courses/ Modules/Units* | Advanced Digital Signal Processing | 12 | | | 12 |
| | Advanced Digital System Design | 12 | | | 12 |
| | VLSI Design Techniques | 12 | | | 12 |
| | Embedded System Design | 12 | | | 12 |
| | Dissertation for M.Eng. Electronics | 120 | | | 120 |
| | **Total Credits for Core courses** for Master of Engineering in Electronics Engineering ***(By Course Work)*** | 168 | | | **168** |
| | Total credits for Research Dissertation/ Thesis Master of Engineering in Electronics Engineering ***(By Research Work)*** | ***240*** | | | ***240*** |

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| ***STRANDS/ SPECIALIZATION*** | *Subjects/ Courses/ Modules/Units* | ***Credits Per Relevant NCQF Level*** | | | ***Total Credits*** |
| | | ***Level [9]*** | ***Level [ ]*** | ***Level [ ]*** | |
| **Level 9 Elective Modules: Choose six Modules (72 credits) from the following list.**<br>***ELECTIVES*** | ASIC and FPGA Design | 12 | | | ***12*** |
| | Advanced Digital Image Processing | 12 | | | ***12*** |
| | Wireless Adhoc and Sensor Networks | 12 | | | ***12*** |
| | Nano Electronics | 12 | | | ***12*** |
| | Medical Instrumentation | 12 | | | ***12*** |
| | MEMS and NEMS | 12 | | | ***12*** |
| | Advanced Electronics System Design | 12 | | | ***12*** |
| | Healthcare Technologies and IoMT | 12 | | | ***12*** |
| | Internet of Things | 12 | | | ***12*** |
| | Advanced Microprocessors and Microcontrollers | 12 | | | ***12*** |

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| | **Total credits for Electives** | | | | ***72*** |
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| ***2.*** | | | | | |
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| ***Electives*** | | | | | |
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| *SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL* | |
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| *TOTAL CREDITS PER NCQF LEVEL* | |
| ***NCQF Level*** | ***Credit Value*** |
| ***NCQF Level 9*** | ***240*** |
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| ***TOTAL CREDITS*** | ***240*** |

***Rules of Combination:***

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

To graduate with a 2-years Master of Engineering **Electronics Engineering**, students must have successfully completed a minimum of 240 Credits.

Master of Engineering in **Electronics Engineering** ***(By Course Work)***

The credit combination for the qualification is from 168 core components and 72 elective components. For elective components choose at least 72 credits from the list of elective modules.

Master of Engineering in **Electronics Engineering** ***(By Research Work)***

The student needs to submit a Research Dissertation/ Thesis and the credit value is 240.

## *ASSESSMENT ARRANGEMENTS*

This qualification is assessed and moderated as follows:

**Master of Engineering (Electronics Engineering) By Course Work**

**Formative assessments:** The candidates will be evaluated based on the summative assessment approach which includes test, lab report and assignment. This evaluates the attainment of the highly specialised knowledge and skills for qualification learning outcomes. Evaluation will be done on set of skill to identify the module specific learning outcomes. Formative assessment weightage is 40%. Learners need to complete a research dissertation and submit at the end of the qualification.

**Summative assessments:** The type of summative assessment used is final examination, which is with the weightage of 60%. Formative assessment and summative assessment combined to produce the final mark.

Final Mark (100Marks) = Summative Assessment (60 Marks) + Formative Assessments (40 Marks)

**Pass Requirements:** The student will be considered as passed each module after attaining weighted mark of 50% and above. The final mark for the qualification is calculated by averaging the marks obtained in the various modules and the dissertation and Viva Voce.

**Master of Engineering (Electronics Engineering) By Research Work**

**Formative assessment:**

A student doing masters by research must demonstrate serious academic research capacity by presenting an acceptable research concept. Within two months following the first registration, a student is expected to have identified a research topic and to submit a concept paper. With six months the student is expected to write and then present their proposal, if accepted the student continues to write their thesis after completing successfully all the objectives approved in the proposal and sufficient publications in International Journals and Conferences.

## *MODERATION ARRANGEMENTS*

This qualification is moderated as follows:

- **Internal Moderation** - Assessment instruments shall be subjected to internal moderation by BQA registered and accredited Assessors and Moderators before administering to ensure fairness, validity, reliability, and consistency of assessments.

