SECTION A:	***QUALIFICATION DETAILS***																	
QUALIFICATION DEVELOPER (S)	*BOTHO UNIVERSITY*																	
TITLE	Bachelor of Engineering in Computer Engineering														***NCQF LEVEL***		*8*	
FIELD	Manufacturing, Engineering and Technology			***SUB-FIELD***	Computer Engineering										***CREDIT VALUE***		*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

Rationale:

Botswana is a fast-developing country, with increasing in number of industries and technologies. According to the “Long Term Vision for Botswana- Vision 2016”, Botswana seeks to have an innovative, prosperous and productive nation. The country is focusing on developing an education which provides technical skills for the youth, which states “Education has not been adequately geared to the needs of the country, and to the job market. The challenge is to place greater emphasis on technical and practical subjects, and business skills - the skills that are most needed”. Currently, there is a need to develop Botswana’s technical research and development, and shortage of trained expertise in some areas play an impediment in the implementation of projects. For this purpose, development and technical research base is a requirement, which will take into

account the factors of adaptation of these technologies to the local and global conditions. This emphasizes the need for strong base in technology fields such as computer engineering.

Botswana seeks among other development imperatives to be an innovative, prosperous, and productive nation with a youth endowed with technical skills and competencies. Furthermore, and through its Vision 2036 Botswana envisages to be a knowledge economy aligned with the global agenda for sustainable development. This qualification forms part of the foundation for the realization of the aforementioned vision by providing the nation with competent computer Engineers.

The Human Resources Development Council (HRDC) *Priority skills (Current and Future)* document articulates the need for human resources in engineering. The occupations related to the Bachelor of Engineering in Computer Engineering qualification which are mentioned in the HRDC document are System administrators, Computer Network Professionals, Applications Programmers, System Analysts, Software developers, ICT security managers, ICT service mangers and Information technology information system specialist. The Computer Engineering graduates are equipped to work in the above-mentioned occupations.

This qualification develops the necessary knowledge, skills and practical experience in students to enable them to meet this challenge. The Qualification modules build on the 'Bachelor of Engineering in Computer Engineering curriculum provide students with the necessary mix of technical, organizational and management knowledge skills and competency to qualify them as Computer Engineer professionals. The level of the qualification (Level 8) meets the requirement set by Botswana Qualification Authority's NCQF Regulations.

A market survey was conducted to establish the need to offer B.Eng. in Computer Engineering and determine viability of the qualification in line with industrial and business trends. The responses from the survey were positive with inkling that Computer Engineering qualification is needed and sustainable. This qualification produces Computer Engineering Graduates who can be employed by global industry and the local industry.

PURPOSE:

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

- Manage computer engineering projects

- Apply scientific, mathematical, and engineering knowledge to come up with innovative solutions to unpredictable and complex real-life problems and challenges that beset the country.
- Apply the latest technologies and tools in computer hardware and software design, computer based systems, network design and security, and electronic design automation
- Apply Computer Engineering principles in the different functional units of an organisation
- Reflect on managerial decisions and applications and to assess the effect thereof in the holistic context of Computer Engineering as a practice.

ENTRY REQUIREMENTS (including access and inclusion)

Entry into this qualification is through any one of the following requirements:

1) NCQF Level 4, Certificate IV.
2) Certificate V holders may be granted exemptions based on the relevance of the subjects.
3) Applicants that do not meet the above criteria but possess relevant industry experience will be considered through Recognition of Prior Learning (RPL).

SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
1. Apply the principles of mathematics, science, and Engineering in the areas of Computer Engineering and related disciplines.	1.1 Demonstrate the ability to apply the knowledge on mathematics, science, and engineering. 1.2 Assess the scientific and mathematical applications in areas of engineering modules and their applications. 1.3 Demonstrate the ability to apply scientific and Engineering theories, principles and laws in engineering problems. 1.4 Analyse and choose appropriate mathematical tools for solving engineering problems by applying scientific and engineering knowledge. 1.5 Identify uncertainty and risk using probability and statistics.
2. Design and conduct experiments with appropriate techniques and tools and critically investigate, analyze and interpret data.	1.1 Assess the design in terms of the social, economic, legal, health, safety, and environmental impact and benefits. 1.2 Investigate the methodologies used to conduct the experiments. 1.3 Use appropriate laboratory equipment and software tools for designing, testing and analysis. 1.4 Conduct experiments and critically investigate, analyse and interpret data.

