QUALIFICATION SPECIFICATION SECTION A						
QUALIFICATION DEVELOPER	Limkokwing University of Creative Technology					
TITLE	Bachelor of Science in Software Engineering			**NCQF LEVEL**	7	
FIELD	Information and Communication Technology		**SUB-FIELD**	Software Engineering		
New qualification	√	Review of existing qualification				
SUB-FRAMEWORK	General Education		TVET		Higher Education	√
QUALIFICATION TYPE	Certificate		Diploma		Bachelor	√
	Bachelor Honours		Master		Doctor	
CREDIT VALUE	525					

1.0 RATIONALE AND PURPOSE OF THE QUALIFICATION

1.0 Rationale of the Qualification

The National Information and Communication Technology (ICT) policy, (Maitlamo Policy, 2007) provides Botswana with a clear and compelling roadmap that drives the social, economic, cultural and political transformation through planning and implementation of contextual and effective ICTs in terms of human resource development, infrastructural planning and utilisation. Therefore, the National ICT Policy's Vision is: "Botswana will be a globally-competitive, knowledge and information society where lasting improvements in social, economic and cultural development are achieved through effective use of ICT". Current critical ICT infrastructural set ups in execution are e-Government, e-Legislation, e-Education, e-Health, e-Commerce, e-Agriculture and e-Tourism. Based on the Maitlamo policy baseline study the following issues were noted as strategic lasting improvements to be constantly attended to:

The policy recommended that human skill development in evolving ICT skills like software engineering should be adopted with the intention of producing local ICT skills-set in software engineering that can deliver quality oriented, robust and rigours developed local software applications. This recommendation resulted from noting that "…Websites being introduced by Ministries are not designed around the needs of clients, have no common standards or "look and feel". The challenge of failing to implement an overarching e-Government strategy is the danger of creating "cyber stovepipes", wasting

money, increasing costs and missing opportunities for service improvements through Electronic Service Delivery" (Pg7). The Maitamo policy also advocated for skilling ICT graduates in relevant and emergent ICT skills than the generic ICT skills so that Botswana can achieve its long-term development goals in providing Software Engineering skills-sets that can implement the critical ICT infrastructural development for evolving ICT and emergent technologies. Information Technology graduates need the necessary skills to support and drive a knowledge-based economy and to create an information society, key determinants of economy diversification.

Botswana's Science and Technology policy (1998) was created to direct and monitor attainment of sustainable social and economic development through a coordinated and integrated application of science and technology. The BNSTR May 2009) reports explicitly stated that Botswana labour market "…were deemed in short supply of local ICT (software development, hardware development); database administrators, security specialists (ICT), forensic specialists (ICT), software developers, project managers (ICT) and system analysts…" The report further alluded to a global outlook projection of trends in ICT manpower developments on a global scale and intimated that "…Information and Communication Technology will be high on demand as the world moves towards a technology driven state, the primary industries of construction, mining and oil and gas will also see significant demand. Within ICT, software engineers and networking engineers are forecast to be of greatest demand…" Software engineering skills sets are appropriate skills to drive the Botswana government's effort to create Knowledge based economy, Information Society and diversification of the economy. The BNSTR May 2009 also reported that Batswana ICT graduates trained in local tertiary institutions lacked contemporary and relevant skills in emerging ICT technologies dubbed as "mismatch skills" between what the ICT industry expects and what the tertiary institutions produced. This phenomenon was attributed to "acquisition of inappropriate skills which has caused graduate unemployment in some ICT fields" and that the training accorded to ICT graduates was mainly based on generic ICT Qualifications. ICT projects planned and proposed by the Botswana national ICT policy and advocated by the Science and Technology policy require contemporary and specific skills for developing software applications for emerging ICT technologies.

