

 BOTSWANA Qualifications Authority	BQA NCQF QUALIFICATION TEMPLATE	Document No.	DNCQF.P02.GD01
		Issue No.	01
		Effective Date	27.01.2021

SECTION A:												QUALIFICATION DETAILS						
QUALIFICATION DEVELOPER (S)						Botho University												
TITLE			Bachelor of Technology in Software Engineering						NCQF LEVEL			7						
FIELD		Information and Communication Technology			SUB-FIELD		Software Engineering			CREDIT VALUE			480					
<i>New Qualification</i>				<input checked="" type="checkbox"/>		<i>Review of Existing Qualification</i>												
SUB-FRAMEWORK				General Education			TVET			Higher Education			<input checked="" type="checkbox"/>					
QUALIFICATION TYPE	Certificate	I	II	III	IV	V	Diploma	Bachelor	<input checked="" type="checkbox"/>									
	Bachelor Honours			Post Graduate Certificate			Post Graduate Diploma											
	Masters						Doctorate/ PhD											

RATIONALE AND PURPOSE OF THE QUALIFICATION

RATIONALE:

Botswana Vision 2036 (HIRDC, 2017) entails emphasis on information communication technologies, financial and business and transport among others. On ICT more emphasis is on ICT being an enabler for efficient service delivery across all sectors' (HIRDC, 2017:16). Priority skills in each occupation have been identified and these include both the core skills and soft skills (HRDC, 2016).

'Information and Communication Technology' has been identified as one of the occupations that are currently experiencing shortages in the labor market (short term) and occupations that show a relatively strong employment growth (long term) (HRDC, 2016). Software Engineering is amongst the list, which makes it pertinent to introduce Software Engineering to create qualified and grounded software designers and developers.

In accordance with the Botswana National Development Plan 11 research and innovation remain critical factors in ensuring and sustaining national competitive advantage, economic growth and diversification with the main aim of achieving an efficiency-driven economy. Software design and development have been mentioned as an

 BOTSWANA Qualifications Authority	BQA NCQF QUALIFICATION TEMPLATE	Document No.	DNCQF.P02.GD01
		Issue No.	01
		Effective Date	27.01.2021


area that can support innovative ways of solving business and industrial problems to enhance business processes through deployment of locally developed applications.

The Government of Botswana developed a National Information and Communications Technology (ICT) Policy dubbed Maitlamo Policy (2004) that was in line with other government initiatives and assist in achieving Vision 2036 which envisioned that the National ICT Policy would position Botswana for sustained growth in the digital age by serving as a key catalyst in achieving social, economic, political and cultural transformation within Botswana. The proposed qualification will enhance the development of secure, efficient and legal systems guided by the Maitlamo policy.

A market survey was carried out to establish the need to offer a B. Tech in Software Engineering and determine viability of the qualification in line with industrial and business trends. The responses from the survey were positive with inkling that the Software Engineering qualification is needed and sustainable. According to the survey, there was a 63% recommendation of software engineering by the industry participants.

Over 133 industry stakeholders were used for collecting data from across the country, but only 60 participants gave successful response. Most of the participants are based in the Southeast of Botswana, with about 48.3% responses from the Southeast region, and about 21.7% from Northeast, 16.7 in Central and 10% in South Central. Further, the participants were from various types of businesses, thus having 45% of responses from government organizations, with private companies at 41.7% and parastatals at 13.3%. The outreach was to balance between the various types of employment a graduate can be employed, and the regions where the graduates can find employment.

The questionnaire distribution was targeting different sectors which operated on IT services or their departments. The research covered a broad spectrum of sectors which engage IT services or IT products for their operations. These include health, education, construction, mining, telecommunications, media, welfare, hospitality amongst the very large industry in Botswana. As IT is used in all sectors, the intent of the survey was to understand the need for the programme in these various sectors, and if they are useful for their operations by graduates.