**External Moderation** - Exit level assessment instruments shall be moderated by an External Moderator to ensure fairness, validity, reliability, and consistency of assessments. Qualified external moderators shall be appointed from an accredited Education Training Provider (ETP).

## *RECOGNITION OF PRIOR LEARNING*

The Recognition of Prior Learning (RPL) is a critical mechanism for access to further study and to promote equity and in this regard, the conforms with the national RPL system. The University supports an approach which values all learning through an open and transparent approach to the assessment of that learning and acknowledges that learning may be achieved through formal, non-formal or informal pathways, and that provision should be made in recognition of this to determine the credit outcomes of an individual application for credit.

The role players in the RPL process are as follows:

- RPL candidate
- RPL administrator
- RPL assessor
- The Head of relevant academic department

## *CREDIT ACCUMULATION AND TRANSFER*

RPL and CAT will be considered for award of Qualification.

## *PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)*

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

**Vertical:**

Completion of Master's in Electronics Engineering meets the requirement for admission to a

- Doctor of Philosophy in Electrical Engineering
- Doctor of Philosophy in VLSI Engineering
- Doctor of Philosophy in Embedded Systems Engineering

**Horizontal:**

A Master's in Electronics Engineering candidate could continue to pursue a Master's program in any other university in the Electronics specialized disciplines such as;

- Master's in Applied Electronics Engineering
- Master's in Electrical Engineering
- Master's in Industrial Electronics Engineering
- Master's in Control and Instrumentation Engineering

- Master's in VLSI Engineering
- Master's in Embedded Systems Engineering

**Employment Pathway:**
The qualification will produce graduates' suitable positions as
Service Engineer
Design Engineer
Project Engineer
VLSI Engineer
Embedded Systems Engineer
Circuit Designer
Project Manager
Research Engineer
Network Engineer
System Design Engineer

## *QUALIFICATION AWARD AND CERTIFICATION*

The learner will be awarded a **"Master of Engineering in Electronics Engineering"** after attaining 240 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.

## *SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY*

**MEng Electronics Engineering, BIUST, NQF level 9, 240 Credits.**
The proposed qualification seeks to provide an educational approach where emphasis is placed on integrated research and taught studies and on the production of graduates who are specialists in Electronics Engineering compared to the other qualifications offered by the universities benchmarked from. The developed Electronics Engineering qualifications aims to produce highly qualified engineers in the domain of communication engineering, electronics engineering, medical electronics to support the growth of Botswana economy. Strong relationship is to be established with the electronics companies in Botswana to adapt the Specialization course to the critical needs encountered in this industry. Collaboration and Memorandum of Understanding (MOUs) with different industrial companies will allow ease of access for student research to be tied to practical industrial problems. Therefore, the output of each student research will yield direct solution(s) to the electronics industry both locally and internationally. This also enables student to be industry-ready at graduation. Students will have a great opportunity to learn through projects, internships, and interactions with the current companies in their domain and to create their own business mainly in the electronics engineering industry. Candidates are required to achieve a minimum of 240 credits to graduate.

Graduates for this qualification may pursue PhD in Electrical Engineering, Energy Engineering, VLSI, Embedded Systems at NCQF Level 10. A Master's in Electronics Engineering candidate could continue to pursue a master's qualifications in any other university in the Electronics specialized disciplines such as Master's in Applied Electronics Engineering, Master's in Electrical Engineering, Master's in Industrial Electronics Engineering, Master's in Control and Instrumentation Engineering, Master's in VLSI Engineering, Master's in Embedded Systems Engineering. Graduates may work as power plant engineers, control engineer, manager, energy engineer, circuit designer, VLSI engineer, medical electronics engineer consulting engineers and researchers.
Thus, the proposed degree qualification compares better with MEng Electronics Engineering offered in the UK and South Africa.

| ***REVIEW PERIOD*** |
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| 5 years in line with the NCQF |

**For Official Use Only:**

| **CODE (ID)** | | | |
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| **REGISTRATION STATUS** | **BQA DECISION NO.** | **REGISTRATION START DATE** | **REGISTRATION END DATE** |
| | | | |
| **LAST DATE FOR ENROLMENT** | | **LAST DATE FOR ACHIEVEMENT** | |
| | | | |
| **REVISION DATE:** | | **NAME OF PROFESSIONAL BODIES/REGULATORY** | |