BQA NCQF QUALIFICATION TEMPLATE

SECTION A:	QUALIFICATION DETAILS													
QUALIFICATION DEVELOPER (S)	Botswana International University of Science and Technology													
TITLE	Master of Science in Astrophysics										**NCQF LEVEL**	9		
FIELD	Natural, Mathematical and Life Sciences										**CREDIT VALUE**	240		
SUB FIELD	Physical Sciences													
New Qualification	X	Legacy Qualification		Renewal Qualification										
				Registration Code										
SUB-FRAMEWORK	General Education		TVET		Higher Education	X								
QUALIFICATION TYPE	Certificate	I		II		III		IV		V		Diploma		Bachelor
	Bachelor Honours		Post Graduate Certificate		Post Graduate Diploma									
	Masters	x	Doctorate/ PhD											

RATIONALE AND PURPOSE OF THE QUALIFICATION

RATIONALE:

The rollout of science, technology, and innovation in social, economic and business sectors has been identified as critical to transforming Botswana into a globally competitive knowledge-based economy. Moreover, several documents have also highlighted the need to produce high-calibre graduates with strong problem-solving skills, in-depth scientific knowledge, and transferable skills that are desirable in industry and research. Towards this end, several initiatives are being pursued. As an example, Botswana is partnering in the Square Kilometre Array (SKA) project, a large project to build an array of radio telescopes in South Africa and Australia, where Botswana will also host some of the antennas on the BIUST campus (to provide a larger baseline for interferometry). Botswana is also a partner in the HIRAX project, with thousands of radio dishes to be placed in the Karoo region to search for fast radio bursters (FRBs) and perform cosmological experiments. Finally, Botswana is part of the African VLBI Network (AVN) where telescopes in Southern Africa are essential to provide longer baselines for the Event Horizon experiment to image black holes. Some AVN antennas will be hosted on the BIUST site. We also plan to build an 11m antenna from purely Botswana resources (as far as this is possible) to provide an independent scientific facility for Botswana scientists. Botswana also intends

to build an optical observatory at BIUST in collaboration with Thailand to monitor and exploit transient objects (including earth-grazing asteroids). The Master of Science in Astrophysics will, therefore, equip learners with the skills and training that are needed to contribute to these initiatives.

The Master of Science in Astrophysics qualification will comprise both coursework and research components; the graduate will have a fundamental understanding of advanced concepts in Astronomy, as well as practical research experience in terms of conceptualisation of a research question, investigation thereof, reporting, solving, and evaluating scientific research. Graduates will be adaptable and be in possession of transferable skills suitable for different types of employment and be able to initiate and implement constructive change in their communities, professions and workplaces.

PURPOSE: (itemise exit level outcomes)

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

- Design, execute, and critically evaluate independent research projects in astrophysics, contributing to the advancement of knowledge within the field through the application of observational data, theoretical analysis, and simulation tools
- Analyze complex astrophysical phenomena, employing logical reasoning and problem-solving strategies to interpret scientific data and provide innovative solutions.
- Apply advanced research and industry sought after skills in data processing, computing, and programming, through local research expertise in Astronomy and Astrophysics
- communicate complex astrophysical concepts, research findings, and technical information effectively to both specialist and non-specialist audiences through written reports, presentations, and publications

MINIMUM ENTRY REQUIREMENTS (including access and inclusion)

1. Bachelor of Science in Physics/Astronomy, NCQF Level 7 or equivalent.
2. There would be a provision for entry through Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) to all candidates through institutional policies in line with national RPL and CAT policies.

SECTION B	**QUALIFICATION SPECIFICATION**
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
1. Analyse and synthesise specialised research developments in different areas of astrophysics, demonstrating the ability to critically evaluate recent advancements and integrate knowledge to address complex astrophysical problems.	1.1 conduct a thorough literature review of specialised research developments in different areas of astrophysics 1.2 Integrate current knowledge with recent developments in specialised areas of astrophysics to synthesise novel or alternative approaches.