 BOTSWANA Qualifications Authority	BQA NCQF QUALIFICATION TEMPLATE	Document No.	DNCQF.P02.GD01
		Issue No.	01
		Effective Date	27.01.2021

Companies showed that they were using IT tools for so many services, some in development, communications, security, databases. The most service used by companies is finding IT solutions and providing IT support for computer users. Some of the companies that participated in the survey also indicated that they provided IT services and support to other companies, therefore using IT for business and not just their own internal operations.

There was a 63% recommendation of software engineering by the industry participants. Out of the 60 responses, 38 of them would recommend another person to do the programme. This being above average indicates a high demand of the programme, agreeing with the results on “Software Engineering” demand by the industry. A total of 27 responses indicated the programme in high demand, whilst a good 23 respondents were on average.

Questionnaires for potential students were distributed to a total of 150 students in senior secondary schools from which 110 correctly entered responses were recorded. 55% of the responses were from local private schools while 45% were from public schools. The demographics showed that the majority of respondents are form 5 students with 66% followed by form 4 with 31% while form 6 constitute only 3%. On gender, the majority of respondents were males with 53%, while the females were at 43%.

Furthermore, an academic review report and industry review reports were done to confirm that this qualification is needed for the country.

According to the Weekend Post (2017)¹ citing HICT Institute Botswana, there are top ten jobs that graduates can apply internationally and these are categorised as 1) Software engineer, 2) System analyst, 3) Business Analyst, 4) Technical Support, 5) Technical consultant, 6) Network Engineer, 7) Technical sales, 8) Project Manager, 9) Web developer, 10) Software Tester. Amongst the aforementioned top ten jobs, candidates can apply for all job categories except Network Engineer which is not under the software domain. All other jobs can fall under the software engineering domain.

The Interim Skills in Demand in Botswana (HRDC, 2016) indicates that Software Developers and Programmers, Systems Administrators, IT Service Managers, Database Designers and Administrators, Systems Analysts, and

 BOTSWANA Qualifications Authority	BQA NCQF QUALIFICATION TEMPLATE	Document No.	DNCQF.P02.GD01
		Issue No.	01
		Effective Date	27.01.2021

Web and Multimedia Developers are amongst the top 20 skills in demand in Botswana. The proposed qualification is in line with the IT skills in demand as learning outcomes at the exit of the qualification.

The B. Tech in Software Engineering is designed to enable the students to create high-quality software applications for complex organizational environments, with an emphasis on good engineering practices that allow for ease of maintenance and the use of existing components. Candidates enrolled in this qualification will familiarize with the tools and rigorous methodologies used to develop mission-critical and safety-critical software systems. They will be equipped with skills to critically evaluate design paradigms, languages, algorithms, and techniques used to develop large-scale and complex software systems and a deep appreciation of the importance of software architecture, testing, documentation, and maintainability.

PURPOSE:

The main purpose of this qualification is to equip candidates with knowledge, skills and competence to:

- develop, design, test and maintain software projects.
- adapt and use specific software needed for industry, business, or function.
- apply latest technology and tools.
- analyse, interpret and apply Software Engineering principles in different functional units of an organization.
- reflect on their managerial decisions and to assess the effect thereof in the holistic context of Software Engineering as a practice.


ENTRY REQUIREMENTS (including access and inclusion)

Minimum Entry requirement into this qualification is:

- 1) NCQF level 4, Certificate IV (General Education or TVET).
- 2) 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
<p>1. Apply knowledge of computing fundamentals, computing specialization, mathematics, probability and statistics, science, and methodologies</p> 	<p>1.1 Explain computational theory and its application to a wide range of problems.</p> <p>1.2 Apply mathematical foundations and algorithmic principles in the modelling and design of software systems.</p> <p>1.3 Determine various use of mathematical tools for data analysis.</p> <p>1.4 Demonstrate and formulate algorithms and pseudo code to solve complex problems.</p> <p>1.5 Investigate techniques to solve a variety of discrete mathematical, linear algebra, probability and statistics problems.</p> <p>1.6 Evaluate the correctness and efficiency of algorithms to a solve a problem.</p>
<p>2. Design solutions for broadly defined computing technology problems, and contribute to the design of systems or processes to meet specified needs</p>	<p>2.1 Develop database through applying database concepts using latest technologies.</p> <p>2.2 Generate database applications with standard Security measures.</p> <p>2.3 Evaluate standards-based policies for administration and maintenance of databases.</p> <p>2.4 Describe conceptual models for creating database system</p>
<p>3. Select and apply appropriate techniques, resources, and modern computing tools to broadly defined computing activities</p>	<p>3.1 Describe artificial intelligence process for software development</p> <p>3.2 Apply artificial intelligence techniques in the software development process.</p> <p>3.3 Identify parallel and distributed software engineering process.</p>

