SECTION A:	***QUALIFICATION DETAILS***																	
QUALIFICATION DEVELOPER (S)	University of Botswana																	
TITLE	Bachelor of Science (Physics with Meteorology)															***NCQF LEVEL***	7	
FIELD	Natural, Mathematical and Life Sciences			***SUB-FIELD***	Meteorology											***CREDIT VALUE***	500	
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:

Life on our planet, and the society in general, depend critically on the dynamical processes in the atmosphere which ultimately inform the availability, or otherwise, of resources like air and water. With the recent attention to global warming and climate change, there has been an unprecedented awareness in the future of these natural resources. It is common knowledge that many of the human conflicts and tragedies in Africa are related to the sharing of natural resources. Pillar 3 of Botswana Vision 2036 recognizes the need for sustainability of these natural resources and its potential to uplift the livelihood of her citizens.

The sustainability of these natural resources requires scientific skills in understanding the physical processes in the atmosphere, which inform our weather and, ultimately, climate on Earth. These skills are in very short

supply in the developing countries of the world especially, in Botswana. It is largely due to this dearth of expertise that limits the participation of scientists from developing countries in international affairs like the Inter-governmental Panel on Climate Change (IPCC). Shortage of manpower also impact the contributions from developing countries when the World assembles under the banner of the United Nations Framework Convention on Climate Change (UNFCCC).

Until very recently, the country of Botswana has been developing skills in the understanding of the physical processes in the atmosphere (a.k.a Meteorology) by sending her citizens for training in institutions all over the world where such opportunities are available. The need and demand for local expertise in Meteorology informed the establishment of a Physics-with-Meteorology qualification at the University of Botswana; knowing full well that the foundation of Meteorology is Physics. The proposed qualification has economic benefits as training personnel locally would reduce training costs hence channel the surplus capital to other critical sectors of the economy. Furthermore, huge economic losses due to crop damage by extreme weather events could be prevented by training more personnel in areas like meteorology and related fields like agrometeorology who could give timely and well-informed advisories to the public and relevant stakeholders.

The qualification aims to produce graduates that fit in various multidisciplinary work environments at national, regional and global levels. The proposed qualification is a response to growing demands for agrometeorologists, climatologists, weather forecasters, and automatic weather station technologists in the country. The Human Resources Development Council (HRDC, 2016) has identified agricultural climatologist as an occupation in high demand. Therefore, the qualification produces graduates in line with HRDC priority occupations.

With the envisaged development of a critical mass of expertise in the discipline, Botswana will be able to fill its quota in United Nations Organizations like the World Meteorological Organization (WMO), United Nations Environment Programme (UNEP), United Nations HABITAT, UNFCCC, IPCC etc., and participate meaningfully at international level. Furthermore, knowledge on the trend of the physical processes in the atmosphere will enable a country like Botswana predict future trends of natural parameters, like precipitation and temperature, in manners that will enhance national policies on adaptation and mitigation for agricultural purposes in a semi-arid environment.

PURPOSE:

The purpose of the qualification is to build the necessary knowledge, understanding, abilities and skills required for further learning towards becoming a competent meteorologist. The recognized purpose of this bachelor's degree in physics-with-meteorology is to equip graduates with knowledge, competence, and skills to:

- Develop strategies for extreme weather events and offering advice before the onset.
- Carry out risk assessment, vulnerability analysis and exploration of effects of weather disasters to effectively provide capacity building and support to relevant stakeholders.
- Promote preparedness, risk reduction and management towards hazardous weather and related disasters.
- Contribute to the knowledge based economy and national development in meteorology and related areas.

ENTRY REQUIREMENTS (including access and inclusion)

i. Candidates must have successfully completed certificate NCQF level 4 (General Education or TVET).

OR

ii. Special Entry: Candidates who do not meet the minimum academic qualifications stated above will be considered through a Recognition of Prior Learning (RPL) process which shall be administered according to the National RPL Policy. Furthermore, there will be a provision for Credit Accumulation Transfer to the learner in case they transfer from another comparable institution as per the National Policy on Cat.

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SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
3.1 Demonstrate knowledge of physical processes in the atmosphere.	3.1.1 Contribute to national policy processes on issues related to climate change. 3.1.2 Apply knowledge and skills to sift through the maze of atmospheric data to determine which ones are relevant to country situations. 3.1.3 Demonstrate understanding and skill in interpreting global climate data for early warning expertise in case of natural disasters.
3.2 Carry out weather and climate forecasting for the benefit of the whole strata of society.	3.2.1 Analyse climatic data to forecast extreme events like floods, heat waves etc. for the benefit of investors and practitioners in finance, agriculture and recreational (sports) sectors of the economy. 3.2.2 Plan how to prepare and recover from a wide variety of extreme weather hazards and assess the need to take proper actions from future threats 3.2.3 Provide forecasting skills to non-professionals in climate-related studies. 3.2.4 Recommend ways to deal with harsh climatic conditions affecting animals, plants, infrastructure, and humans.
3.3 Analyse meteorological concepts, theories, and issues of education policy in a systematic way.	3.3.1 Apply meteorological concepts and theories to facilitate learning in related areas at the secondary schools. 3.3.2 Integrate knowledge in meteorology into the learning curricula of other disciplines.

