SECTION A:	QUALIFICATION DETAILS														
QUALIFICATION DEVELOPER (S)	Department of Teacher Training and Technical Education (TT & TE)														
TITLE	Diploma in Science Laboratory Technology												**NCQF LEVEL**	6	
FIELD	Manufacturing, Engineering & Technology		**SUB-FIELD**	Science Laboratory Technology									**CREDIT VALUE**	360	
New Qualification		✓	Review of Existing Qualification												
SUB-FRAMEWORK	General Education		TVET		✓	Higher Education									
QUALIFICATION TYPE	Certificate	I		II		III		I V		V	✓	Diploma		Bachelor	
	Bachelor Honours			Post Graduate Certificate								Post Graduate Diploma			
	Masters			Doctorate/ PhD											

RATIONALE AND PURPOSE OF THE QUALIFICATION

RATIONALE:

Sub field of Science Laboratory Technology has been identified as one of the occupations in high demand as outlines in the occupation Code No. 3212, 3116 among others (HRDC report, 2019). This is based on the Labour Market Analysis conducted by the HRDC.

Prioritization of occupations in demand is informed by national priorities as outlined in the VISION 2036(page 17), National Development Plan (NDP 11, page 71) and long-term strategies of the different sectors of the economy. Development of the human capital is essential in achieving the VISION 2036.

The HRDC document (page 9) outlines the Priority Skills and Development Trends. It states that Medical Laboratory Scientists, Instrumentation Technicians, Chemical Technicians Science and Technology Researchers and related Workers have been identified as one of the top priority occupations in demand. Occupations in high demand are occupations that are currently experiencing shortages in the labour market (short term) and occupations that show relatively strong employment growth (long term). Further support for the need for technician cadres in natural sciences was reflected in the Botswana Institute for Development Policy Analysis (BIDPA 2001). The BIDPA National Manpower Projections report, 2001 has listed several areas in science where more training is necessary:

Core to the development of this qualification is to bring out the culture of professionalism and service excellence in the laboratory science technology cadre. The skills that the Candidates will acquire on completion of this qualification will enable them to make an effective contribution to the laboratory science technology space. The qualification will give the Candidates a wide range of knowledge and skills to match the needs of the Candidates, Employers, and the science laboratory technology industry as a whole

PURPOSE:

The purpose of this qualification is to produce Scientific laboratory technicians' graduate with advanced technical knowledge, skills, and competencies to

- Perform laboratory tests to produce reliable and precise data to support scientific investigations
- Follow strict safety procedures and safety checks in preparation of specimens and samples for laboratory analysis
- Construct, maintain and operate standard laboratory equipment.
- Ensure the laboratory is well-stocked and resourced and that everything is clearly and correctly

ENTRY REQUIREMENTS (including access and inclusion)

Minimum entry requirement for this qualification is a:

- Certificate IV, NCQF level 4 (TVET/ HE) or equivalent
- Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer Policies of the ETP, which are aligned to National/ BQA policies will apply for admission

SECTION B QUALIFICATION SPECIFICATION	
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
LO 1 Manage safety, health, and environment and quality issues in the laboratory.	1.1 Ensure availability of safety equipment in the laboratory. 1.2 Prepare manuals as per the organisations 'requirements. 1.3 Equip first aid kit as per international best practices. 1.4 Ensure accessibility of first aid kit to all lab users. 1.5 Ensure availability of material safety data sheet (MSDS) for all materials. 1.6 Coordinate training on safety to all laboratory users. 1.7 Take stock of health and safety risks in the lab. 1.8 Implement mitigation strategies for all risks identified.
LO 2 Demonstrate the knowledge and practical skills for chemical nomenclature, classification of chemicals, location, chemical inventory system and design and function of a chemical store	2.1 Take stock of environmental risks in a laboratory. 2.2 Implement mitigation steps of environmental risks in a Laboratory. 2.3 Identify structural faults or defects of a chemical store. 2.4 Monitor maintenance of a chemical store. 2.5 Maintain labelling in a chemical store as per recommended laboratory standards. 2.6 Maintain proper storage in a chemical store as per recommended laboratory standards. 2.7 Maintain credibility of samples in a storeroom. 2.8 Monitor adherence to safe laboratory practices.