<p>4. Understand and assess societal, legal and cultural issues within local and global contexts, and the consequential responsibilities relevant to computing technologist</p>	<p>4.1 Evaluate the significance of evolving software engineering tools in resolving indigenous societal and economic problems.</p> <p>4.2 Apply different cutting-edge software engineering tools in designing and developing modern software applications.</p> <p>4.3 Create possible innovative tools to assist in solving Indigenous or global socio-economic problems.</p>
<p>5. Function effectively as an individual and as a member or leader in diverse technical teams</p>	<p>5.1 Describe leadership principles and practices in Software Engineering.</p> <p>5.2 Illustrate the characteristics and approaches inherent to successful leadership of Software Engineering teams.</p> <p>5.3 Start and complete an agile software development project.</p> <p>5.4 Evaluate and use appropriate software engineering tools.</p>
<p>6. Communicate effectively with the computing community and write effective reports, design documentation and make effective presentations</p>	<p>6.1 Illustrate verbal communication.</p> <p>6.2 Demonstrate report Writing skills.</p> <p>6.3 Publish System requirements documentation.</p> <p>6.4 Develop user manuals and system test documentations.</p> <p>6.5 Create project review and project walkthrough documents</p> <p>6.6 Demonstrate system artefact to users and stakeholders</p>
<p>7. Ability to show software engineering skills and programming skills</p>	<p>7.1 Evaluate software development methodologies.</p> <p>7.2 Identify and examine theory for software Development.</p> <p>7.3 Apply models and theories for requirements Specification.</p> <p>7.4 Demonstrate use of new and emerging software development tools.</p> <p>7.5 Produce different software designs based on architecture for the envisioned software.</p> <p>7.6 Illustrate Software testing techniques.</p> <p>7.7 Assess Software testing tools.</p> <p>7.8 Develop and apply testing strategies for software applications</p>

<p>8. Identify and solve broadly defined computing problems reaching substantiated conclusions using analytical tools appropriate to the discipline or area of specialization</p>	<p>8.1 Adopt various promising software engineering tools in designing and developing modern software applications</p> <p>8.2 Evaluate the correctness and efficiency of tools to solve a given problem</p>
<p>9. Understand and commit to professional ethics, responsibilities, and norms of computing technologist practice</p>	<p>9.1 Observe business policies guiding software development.</p> <p>9.2 Evaluate national data access and security policies.</p> <p>9.3 Assess Software Engineering Code of Ethics and Professional Practice.</p> <p>9.4 Describe appropriate industry standards for software development.</p>
<p>10. Recognize the need, and have the ability, to engage in independent learning for continual development as a computing technologist</p>	<p>10.1 Demonstrate the ability to achieve business objectives through the effective use of software technologies.</p> <p>10.2 Develop and test software systems and applications to support business services or functions.</p>