	1.5 Analyse and draw a conclusion from the interpret information derived from the collected data. 1.6 Present the objective of the investigation, methods, results and conclusions in a technical report formally. 1.7 Apply computer engineering safety standards and codes of practice in investigations and experimentation.
3. Design a system, component or process per given specifications and requirements in the areas of Computer Engineering and related disciplines.	3.1 Demonstrate the ability to gather information about the Specifications and requirements for designing a component, process, or system. 3.2 Apply procedural and non-procedural design and synthesis steps based on solution feasibility. 3.3 Design end products & evaluate them. 3.4 Assess the methodologies used to design an end product and demonstrate the ability to present a complete document summarising the system, component or process. 3.5 Present a complete document summarising the system components or processes. 3.6 Perform formal analysis and modelling on engineering systems, components, or processes.
4. Identify solutions to problems and projects by making use of diverse technical knowledge and skills acquired.	4.1 Identify and formulate the problem. 4.2 Identify and use relevant information, technical knowledge and skills for solving problems. 4.3 Formulate various approaches that would lead to workable solutions. 4.4 Evaluate solutions and select the best solution. 4.5 Demonstrate compiling and troubleshooting skills.

	4.6 Formulate and present a solution in an appropriate form satisfy user needs, applicable standards, codes of practice and legislation
5. Conceptualize and assess constraints that may influence Engineering problems, systems and/or projects.	5.1 Identify & differentiate engineering problems. 5.2 Ability to put engineering problems in solvable form and develop and evaluate alternative solutions. 5.3 Demonstrate the assessed constraints. 5.4 Formulate the engineering problem to satisfy user needs. 5.5 Plan and manage the design process to focus on important issues that deal with constraints.
6. Follow development trends in Computer Engineering and related disciplines.	6.1 Demonstrate the functions of new and emerging software. 6.2 Identify the benefits of Emerging technologies in Computer Engineering. 6.3 Research on discipline-related development trends. 6.4 Engage in life-long learning and evaluate the importance of it.
7. Act professionally and ethically and take responsibility for exercising judgment commensurate with knowledge and experience.	7.1 Adhere to Engineering code of conduct. 7.2 Demonstrate the ability to take responsibility for consequences stemming from individual actions and/or teamwork. 7.3 Make decisions within Engineering or related fields. 7.4 Describe the ethical implications of engineering decisions in terms of trustworthiness, the impact on the environment, business and economy.

8. Communicate effectively via graphic, numeric, verbal and written media with engineering audiences and the community at large.	8.1 Evaluate different communication methods. 8.2 Prepare and present cost estimates, work schedules, instruction manuals and engineering project reports. 8.3 Demonstrate effective communication skills 8.4 Prepare and interpret Engineering drawings and specifications. 8.5 Ensure correct interpretation of instructions 8.6 Ensure that clear instructions are given to subordinates using appropriate language and communication aids. 8.7 Provide information in a format that can be used by others involved in the engineering activity. 8.8 Oral presentations are made using language, structure, style, visual media and supporting documents appropriate to the audience and purpose. 8.9 Adapt the structure, style and language of communication in reports and presentations to be appropriate in the case of either a technical/non-technical or expert /non-expert audience. 8.10 Use an appropriate and effective blend of graphical, textual and numerical computer engineering information presentation in order to achieve a clear communication objective and conclusion.
9. Reason critically and develop alternative views and/or solutions.	9.1 Develop new designing techniques. 9.2 Demonstrate knowledge on critical thinking and reasoning.

	9.3 Able to come up with new engineering solutions.
10. Work effectively as an individual, in teams and in multidisciplinary environments showing leadership and with professional interpersonal skills.	10.1. Work as individual and as a member of a team is in various projects. 10.2. Demonstrate leadership skills. 10.3. Organise and manage projects. 10.4. Mentor and train team members. 10.5. Build and maintain relationships, respect, and trust with team member. Recognise and discharge responsibilities within team members. 10.6. Ensure that different social and cultural values are taken into account when dealing with colleagues, clients and stakeholders. 10.7. Effective documentation team contributions emanating from discussions and meetings 10.8. Demonstrate effective communication with team members.
11. Demonstrate knowledge and understanding of Engineering management principles in society, industry and physical environment and address the issues by analysis and evaluation.	11.1. Demonstrate the Engineering management principles. 11.2. Assess the impact on the physical environment due to Engineering Activity. 11.3. Demonstrate the occupational and public health and safety. 11.4. Analyse the personal, social, cultural values and requirements of those affected by engineering activities. 11.5. Evaluate the impact of technology on the society and industry. 11.6. Demonstrate the ways to address the issues.