LO 3 Employ key instrument maintenance techniques**.**	3.1 Prepare standard operating procedures (SOS) of Instruments. 3.2 Monitor maintenance plan of instruments. 3.3 Maintain logbook of instruments. 3.4 Calibrate equipment in a laboratory. 3.5 Verify equipment in a laboratory. 3.6 Perform minor maintenance of laboratory instruments. 3.7 Maintain equipment records in a laboratory. 3.8 Analyse measurements and estimate uncertainties of instruments.
LO 4 Apply skills of purchasing, stock keeping of equipment and the procedure for disposal of assets and discuss quality control and assurance in laboratories.	4.1 Take stock of resources in a laboratory. 4.2 Manage stock level in a laboratory. 4.3 Procure laboratory supplies. 4.4 Maintain records of laboratory resources.
LO 5 Demonstrate sample management techniques.	5.1 Prepare for sampling of customers/clients 5.2 Prepare sampling materials and equipment of customers 5.3 Collect samples for sampling analysis 5.4 Document sample information for laboratory analysis 5.5 Package the samples in preparation for laboratory analysis 5.6 Maintain credibility of samples post analysis 5.7 Educate the public on sample handling 5.8 Receive samples from customers for analysis

LO 6 Demonstrate the skills for managing a laboratory session in a training laboratory.	6.1 Demonstrate familiarization with laboratory protocol basing on standards 6.2 Plan a laboratory session as per specified standards 6.3 Prepare reagents and solution as required for laboratory sessions 6.4 Set up apparatus, equipment, and materials in preparation for a laboratory session 6.5 Perform a laboratory pre-run as related to laboratory session 6.6 Perform the laboratory session as per standards
LO 7 Carry out sample analysis as per client`s requirement and prescribed standards	7.1 Prepare reagents and solutions based on standards 7.2 Weigh samples according to laboratory standard 7.3 Treat samples for laboratory use according to standards 7.4 Prepare materials, apparatus, and equipment for laboratory use 7.5 Perform analysis of samples as per laboratory standards 7.6 Employ quality control measures in laboratory practice 7.7 Report results of the laboratory
LO 8 Demonstrate Supervisory skills of subordinates to ensure proper administration of the laboratory	8.1 Induct staff on laboratory protocols 8.2 Assign duties to laboratory staff members 8.3 Review Performance of laboratory staff members 8.4 Reward performance of laboratory staff members 8.5 Support low performer amongst laboratory staff members

	8.6 Support management for complete organisational mandate fulfilment 8.7 Support staff welfare programmes for complete organisational mandate fulfilment
LO 9 Demonstrate effective communication, entrepreneurial, research skills, health and safety practices and display professionalism and good work ethics	9.1 Prepare for business using the specified standards 9.2. Sell the goods and services to show skills of running a business 9.3 Evaluate business operation by reviewing the trade history 9.4. Demonstrate mastery of the interview process 9.5. Conduct a formal meeting with laboratory personnel 9.6 Produce an Investigative Report to demonstrate mastery of report writing 9.7. Maintain housekeeping including management waste disposal in laboratory environment. 9.8. Adhere to safety rules and regulations of the laboratory environment. 9.9. Carry out fire drills and apply first Aid for laboratory staff and customers.
LO 10 Demonstrate knowledge and practical skills for biochemical analysis of biological molecules.	10.1 Perform biochemical analysis tests and procedures of carbohydrates, lipids, and proteins as per laboratory standards. 10.2 Carry out Qualitative Tests for Carbohydrates using Fehling's test, benedict's test, Iodine Test using the standard procedures. 10.3 Qualitative Test for the Presence of Fatty Acids by Titrimetric Method. 10.4 Qualitative Tests for Proteins by nitrogen estimation using Micro-Kjeldahl Method.

LO 11 Demonstrate knowledge and practical skills for cell biology lab and DNA manipulation techniques.	11.1 Prepare animal and plant material for display. 11.2 Perform molecular biology tests and procedures as per laboratory standards. 11.3 Perform DNA manipulation techniques according to laboratory standards.
LO 12 Demonstrate knowledge and practical skills for manipulating microbes in a food and water analysis laboratory.	12.1 Control microbial population in biological samples 12.2 Perform food analyses as per customers' requirements 12.4 determine Microbial composition of aquatic habitats and water analysis in laboratory samples
LO 13 Demonstrate foundational knowledge in microbiology and basic practical concepts and skills for the bacteriology lab.	13.1 Prepare culture media according to laboratory standards 13.2 Perform aseptic techniques in laboratory standards 13.3 Perform microscopic examination of samples provided by customers for analysis 13.4 Prepare trial batches for evaluation according to laboratory standards
LO 14 Demonstrate skills to perform basic Instrument chemical analysis using ultraviolet, visible, and infrared spectroscopy, atomic emission spectroscopy, atomic absorption spectroscopy and chromatography.	14.1 Demonstrate skills in sample handling in preparation for analysis 14.2 Apply complex instrumental techniques of ultraviolet, visible, infrared, atomic emission, and atomic absorption spectroscopy 14.3 Apply routine spectrometric techniques in sample analysis