SECTION C		QUALIFICATION STRUCTURE				
COMPONENT	TITLE	Credits Per Relevant NCQF Level				Total Credits
		Level [5]	Level [6]	Level [7]	Level [8]	
FUNDAMENTAL COMPONENT <i>Subjects/ Courses/ Modules/Units</i>	Communication for Computing Professionals	---	---	15	---	15
	Mathematics for Science & Engineering	15	---	---	---	15
	Professional, Ethical, and Social Issues in Computing	15	---	---	---	15
	Discrete Structures	---	15	---	---	15
	Calculus for Computing	---	15	---	---	15
	Linear Algebra	---	15	---	---	15
	Probability and Statistics	---	---	15	---	15
CORE COMPONENT <i>Subjects/Courses/ Modules/Units</i>	Introduction to Computing and Programming I	15	---	---	---	15
	Principles of Software Engineering	15	---	---	---	15
	Introduction to Computer Programming II	---	15	---	---	15
	Software Engineering	---	---	15	---	15
	Introduction to Information Security	---	15	---	---	15
	Web Design Development	---	15	---	---	15

	Programming using C++	---	15	---	---	15
	Software Development Project	---	---	15	---	15
	Introduction to Java Programming	---	---	15	---	15
	Computer Networks and Applications	---	---	15	---	15
	Data Structures and Algorithms	---	---	15	---	15
	Software Architecture and Patterns	---	---	15	---	15
	Software Project Management	---	---	15	---	15
	Programming using Python	---	---	15	---	15
	Software Requirements Analysis and Design	---	---	15	---	15
	User Interface Design and Implementation	---	---	15	---	15
	Professional Practice	---	---	60	---	60
	Software Testing	---	---	15	---	15
	Project	---	---	---	30	30
ELECTIVE/ OPTIONAL COMPONENT	Parallel and Distributed Software Engineering	---	---	15	---	15
	Software Quality Assurance	---	---	15	---	15

 BOTSWANA Qualifications Authority	BQA NCQF QUALIFICATION TEMPLATE	Document No.	DNCQF.P02.GD01
		Issue No.	01
		Effective Date	27.01.2021

<i>Subjects/Courses/ Modules/Units</i>	Entrepreneurship and Innovation	---	---	15	---	15
	Software Quality Control	---	---	---	15	15
	Software Testing and Maintenance	---	---	---	15	15
	Artificial Intelligence	---	---	---	15	15

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL

TOTAL CREDITS PER NCQF LEVEL


NCQF Level	Credit Value
Level 5 Credits	60
Level 6 Credits	105
Level 7 Credits	270
Level 8 Credits	45
TOTAL CREDITS	480

Rules of Combination:

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

B. Tech in Software Engineering is 480 credits, thus the normal full-time duration for the qualification is four years consisting of seven taught semesters and one professional practice in Computing or internship semester. A student who successfully completes the above specified four years qualification need to be awarded the qualification.

- The full semester internship module, called the Professional Practice module, may typically be done after the student has passed at least 240 credits worth of modules.

 BOTSWANA Qualifications Authority	BQA NCQF QUALIFICATION TEMPLATE	Document No.	DNCQF.P02.GD01
		Issue No.	01
		Effective Date	27.01.2021

- The credit combination for this qualification is from 165 fundamental components, 285 core components and the remaining 30 is from elective components

ASSESSMENT ARRANGEMENTS

This qualification is assessed and moderated as follows:

Formative Assessments – 40%

Summative Assessment – 60%

Project: Students need to do a project and submit their project work at the end of the qualification.

Professional Practice: All students will go through the work placement. Tutor assigned to student will visit the intern at workplace and do the evaluation. (15%). A second visit at the intern's place is conducted and evaluation is completed (15%). Supervisor evaluates the intern and submits a report to the tutor (20%). At the end of professional practice, the student will submit a project report (50%).

Pass requirements:


A learner passes a module if he/she obtains a final mark of 50% or more in the module. The final mark is constituted of the formative assessments (40%) and the summative assessment (60%). A learner qualifies for the B. Tech in Software Engineering degree on NCQF level 7 when he/she passed all required modules individually. The final mark for the qualification is calculated by averaging the marks obtained in the various modules. The student should complete 480 credits to complete the qualification.

MODERATION ARRANGEMENTS

Both internal and external moderation will be done in-line with the Moderation policy of the Institution.

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.

 BOTSWANA Qualifications Authority	BQA NCQF QUALIFICATION TEMPLATE	Document No.	DNCQF.P02.GD01
		Issue No.	01
		Effective Date	27.01.2021

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:

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.