	3.3.3 Contribute to curriculum reviews at the primary and secondary levels of education on issues related to climate.
3.4 Conduct research or inquiry related to climate studies.	3.4.1 Justify the importance of research in climate-related studies. 3.4.2 Identify specific research problem. 3.4.3 Generate different research designs. 3.4.4 Apply relevant ethics of conducting climate related research. 3.4.5 Compile a literature review based on the research problem. 3.4.6 Collect scientific research data. 3.4.7 Interpret scientific theories, models, and results within the field of atmospheric or related studies. 3.4.8 Report on small-scale research in a systematic, professional, and academically appropriate way. 3.4.9 Use statistical and mathematical methods or modelling software for data analysis 3.4.10 Illustrate scientific parlances in atmospheric physical processes in simple form for the benefit of non-professionals. 3.4.11 Present climate-related data in comprehensible language and form to policymakers and stakeholders.
3.5 Demonstrate the knowledge of global social, economic, and political issues in relation to Climate change.	3.5.1 Sensitize political leadership on the potentials of human conflict and tragedies that are rooted in climate change. 3.5.2 Provide expert opinion on the effects of climate change on human conflict resolutions.

	3.5.3 Review elements of legislations related to climate change at both local and international, that impact on social, economic, and political well-being of citizens.
3.6 Demonstrate understanding of meteorological instruments, observation methods, measurement techniques, repairs, calibration, and fault finding.	3.6.1 Assemble automatic weather stations and related instruments. 3.6.2 Diagnose and repair malfunctioning weather instruments. 3.6.3 Calibrate a wide range of meteorological instruments. 3.6.4 Modify meteorological instruments for specialized applications. 3.6.5 Design new meteorological instruments.
3.7 Show understanding of weather maps, charts, and meteorological diagrams.	3.7.1 Record climatic observations as per required standards. 3.7.2 Identify key features on weather maps, including air temperature, relative humidity, wind speed, rainfall, and many others. 3.7.3 Interpret weather charts and forecasts. 3.7.4 Present weather/climate data and information to a non-professional. 3.7.5 Describe complex atmospheric phenomena and processes in the atmosphere. 3.7.6 Synthesize climatic information from maps.

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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*	Communications and Study Skills	12				12
	Academic and Professional Communication (Science)	12				12
	Computer Skills Fundamentals	16				16
CORE COMPONENT *Subjects/Courses/ Modules/Units*	Geometrical Optics and Mechanics	12				12
	General Chemistry	16				16
	General Chemistry		16			16
	Introductory Mathematics	16				16
	Introductory Mathematics		16			16
	Electricity and Magnetism, Introduction to Modern Physics	12				12

	Properties of Matter, Basic Thermodynamics, and Introduction to Nuclear Physics		12			12
	The Earth's Atmosphere		12			12
	Introduction to Mathematical Statistics		12			12
	Calculus		12			24
	Calculus			12		
	Basic Electronics		12			12
	Thermodynamics		12			12
	Numerical Methods		12			12
	Computer Programming-FORTRAN		12			12
	Internship: Synoptic Meteorology		12			12
	Atmospheric Radiation			12		12
	Atmospheric and Ocean Dynamics I			12		12
	Mathematical Methods for Physical Sciences			12		12
	Mathematical Statistics			12		12
	Introduction to Agrometeorology			12		12

	Numerical Weather Prediction			12		12
	Electronic Instrumentation			12		12
	Internship: Forecasting and Agrometeorology			12		12
	Global Circulation Models				24	24
	Atmospheric and Ocean Dynamics I				12	12
	Boundary Layer Meteorology				12	12
	Global Climate Change				12	12
	Cloud Physics				12	12
	Research Project				24	24
ELECTIVE/ OPTIONAL COMPONENT *Subjects/Courses/ Modules/Units*	None Science Electives (Only two allowed and can be taken from second year)		12	12		24
	Science based options (Choose 36 credits made up of a minimum of three optional courses from both NCQF Levels 6 and 7- from Science Based Courses)		12	24		36