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*	Principles of Computer Engineering	***10***				***10***
	Physics -1	***10***				***10***
	Physics -2	***10***				***10***
	General Chemistry -1	***10***				***10***
	General Chemistry -2	***10***				***10***
	Engineering Mathematics-1	***10***				***10***
	Engineering Mathematics-2		***10***			***10***
	Engineering Mathematics-3		***10***			***10***
	Engineering Mathematics-4		***10***			***10***
	Pre-calculus Mathematics	***10***				***10***
	Linear Algebra		***10***			***10***
	Introduction to Software Engineering			***10***		***10***
	Computer and its essentials -1	***10***				***10***

	Computer and its essentials - 2		***10***			***10***
	Electrical and Electronics Engineering Workshop Practice		***10***			***10***
CORE COMPONENT *Subjects/Courses / Modules/Units*	Engineering Drawing		***10***			***10***
	Engineering Workshop Practice		***10***			***10***
	Procedural Programming in C		***10***			***10***
	Academic writing for STEM		***10***			***10***
	Computer Organization & Design		***10***			***10***
	Electrical and Electronics Engineering		***10***			***10***
	Electrical and Electronics Engineering Lab		***5***			***5***
	Object Oriented Programming in Java		***10***			***10***
	Object Oriented Programming Lab		***5***			***5***
	Year 2 design & make project		***10***			***10***
	Analogue Electronics		***10***			***10***
	Digital Electronics		***10***			***10***
	Analog and Digital Electronics Lab		***5***			***5***
	Signals and Systems		***10***			***10***
	System Software		***10***			***10***
	Year 3 design and Make project		***10***			***10***
	Internet of Things		***10***			***10***

	Design and Implementation of Digital Systems			***10***		***10***
	Design and Implementation of Digital Systems Lab			***5***		***5***
	Compiler Design			***10***		***10***
	Compiler Design Lab			***5***		***5***
	Microprocessor & Microcontrollers			***10***		***10***
	Microprocessor & Microcontrollers Lab			***5***		***5***
	Digital Signal Processing			***10***		***10***
	Control Systems			***10***		***10***
	Principles of Communication Engineering			***10***		***10***
	Data Communication Networks			***10***		***10***
	Data Communication Networks Lab			***5***		***5***
	Database Management Systems			***10***		***10***
	Database Management Systems Lab			***5***		***5***
	Research Methods in STEM				***10***	***10***
	Operating Systems				***10***	***10***
	Entrepreneurship and innovation				***20***	***20***
	Research Project 1				***10***	***10***
	Engineering Project Management				***10***	***10***
	Embedded systems				***10***	***10***

	Concurrency & Parallelism				***10***	***10***
	Professional Practice				***60***	***60***
	Research Project 2				***10***	***10***
	Data Structures and Algorithms				***10***	***10***
	Grid Computing				***10***	***10***
ELECTIVE/ OPTIONAL COMPONENT *Subjects/Courses / Modules/Units*	Cryptography and Network Security				***10***	***10***
	Artificial Intelligence				***10***	***10***
	Ad Hoc and Sensor Networks				***10***	***10***
	Bioinformatics				***10***	***10***
	Cloud Computing				***10***	***10***
	Algorithm and Analysis Design				***10***	***10***

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	***Credit Value***
Level 5	***80***
Level 6	***215***
Level 7	***115***
Level 8	***190***
TOTAL CREDITS	***600***

Rules of Combination:

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

Bachelor of Engineering in Computer Engineering will have 600 credits and take five years to complete under the normal full-time mode of study.

- ALL core unit standards constituting 600 credits should be achieved (Level 5- 80 credits, Level 6 - 215 credits, Level 7- 115 credits and Level 8- 190 Credits).
- The full semester internship module, called the Professional Practice module, may typically be done after the student has passed at least 360 credits worth of modules.
- The credit combination for this qualification is from 150 fundamental components, 430 core components and the remaining 20 is from elective components.

ASSESSMENT ARRANGEMENTS

This qualification is assessed as follows:

Formative assessment: 40%

Summative assessment: 60%

Assessment Types:

- Practical test
- Class assignments
- Presentations
- Informal class tests
- Formal modular tests

Summative assessment:

Assessment, focusing on the achievement of the exit-level outcomes, will be done by means of a written or practical examination at the end of every module.

Project: Students will need to do project and submit their project work along with a report for the project modules.

Professional Practice: All students must undergo a workplace training under a supervisor who monitors students' workplace performance using a weekly logbook and submits a final evaluation report to the tutor. A tutor assigned to a student visits the intern twice at workplace, each time making his/her evaluation. At the end of the professional practice, a student will submit a project report. All the marks, namely from tutor visits, supervisor evaluation and project report evaluation will be captured in a form called 'internship report feedback form'.