In the NDP10, one key strategic plan adopted was to foster ICT as a tool for Botswana's economic diversification from non-renewable-resource driven economy to a knowledge driven economy. ICT integrations and adoption was an input from, Maitlamo Policy 2007 which advocated for e-governance and eventually creation of an information society. The NDP10 recognised the fact that "….ICT

(software development, hardware development); database administrators, security specialists (ICT), forensic specialists (ICT), software developers, project managers (ICT) and system analysts…" are the most critical ICT skills needed in the Botswana labour market (pg. 34). The report also forecast the growing demand for key expertise in ICT such as "software engineers and networking engineers" as both the developed and developing move towards technology driven economies. The Human Resource Development Council 2016 report also listed software developers and software engineers among the top occupations in high demand in Botswana. The notion of ICT rising demand was also part of the National Development Plan 11 which prioritised training of ICT personnel in order to enhance the sector's contribution to economic and export diversification. NDP11, emphasised the training of local software engineers who would create content and applications that are relevant to the Botswana market and facilitate the implementation of national programmes such as e-Government, e-Health, e-Education and e-Commerce. Software engineering skills are also needed in the development of the information systems architecture that will enable the government to provide E-Services as envisaged in the Botswana E-Government Policy 2011-2016.

Institutional consultations with the ICT industry, former and current students of the qualification identified the hard and soft skills needed in the industry. The industry needs graduates who have programming skills, software debugging skills, software documentation and testing skills, verbal and written communication skills, analytical and problem-solving skills, managerial skills, among others. Because software technology evolves rapidly graduates need to be lifelong learners who can combine technical expertise with context-sensitive soft skills in order to cope with complex situations in real life. The above show that there is need for Botswana's institutions of learning to develop software engineering qualifications that are closely aligned to the design, implementation and maintenance needs of the local, regional and global ICT industry.

1.2 Purpose of the Qualification:

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

- Create models for a given problem using analysis and design models.
- Develop a lifelong learning attitude towards the field of software engineering.
- Develop creative software applications to solve clients' problems.
- Display strong interpersonal and intrapersonal skills to enable them to work as members of a project team.

- Observe the ethical and professional codes of the industry.
- Possess critical thinking, problem-solving and analytical skills to execute tasks related to the application of software engineering techniques, theories, and methodologies.
- Assume responsibility and accountability for work done.

2.0 ENTRY REQUIREMENTS (including access and inclusion)

Minimum entry requirement for this qualification is a:

NCQF level 4, Certificate IV or equivalent, with a pass in English, Mathematics and a science subject

Recognition of Prior Learning (RPL):

There will be access through Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) in accordance with the RPL and CAT National Policies.

3.0 QUALIFICATION SPECIFICATION	SECTION B
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
3.1 Justify appropriate methods and approaches using SE principles for creating software-applications	3.1.1 Decide through research use of SE tools and techniques to be used for software application to be developed 3.1.2 Evaluate appropriate software methodologies to be used in developing complex software. 3.1.3 Compile a feasibility study for developing software application 3.1.4 Present a feasibility report for initiating a software development project to stakeholders. 3.1.5 Defend a software project for approval from sponsors and other stakeholders.
3.2 Create models for representing a solution based on the analysis of software requirements elicited	3.2.1 Interpret a given case study scenario with view to establish domain software requirements 3.2.2 Select relevant techniques for eliciting software functional requirements from domain stakeholders. 3.2.3 Elicit user requirements using appropriate theories of interaction with software users to derive software functional and nonfunctional requirements. 3.2.4 Construct relevant diagrams representing user functional requirements and models using relevant software modeling tools 3.2.5 Verify and authenticate both applicable functional and nonfunctional requirements using appropriate quantitative methods 3.2.6 Compile a typical Software Specification Document for purposes of initiating a software application with the sponsor
3.3 Develop Design models for implementing software	3.3.1 Construct various software designs based on the architecture of the software to be implemented