RECOGNITION OF PRIOR LEARNING

Provision of RPL for award of the qualification will be in line with the National RPL policy.

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.

CREDIT ACCUMULATION AND TRANSFER

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

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.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Learning Pathway:

Vertical:

Completion of a Bachelor’s Degree in Software Engineering meets the requirement for admission to a Bachelor’s Degree Honors; Post-Graduate Diploma or Post-Graduate Certificate (NCQF level 8) in the same or a cognate field like:

Computer Science and Software Engineering
Computer Hardware and Software Engineering
Software Systems Development

Horizontal:

A B. Tech in Software Engineering graduate could continue to pursue a bachelor's degree in any other university in the Software Engineering specialized disciplines such as;

- BSc in Computer Science and Software Engineering
- BEng Computer Hardware and Software Engineering
- BSc in Software Systems Development

Employment Pathway:

- Analyst Programmers
- Software Developers
- Software Engineers
- Software Testers
- Web Developers
- Solutions Architects

QUALIFICATION AWARD AND CERTIFICATION

The candidate will be awarded a **Bachelor of Technology in Software Engineering** after attaining 480 credits as specified in the rules of combination and credit distribution.

REGIONAL AND INTERNATIONAL COMPARABILITY

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

Regional: No University in the region is offering this qualification.

 BOTSWANA Qualifications Authority	BQA NCQF QUALIFICATION TEMPLATE	Document No.	DNCQF.P02.GD01
		Issue No.	01
		Effective Date	27.01.2021

International:

National university of Singapore - Bachelor of Technology (Software Engineering)
 SRM University, India - Bachelor of Technology (Software Engineering)
 Jain (Deemed to be University), India - Bachelor of Technology (Software Engineering)

National university of Singapore - Bachelor of Technology (Software Engineering)


Both qualifications have many common modules such as: Software Project Management, Software Quality Control, Parallel and Distributed Software Engineering Professional, Ethical, and Social Issues in Computing, Discrete Structures, Calculus for Computing, Linear Algebra, Probability and Statistics, Introduction to Computing and Programming I, Introduction to Computing and Programming II, Software Requirements Analysis and Design and User Interface Design and Implementation. The proposed qualification has the following additional modules: Software Testing, Artificial intelligence, Programming using C++, Introduction to Java Programming and software development project.

SRM University- Bachelor of Technology (Software Engineering)

Both qualifications have many common modules such as: Programming using C++, Programming in Java, Software Project Management, Requirements Engineering and Software Quality Assurance, Software Engineering Principles, Software Maintenance and Administration, Software Verification And Validation and Software Architecture And Design. These modules are similar to the ones offered by this qualification. The proposed qualification has the following additional modules: Artificial intelligence, Web design development, Ethical, and Social Issues in Computing, Discrete Structures, Calculus for Computing, Linear Algebra, Probability and Statistics, Introduction to Computing and Programming I, Introduction to Computing and Programming II and software development project.

Jain (Deemed to be University)- Bachelor of Technology (Software Engineering)

Both qualifications have many common modules such as: Computer Networks, Software Engineering, Software testing, Software Project Management, Software Architecture and Design, HTML, CSS, and JAVA Script, Information Security, Artificial Intelligence. These modules are similar to the ones offered by this qualification. The proposed qualification has the following additional modules: Ethical, and Social Issues in Computing,

 BOTSWANA Qualifications Authority	BQA NCQF QUALIFICATION TEMPLATE	Document No.	DNCQF.P02.GD01
		Issue No.	01
		Effective Date	27.01.2021

Discrete Structures, Calculus for Computing, Linear Algebra, Probability and Statistics, Introduction to Computing and Programming I, Introduction to Computing and Programming II and Programming using C++.

The duration of all the above listed qualification is 4 years. The proposed qualification compares favourably with the other qualifications internationally in terms of purpose and content covered.

REVIEW PERIOD

5 Years