Pass requirements:

A learner qualifies for the BEng in Computer Engineering degree on NCQF level 8 when he/she passes all required individual modules. A student passes a module if he/she obtains a final mark of 50% or more in the module. The final mark is constituted of formative assessments (40%) and the summative assessment (60%). The final mark for the qualification is calculated by averaging the marks obtained in the various modules. The student must successfully complete 600 credits to complete the qualification.

MODERATION ARRANGEMENTS

Moderation of assessments focuses on:

a) Ensuring that the assessment is aligned to the module objectives and the learning outcomes.
b) Ensuring that the assessment is consistent on all levels within the institution and does not show any bias or academic disregard and that it is immune to all forms of prejudice.
c) Ensuring that the level of assessment appropriately matches the students' level of study i.e. the assessments remain viable, relevant and provide an accurate judgement of a student's achievements and level of knowledge.

d) Maintaining consistency in the marking process.

Pre-assessment Moderation:

This moderation is carried before assessment tasks are given to students. All submitted sets of question papers &marking keys are shared with the moderators. Each assessment pack should be moderated by two Moderators where possible. The question paper moderation report should be filled in for each question paper. Moderator report will be shared with question paper setter so that moderator feedback will be taken into account when finalizing the question paper.

Post-assessment moderation or moderation of marking:

Moderation of completed assessment tasks is categorized as post-assessment moderation. It is carried out after assessment tasks have been marked. The set of answer scripts and marking keys are shared with the moderators. At least 10% of the answer scripts in a module should be moderated during post assessment moderation.

The moderators and assessors are well trained and have registered with BQA. The internal and external moderation will be done in-line with the Moderation policy of the Institution.

RECOGNITION OF PRIOR LEARNING

Candidates may apply the 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), or credit Accumulation and Transfer (CAT) will be expected to provide evidence of such learning that much be relevant, sufficient, valid, verifiable and authentic. Provision of RPL for award of the qualification will be in line with the National RPL policy.

CREDIT ACCUMULATION AND TRANSFER

A clear framework through which students can accumulate learning credits and transfer such credits toward appropriate qualifications helps to validate and recognize learning gained through formal and informal means, provides flexibility to students, and allows students to progress relatively seamlessly through their lifelong

learning journey. Credit transfer Will be applied in line with National Credit Accumulation and Transfer (CAT) Policy.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Learning Pathway:

Vertical:

Having obtained this qualification, the following possibilities are there for further study:

Bachelor's Degree Honours, Post-Graduate Diploma or Post-Graduate Certificate (NCQF level 8) in computer engineering, software and data engineering, Data analytics, network engineering, software development and multimedia, embedded systems, computer security engineering, artificial intelligence, information technology.

Horizontal:

- BEng in Software and Data engineering
- BEng in Computer Security engineering
- BEng in Network engineering

Employment Pathway:

The qualification will produce graduates suitable for positions as analyst, designers, programmers, testers, troubleshooting professionals, telecommunication Professionals, robotics, security professionals, healthcare and technology and equip them well for further management responsibilities.

QUALIFICATION AWARD AND CERTIFICATION

The learner will be awarded 'Bachelor of Engineering in Computer Engineering' after attaining a minimum 600 credits as specified in the rules of combination and credit distribution. If the candidate does not meet the prescribed credit value of the qualification, then the student will exit with a transcript.

REGIONAL AND INTERNATIONAL COMPARABILITY

This Qualification was compared with various universities running similar qualifications. The following universities and their qualifications were taken for the comparisons:

Regional: University of Pretoria, South Africa **-** Bachelor of Engineering, Computer Engineering **International:** University of Victoria, Canada - Bachelor of Engineering, Computer Engineering **Summary:**

University of Pretoria, South Africa - Bachelor of Engineering (Computer Engineering)

Similarities

- The core modules in this qualification and Pretoria University are almost similar. For e.g. Programming and Electronics modules.

Both the universities have project module for two consecutive semesters.

Differences

- The learners are given a choice to learn modules of their interest later in their course work. This helps them to acquire more knowledge on their area of interest. Pretoria University teaches all core modules.

University of Victoria, Canada - Bachelor of Engineering, Computer Engineering

Similarities

- There are many common modules to both the qualifications such as Data structures, Programming, Data base.

Differences

- The learners are given theory and practical knowledge for different modules in the same semester. E.g. Digital Electronics, Data Communication, Microprocessors, Database Management systems, which helps in better understanding of the modules.

REVIEW PERIOD

5 Years