	14.4 Apply routine chromatographic techniques in sample analysis
LO 15 Demonstrate knowledge of key electronics and instrumentation concepts required for the development of electronics laboratory skills	15.1 Use laboratory application software as required for the development laboratory skills of electronics 15.2 Apply complex instrumental techniques according to standard operating procedures for an instrument 15.3 Apply routine electrometric techniques according to standard operating procedures for an instrument.
LO 16 Apply basic science concepts required for the manipulation of laboratory procedures	16.1 Perform physical and mechanical tests as necessary in a laboratory 16.2 Perform biological procedures as necessary in a laboratory 16.3 Perform chemical tests and procedures as necessary in a laboratory
LO 17 Demonstrate skills to perform basic scientific glasswork and repairs to glass apparatus using simple glassblowing equipment	17.1 Prepare for hand glass blowing process as required for repairs to glass apparatus using simple glassblowing equipment. 17.2 Perform sequence of operations for hand glass blowing glasswork procedure. 17.3 Apply annealing procedures

SECTION C	QUALIFICATION STRUCTURE				
FUNDAMENTAL COMPONENT Subjects/ Courses/ Modules/Units	**TITLE**	**Credits Per Relevant NCQF Level**			**Total (Per** Subject/ Course/ Module/ Units)
		Level [5]	**Level [6]**	**Level [7]**	
	Work Placement	20	40		60.0
	Entrepreneurship	8			8.0
	Numeracy 3		6		6.0
	Project Management		10		10.0
	Integrated Project	20			20.0
	Supervisory Skills		10		10.0
	Work Ethics and Professionalism		6		6.0
	Safety Health environment and quality	4			4.0
	Research skills		8		8.0
	Communication skills 2	8			8.0
	TOTAL FUNDAMENTAL COMPONENT				**140**
CORE COMPONENT Subjects/Courses/ Modules/Units	General Physics Laboratory Skills	6			6.0
	Analytical and Preparative Chemistry	6			6.0
	Fundamentals of Microbiology	6			6.0
	General Chemistry Laboratory Skills	12			12.0
	Laboratory Equipment Maintenance	8			8.0
	Fundamentals of Biology	8			8.0

	Fundamentals of Physics	6			6.0
	Industrial attachment 1	20			20.0
	Fundamentals of chemistry	6			6.0
	Chemical Safety and Management		6		6.0
	Electronics and Instrumentation		12		12
	Food and Aquatic Microbiology		6		6.0
	Sampling Management and Analysis		8		8.0
	Mathematics for science	6			6.0
	Management of Science Laboratory		8		8.0
	Instrumental Analysis		8		8.0
	Cell and Molecular Biology		6		6.0
	Safety, Health and Environment 2		6		6.0
	Industrial Attachment 2		10		10.0
	Industrial Attachment 3		30		30.0
	Research Project		20		20.0
	Glass Blowing	4			4.0
	Laboratory Session Management		6		6.0
	Analytical Biochemistry		6		6.0
	TOTAL CORE COMPONENT				**220**
ELECTIVE/ OPTIONAL COMPONENT Subjects/Courses/ Modules/Units	N/A				

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	**Credit Value**
Level 5	140
Level 6	220
TOTAL CREDITS	**360**

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

The rules of combination for this qualification are defined below and cover the minimum and maximum credit values required to be accumulated, along with details of any mandatory units.

- The Fundamental Component consists of modules/units to the value of **140 credits** all of which are compulsory
- The Core Component consists of modules/units to the value of **220 credits** all of which are compulsory

ASSESSMENT ARRANGEMENTS
There will be **ASSESSMENT** administered for the candidates to satisfy the qualification according to set National Assessment Policy. Formative assessment will contribute 60% and Summative assessment 40% of the total weightings of the assessment
MODERATION ARRANGEMENTS
BQA registered and Accredited Assessors and Moderators will be engaged for the process of Assessing the candidates and moderators for the moderation of the assessments.
RECOGNITION OF PRIOR LEARNING
Recognition of Prior Learning (RPL) Policy shall be applicable for learners with requisite knowledge, skills, and competence gained in an informal or non-formal learning setup to gain part or whole credits towards the qualification.
CREDIT ACCUMULATION AND TRANSFER
Candidates may submit evidence of credits accumulated in related qualification in order to gain part or whole credits towards the qualification.
PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)
LEARNING PATHWAYS **Horizontal and/or Diagonal Articulation (related qualifications of similar level that graduates may consider)** - Diploma in Forensics - Diploma in microbiology