3.0 QUALIFICATION SPECIFICATION	SECTION B
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
applications in view of tradeoffs and design constraints.	3.3.2 Derive specific Input and output interfaces of the application software based on the functional requirements and validate through quantitative methods data handling requirements 3.3.3 Determine appropriate and relevant third party or middleware for interfacing the different components of the software application being developed. 3.3.4 Compose the software application architectural layout based on the software application functionality 3.3.5 Derive the physical specification for implementing information and data repository for the software application based on the data model defined.
3.4 Develop various components of the software applications systems-based design models.	3.4.1 Select appropriate and relevant tools and platforms for developing components of the applications software based on its functionality 3.4.2 Justify the use of development software platforms and other tools based on software engineering principles 3.4.3 Apply developed models and designed plans for developing components of the application software 3.4.4 Develop various units of the application software separate and designated groups. 3.4.5 Integrate to different developed components of the application software into one complete fully functional unit
3.5 Manage complex software development project by providing leadership and control to a project team	3.5.1 Evaluate different options of developing software through using SHELF software 3.5.2 Select relevant tools and methodologies for working in a multipurpose project 3.5.3 Generate possible and creative solutions by integrating various software components which include SHELF

3.0 QUALIFICATION SPECIFICATION	SECTION B
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
	software and developed software to realize application required in a multipurpose project 3.5.4 Analyze and create software patches for integrating two different software applications or reconfigure
3.6 Evaluate software quality using appropriate software measurement metrics to represent reliability and specification.	3.6.1 identify various software testing procedures and apply during the development of software i.e., Unit test, 3.6.2 Plan various software testing and reliability checks for validation and authenticating software functionality 3.6.3 Select appropriate software testing mechanism and tools 3.6.4 Document various results from generated data during application of particular software testing tool 3.6.5 Present results of the software testing and reliability checks done and discuss the implications and needed corrective action
3.7 Manage teams working on complex software engineering projects by providing leadership and control	3.7.1 Develop skills for listening and accommodate subordinate concerns 3.7.2 Participate in projects activities and fulfill the supervisory and monitoring roles to ensure project execution and completion 3.7.3 Call and chair meetings for discussing strategies, solutions, updates and development on software projects managements issues 3.7.4 Delegate and request for results in order to fulfill and execute projects tasks 3.7.5 Document, report and present project budgets, resources and proceeding and results to stakeholders using appropriate tools and techniques 3.7.6 Motivate members in the project by conducting fair practice and moral obligations in key functional project

3.0 QUALIFICATION SPECIFICATION	SECTION B
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
	processes like human resource, budgeting, and many others
3.8 Research through application of numerical and statistical knowledge for testing and improving the quality of developed software.	3.8.1 Approach problems and solve them through researching using appropriate and scientific technologies 3.8.2 Apply relevant research methodologies in conducting software engineering research to produce publishable research documents 3.8.3 Attend research conferences, workshop and seminars with a view to stay updated on latest technologies, theories and methodologies in software engineering and any other emerging technologies 3.8.4 Publish research articles on existing and emerging issues in software engineering in order to create new knowledge and to provide solutions to running problems
3.9 Communicate succinctly to a range of audiences about software technical issues and their solutions	3.9.1 Make oral and written presentations to colleagues and stakeholders 3.9.2 Documents any proceeding of software development using appropriate reporting format 3.9.3 Recognize different report formats for writing special documents like software requirements, software testing and reliability documents 3.9.4 Differentiate different tools for creating software project reports or documents as in Word Processors, Excel, Unified Modeling Language and PowerPoint, Project Management Software, Visio etc. 3.9.5 Present findings and observation to public gathering or one to one basis using appropriate tools for presentation. 3.9.6 Practice continuously both techniques of inter and intra personal communication skills to avoid misrepresentation and wrong conceptualization of discussions