	Mechanics, Vibrations and Waves		12			12
	Computing		12			12
	Advanced Electronics			24		24
	Synoptics and Dynamic Climatology			12		12
	Elements of Air Pollution			12		12
	Physics of the Environment			12		12

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SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	***Credit Value***
5	96
6	164
7	144
8	96
TOTAL CREDITS	500

Rules of Combination:

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

	Bachelor of Science (Physics with Meteorology)
Fundamentals	40
Core	400
Optional/electives	60
Total credits	500

Optional/electives = 60 credits that will be selected as follows:

Minimum electives = 24 credits (None Science Electives: only two allowed and can be taken from second year upwards); and

Minimum optional courses = 36 credits (a minimum of three optional courses can be taken from Science based courses)

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ASSESSMENT ARRANGEMENTS

Formative Assessment

The weighting of formative assessment is 50% of the final assessment mark.

Summative Assessment

The weighting of summative assessment is 50% of the final assessment mark.

MODERATION ARRANGEMENTS

There will be a provision for internal and external moderation for the qualification. Moderators must be registered and accredited by BQA. Both internal and external moderation will be in accordance with existing institutional and national polices.

RECOGNITION OF PRIOR LEARNING

There will be provision for awarding of the qualification through RPL in line with the national Polices on RPL.

CREDIT ACCUMULATION AND TRANSFER

Credit Accumulation Transfer (CAT) polices which are in line with BQA's Polices will be used so that candidates can gain part or full qualification through the stated arrangements.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Learning pathways

Horizontal articulation:

- Bachelor of Science (Meteorology): NCQF level 7
- Bachelor of Science (Agrometeorology): NCQF level 7
- Bachelor of Science (Physics): NCQF level 7

Vertical articulation:

- Bachelor of Science Honours (Meteorology): NCQF level 8
- Master of Science (Agrometeorology): NCQF level 9

- Master of Science (Meteorology): NCQF level 9
- Master of Philosophy (Physics): NCQF level 9

Employment pathways:

- Meteorologists
- Agrometeorologists
- Aviation Meteorologists
- Pilots
- Instrumentation Technicians
- Atmospheric Scientists
- Physics Teachers
- Weather Forecasters
- Automatic Weather Station Technologists
- Academic Researchers
- Climatologists
- Independent Consultants
- Renewable Energy Technologists
- Water and Irrigation specialist

QUALIFICATION AWARD AND CERTIFICATION

Candidates meeting the prescribed requirements will be awarded the degree in accordance with the qualification composition rules and applicable polices.

To be eligible for the award of the Degree: Bachelor of Science (Physics with Meteorology), candidates should have obtained a total of 500 credits.

REGIONAL AND INTERNATIONAL COMPARABILITY

This Bachelor of Science in Physics with Meteorology qualification was benchmarked with similar degree qualifications from around the world (both regionally and internationally), with regards to outcomes and assessment criteria, degree of difficulty and notional learning time. The qualification was compared with the following qualifications:

i. Regional qualification

The University of Nairobi, Kenya offers a Bachelor of Science in Meteorology offered over 4 years. This qualification has been revised in accordance with World Meteorological Organisation (WMO) guidelines. It covers courses in physics, mathematics atmospheric science, meteorology, and other allied disciplines like biometeorology, agrometeorology, marine meteorology, and hydrometeorology. This qualification has many similarities with the proposed one. However, the observed differences are as follows:

- The name of the qualification (Bachelor of Science in Meteorology) is different from the proposed one (Bachelor of Science in Physics with Meteorology).
- The University of Nairobi qualification content is more into the science of meteorology while the proposed qualification has a balance of physics and meteorology. As a result, some of the courses (biometeorology, marine meteorology and hydrometeorology) are not offered by the proposed qualification.

ii. International qualification

The University of Edinburgh, United Kingdom offers a Bachelor of Science in Physics with Meteorology. The qualification is offered over 4 years and is accredited by the Institute of Physics and Royal Meteorological Society. This qualification combines the study of physics with meteorology where students are taught atmospheric processes and techniques to study atmospheric physics, atmospheric dynamics, and the physics of climate. This qualification has a lot of similarities with the proposed Bachelor of Science in Physics with Meteorology as they both have strong foundations in physics, mathematics, atmospheric and meteorology courses. The observed differences are that at Edinburgh, students don not undertake any internship courses while the proposed qualification offers two internship courses at year 2 and 3. Instead of the 2 internship courses, Edinburgh students have an optional “Atmospheric Science Field Skills” course offered at year 3. Lastly, the Edinburgh qualification allows students to take optional honours courses in the final year (4) to qualify for a Bachelor of Science in Physics with Meteorology Honours unlike the proposed qualification.

REVIEW PERIOD

This qualification will be reviewed in a period of five years once registered.

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