- Diploma in Instrumentation
- Diploma in Analytical chemistry
- Diploma in Foods Biotechnology

Vertical Articulation (qualifications to which the holder may progress to)

- Bachelor of Science in lab technology
- Bachelor of Science in Forensics
- Bachelor of Science in microbiology
- Bachelor of Science in Instrumentation
- Bachelor of Science in Analytical chemistry
- Bachelor of Science in Foods Biotechnology

EMPLOYMENT PATHWAYS

On successful completion of this qualification the holder may be absorbed in the job market as:

- Production laboratory
- Teaching laboratory
- Quality laboratory
- Testing laboratory
- Research laboratory
- Calibration laboratory

QUALIFICATION AWARD AND CERTIFICATION

For a Candidate to achieve this qualification they must have acquired a minimum of **360** credits.

Certification

A certificate will be awarded to a Candidate upon completion of the qualification in accordance with applicable policies.

A Candidate will be awarded a Diploma in Science Laboratory Technology

REGIONAL AND INTERNATIONAL COMPARABILITY

REGIONAL

Regionally, South Africa South African Qualifications Authority (SAQA) was used for comparability.

Qualification Benchmarked Against

South African Qualifications Authority (SAQA)

National Diploma Biomedical Technology

Credit Value: 360

Similarities

The similarities are that both qualifications are offering exit outcomes that train graduates to Science Laboratory technology who can work in any laboratory environment. The Botswana Science laboratory technology is at level 6 whilst the National Diploma Biomedical Technology of South Africa is at level 6 (therefore the qualifications are at the same level).

The differences are minor on the exit learning outcomes qualification developer came out with 17 exit outcomes whilst National Diploma Biomedical Technology came out with 12 exit learning outcomes. The differences may be because South African Qualifications Authority (SAQA) qualification combined some of their learning outcomes. However, both students will be able to fulfil the requirements of working in a

laboratory. The National Diploma Biomedical Technology is more skewed to medical laboratory technology, whilst the Science laboratory Technology is developed focusing on a general science laboratory.

The similarity of the selected Institution, compared to the proposed qualifications are components or courses making up the course structures. Both qualifications include a module in communications, marketing, ICT and financial awareness to equip the candidates with the soft skills. Both test / assess for theory and practical examination. The career path for graduates is also the same (Laboratory technicians who can work in any competitive laboratory environment like hospitals, educational institutions, food industries, oil companies, breweries, petrochemical industries, pharmaceutical companies, Agro-based industries and more)

Differences

The difference is the duration of the qualification. The proposed qualification is a 3-year diploma whereas the regional ones are 2-year programmes with similar courses. The other difference is the number of modules offered. The South Africa qualification has electives while the proposed qualification has no electives.

INTERNATIONAL

Internationally, Australia (Australian National Training Authority, ANTA), Institutions were used for comparability

Qualifications Benchmarked Against

1. Australia National Training Authority (ANTA), TAFE

Diploma of Laboratory Technology (MSL50118)

Credit Value: 240

Both qualifications have -process and interpret data, use laboratory application software, analyze data and report results, maintain and calibrate instruments and equipment, monitor the quality of test results and data- making up the structure are similar although named differently. The modules are semesterized with some being electives while some are compulsory modules. The two qualifications offer professional practice (attachment) and a research project. The career path for graduates is also the same (laboratory technicians who can work in any competitive environment). This Diploma of Laboratory Technology (MSL50118) is at level 6 whilst the Science Laboratory technology is at level 6, in relation to Botswana NCQF level descriptor. There is a difference in the weighting of the qualifications Australia is 240 and Botswana is 360. The difference is the duration of the

qualification. The proposed qualification is a 3-year diploma whereas the Australian one is 2-year programmes with similar courses. The other difference is the number of modules offered. The Australian qualification have electives while the proposed qualification has no electives. The similarities are that the Awarding bodies observe RPL through instructor approval and relevant work experience. The career path for graduates is also the same (Laboratory technicians who can work in any competitive laboratory environment like hospitals, educational institutions, food industries, oil companies, breweries, petrochemical industries, pharmaceutical companies, Agro-based industries and more)

REVIEW PERIOD

The qualification will be reviewed every five years.