3.0 QUALIFICATION SPECIFICATION	SECTION B
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
3.10 Manage one's own learning and professional development for purposes of lifelong learning	3.10.1 Identify one's areas of weakness which need strengthening through staff development 3.10.2 Participate in software engineering communities through social media platforms blog and present one's reflection and perception of issues related to software engineering 3.10.3 Collaborate with fellow software engineering experts from different organizations to share knowledge 3.10.4 Subscribe to professional bodies of software engineering
3.11 Observe professional, ethical and cultural codes of conduct in developing software-based applications	3.11.1 Practice principles and values of empathy in a software engineering community or in user domain 3.11.2 Apply principles of ethical and professional practice in conducting software engineering activities in particularly when dealing with different clients 3.11.3 Respect cultural norms of various eco systems related to area of occupation and location 3.11.4 Abide to legal statutes to guide the operations and conduct of software engineering duties in any given context. 3.11.5 Honor working relationships od subordinates and superiors to maintain good working relationships in any give working environment

QUALIFICATION STRUCTURE SECTION C			
	Module Title	**Level**	**Credits**
FUNDAMENTAL COMPONENT Subjects / Units / Modules /Courses	Probability & Statistics	7	10
	Computerized Mathematics	5	10
	Creative and Innovation Studies	5	10
	Business Communication	5	10
	Entrepreneurship	7	10
	Fundamentals of Design	5	10
	Research Methodology	7	10
CORE COMPONENT Subjects / Units / Modules /Courses	Object Oriented Techniques	6	10
	Advanced Object-Oriented Programming	7	15
	Principles of Programming logic and Design	5	10
	Fundamentals of Computer Systems	6	10
	Introduction to Data Communication	6	10
	Interactive Multimedia	7	15
	Introduction to Database	6	15
	Computer Graphics	7	10
	Database System	7	15
	Introduction to Object Oriented Programming	5	15
	Data Communication & Networking	7	15
	Human Computer Interaction	6	10
	Machine learning	7	10
	Operating Systems	7	10
	Web Design and Multimedia	6	15
	Web Programming Techniques	6	15
	Engineering Foundations for Software	6	10
	Discrete Structures	7	10
	Formal Methods	7	10
	Data Structures & Algorithms	6	10
	Industrial Attachment	7	30
	Introduction to Computer Skills	5	10

	Practical Project	7	30
	Ethics & Professional Conduct + IT Law	7	10
	Systems Analysis and Design	6	10
	Software Requirements Engineering	6	10
	Software Design	7	10
	Software Testing and Reliability	7	10
	Principles of Software Engineering	5	10
	Software Development Methodologies	6	10
	Software Change Management	8	10
	Advanced Software Engineering	8	10
	Software Project Management	7	10
	Software Quality Engineering	8	10
	Information Security	7	10
	Computer and network security	7	10
ELECTIVE COMPONENT Subjects / Units / Modules /Courses **(Select 1)**	Design and Implementation of Mobile Systems	8	15
	Virtual Reality	8	15
	Multimedia and Hypermedia Systems	8	15
	Software Agents	8	15
	Character Animation	8	15

Rules of combinations, Credit distribution (where applicable):

Below shows module distribution in relation to fundamental component, core component and elective component. Students are to choose 1 subject out of the set of electives. The total number of credits required for a student to graduate in this qualification is **525** credits including 15 credits from elective modules.

Level	Total no of credits
5	85
6	145
7	250
8	45
Total	**525**

4.0 ASSESSMENT AND MODERATION ARRANGEMENTS

FORMATIVE ASSESSMENT 60%)

The contribution of formative assessment to the final grade shall be **60%**

SUMMATIVE ASSESSMENT (40%)

The contribution of summative assessment to the final grade shall be **40%**

MODERATION ARRANGEMENTS.

Internal and external moderators to be engaged will be BQA accredited subject specialists in relevant fields with relevant industry experience and academic qualifications.

Both internal and external moderation shall be done in accordance with applicable policies and regulations.

5.0 RECOGNITION OF PRIOR LEARNING

There shall be provision for award of the qualification through Recognition of Prior Learning (RPL) in accordance with institutional Policies in line with the National RPL Policy.

Candidates may submit evidence of credits accumulated in related qualification in order to be credited for the qualification they are applying for.

6.0 PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal Articulation

Bachelor of Science in Computer Science
Bachelor of Science in Computer Engineering
Bachelor of Science in Business Information Technology
Bachelor of Science in Business Information Systems
Bachelor of Science in Telecommunications

Diagonal Articulation

Bachelor of Science Electrical Engineering
Bachelor of Science Electronics Engineering
Bachelor of Science Telecommunications

Vertical Articulation

Master of Science Software Engineering

Master of Science Computer Science

Employment Pathways

Graduates of the course may find employment in a range of public and private organisations for the following posts:

- Software Engineer
- Software Technician
- Software Qualification
- Software Architect
- Software Project Manager
- Software Analyst
- Web Site Master
- Software Test Engineer
- Mobile App Developer
- Information Security
- Database developer
- Software Quality Assurance Engineer
- Information Technologist Support Specialist
- Research Scientist
- Information Technologist Educator

QUALIFICATION AWARD AND CERTIFICATION

For a Candidate to achieve this qualification they must have acquired a minimum of **525** credits. The Candidate should pass all the **FUNDAMENTAL, CORE, and ONE ELECTIVE** module.

Certification

A **Bachelor of Science in Software Engineering** will be awarded to a Candidate upon completion of the qualification in accordance with applicable policies. A certificate and transcript will be issued at award.

Criteria	**University of Salford Manchester**	**University of RMIT Australia**	**University of Canterbury**
Country	United Kingdom	Australia	New Zealand
Title of Qualification	BSc in Software Engineering	BSc in Software Engineering	BSc in Software Engineering
NQF Level & Credit Values	▪ 460 Credits	▪ 336 Credits	▪ 480 credits
Main Exit Learning Outcomes	The qualification is outcome based. Places more emphasis on knowledge, skills and competencies software engineering, computers and essentials,	The qualification is outcome based. Places more emphasis on knowledge, skills and competencies software engineering, computers and essentials, professional practice and	The qualification is outcome based. Places more emphasis on knowledge, skills and competencies software engineering, computers and essentials, professional practice and

	professional practice and mathematics and engineering research	mathematics and engineering research	mathematics and engineering research
Domains Covered & Credit Weight	▪ Software Eng. -110cr ▪ Computer Essentials – 40cr ▪ Application Domain - 60cr ▪ Professional Practice - 30cr	▪ Software Eng. - 120cr ▪ Computer Essentials – 120cr ▪ Maths and Eng.–12cr ▪ Professional Practice - 84cr	▪ Software Eng. - 120cr ▪ Computer Essentials – 120cr ▪ Application Domain - 60cr ▪ Maths and Eng. – 60cr ▪ Professional Practice - 20cr
Assessment Strategies	▪ Examinations ▪ Assignments ▪ Practical tests ▪ Projects ▪ Software development tasks	▪ Examinations ▪ Assignments ▪ Practical tests ▪ Projects ▪ Software development tasks	▪ Examinations ▪ Assignments ▪ Practical tests ▪ Projects ▪ Software development tasks
Employment Pathways	▪ Software Programmer ▪ Software developer ▪ System administrators	▪ Software Test Engineer ▪ Software Analyst ▪ Software Developer	▪ Software Test Engineer ▪ Software Analyst ▪ Software Developer

Source –URL	▪ Computer analysts	▪ Mobile App Developer ▪ Information Security ▪ Database programmer	▪ Mobile App Developer ▪ Information Security ▪ Database programmer
	https://www.firstyearmatters.info/ps/SE2018.html	https://www.rmit.edu.au/study-with-us/levels-of-study/undergraduate-study/bachelor-degrees/bachelor-of-software-engineering-bp096	https://resources.sei.cmu.edu/asset_files/TechnicalReport/1990_005_001_15839.pdf

Introductory Statement	**Uganda Technology and Management University**
Title of Qualification	BSc Software Engineering
NQF Level & Credit Values	▪ General Degree ▪ 155 Credits
Main Exit Learning Outcomes	Not Given

		computers and essentials, professional practice and mathematics and engineering
Domains Covered & Credit Weight	▪ Software Eng. - 31cr ▪ Computer Essentials – 51cr ▪ Application Domain - 25cr ▪ Maths and Eng. – 35cr ▪ Professional Practice - 32cr	▪ Software Eng. - 15cr ▪ Computer Essentials – 73cr ▪ Application Domain - 15cr ▪ Maths and Eng. – 7cr ▪ Professional Practice - 11cr
Assessment Strategies	Not Given	▪ Written examinations ▪ Practical examinations ▪ Continuous assessment-assignments, labs, ▪ Seminar evaluation ▪ Midterm test ▪ Case Studies ▪ Project works
Source –URL	Compared Modules/Bachelor of Science in Software Engineering - Uganda Technology And Management University.html	www.utm.ac.mu/files/sthug/Qualifications/site/UG%202015/.../BSEv6_1.pdf

10.1. Comparability and Articulation of The Proposed Qualification with the ones Examined

10.1.1. Regional comparability : Similarity, Differences , Portability and Generalisation

Similarities

- All qualification emphasizes on professional practice to ensure development of competencies.
- All qualifications also offer electives as areas of further specialization in the qualifications, i.e. applied domain.
- All qualifications cover almost all knowledge areas in the domain of Software Engineering.
- Majority of the qualifications are learning outcome and minor are objective based.

Differences

- Not all software engineering qualification use the notional 10 hour learning.
- The total credits awarded at the completion of the qualification are different.

Contextualization

The qualification is contextualised by benchmarking the areas stated above and as follows

- The National Qualification Level shall be BQA NCQF Level 7 and being general degree like many regional qualifications stated.
- The qualifications software engineering shall also adopt elective as means of co-opting specialization according to a majority of the universities.
- The qualification software engineering shall put emphasis on professional practice to build competency through internship attachment, practical final year project and ensuring practical assessments in all practical modules.
- The qualification shall adopt the qualifications learning outcome like a majority of the universities and this in line with the BQA NCQF.

Portability and Generalisation

The qualification based on the similarities and minor differences determined it is portable and generalizable within the regional Universities. In addition, the modules specified in the qualifications for the domain software engineering fall along the same guidelines and compliance according to the IEEE Computer Society and Association Computer Machinery guidelines on developing curriculum for Software Engineering Undergraduates. This also adds to the level of standardization and genera ability of the qualification software engineering.

10.1.2. International comparability: Similarity, Differences, Portability and Generalisation.

Similarities

- All qualification emphasizes on professional practice to ensure development of competencies.
- All qualifications also offer electives as areas of further specialization in the qualifications, i.e. applied domain.
-
- All qualifications cover almost all knowledge areas in the domain of Software Engineering
- Majority of qualifications use the learning outcome based approach
- Similar assessment strategies are used amongst all software engineering qualifications from the international universities
- Majority of international universities have allocated more credits to the software engineering domain

Differences

- Not all software engineering qualification use the notional 10 hour learning to calculate credits
- The total credits awarded at the completion of the qualification are different because of the credit framework used

Contextualization

The qualification is contextualised by benchmarking the areas stated above and as follows

- The National Qualification Level shall be BQA NCQF Level 7 and being a general degree like many regional qualifications stated
- The qualifications software engineering shall also adopt elective as means of co-opting specialisation according to a majority of the universities
- The qualification software engineering shall put emphasis on professional practice to build competency through internship attachment, practical final year project and ensuring practical assessments in all practical modules
- The qualification shall adopt the qualifications learning outcome like a majority of the universities and this in line with the BQA NCQF.

Portability and Generalisation

The qualification based on the similarities and minor differences determined it is portable and generalizable within the international Universities. In addition, the modules specified in the qualifications for the domain software engineering fall along the same guidelines and compliance according to the IEEE Computer Society and Association Computer Machinery guidelines on developing curriculum for Software

Engineering Undergraduates. This also adds to the level of standardization and genera ability of the qualification software engineering.
REVIEW PERIOD
Every 5 years.