	1.3 Evaluate and compare existing research, highlighting key findings, gaps, and emerging trends. 1.4 Synthesize research from various astrophysical domains (e.g., stellar evolution, cosmology, planetary science) and draw connections between them 1.5 Produce a coherent and original synthesis of research that addresses unresolved questions or proposes new avenues for exploration in astrophysics
2. Solve advanced scientific and industrial problems in astrophysics through a directed scientific project or instrumentation development in astrophysics.	2.1 Formulate, analyse, and solve concrete and abstract problems in new and unknown situations to develop new theories, experiments and technology. 2.2 Apply theoretical knowledge to solve real-world contexts 2.3 Integrate knowledge from various subjects and disciplines in solving scientific and industrial problems. 2.4 Evaluate and critique the solutions of self and others to improve solutions.
3. Apply scientific methods and specialised knowledge in astrophysics to design novel solutions to problems in society and industry, considering ethical and cultural issues.	3.1 Apply advanced relevant scientific knowledge to solve current societal and industrial issues. 3.2 Appraise ethically and culturally sensitive decisions on the effects of scientifically based activities on society. 3.3 Identify and assess the socio-economic impact of scientific interventions in society and industry. 3.4 Develop approaches and solutions demonstrating how scientific knowledge benefits society and that scientific advancement leads to socio-economic development.
4. Design, select, and appraise appropriate novel research methods to solve astrophysics and industry-related problems, and engage in and critique current research practices and techniques.	4.1 Develop appropriate astrophysics methodologies to solve societal and industry-related problems. 4.2 Compare and contrast advanced theoretical predictions with published data to evaluate the significance of the results in context. 4.3 Explain the implications of findings on the problem under consideration in the context of astrophysics

	4.4 identify improvements needed in the performance of instrumentation or detectors. 4.5 Demonstrate correct assessment of the results of an experiment or other type of research investigation and draw valid conclusions. 4.6 Develop an analytical ability to manipulate precise and intricate ideas for constructing logical arguments.
5. Carry out supervised specialised research projects to develop new scientific outcomes leading to publication in a learned journal, in the subject.	5.1 Demonstrate and assess appropriate astrophysics research investigations and methodology to produce meaningful results. 5.2 Perform specialised physics research to solve a problem. 5.3 Ensure appropriate analysis of the relevant data is undertaken, and results are discussed and explained in terms of published scientific literature and presented in a written report or publication in prestigious journals. Apply non-verbal forms of representation correctly and appropriately.

SECTION C	**QUALIFICATION STRUCTURE**				
COMPONENT	**TITLE**	**Credits Per Relevant NCQF Level**			**Total Credits**
		Level [7]	**Level [8]**	**Level [9]**	
FUNDAMENTAL COMPONENT Subjects/ Courses/ Modules/Units					0
CORE COMPONENT Subjects/Courses / Modules/Units	Advanced Cosmology			12	12
	Interferometry			12	12
	Galactic Astrophysics			12	12

	Extragalactic Astrophysics			12	12
	Celestial Mechanics			12	12
	Data Science in Astronomy			12	12
	Interstellar and Intergalactic Medium			12	12
	Astroparticle Physics			12	12
	Research Project			120	120
ELECTIVES (Choose two modules)	Astrobiology			12	12
	Magnetohdrodynamics			12	12
	Astroseismology			12	12
	Stellar Spectroscopy			12	12

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level (all level 9)	**Credit Value**
Elective Component	24
Core Component	96
Research Thesis	120
TOTAL CREDITS	240

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

Students need to enroll for a minimum of 240 notional credits which are distributed as follows:

- 8 core modules of (8 x 12 credits = 96 credits + 1 Research Report = 120 credits).
- Elective modules of at least a total of 24 notional credits at NCQF Level 9.

ASSESSMENT ARRANGEMENTS

Formative assessment: 50%.

Summative assessment: 50%.

MODERATION ARRANGEMENTS

Internal and external moderation shall be carried out according to existing policies and regulations.

RECOGNITION OF PRIOR LEARNING

Recognition of Prior Learning (RPL) shall be considered for the award of this qualification according to existing policies and regulations.

CREDIT ACCUMULATION AND TRANSFER

Credit Accumulation and Transfer (CAT) shall be considered for the award of this qualification according to existing policies and regulations.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal articulation

- MSc in Physics
- MSc in Astronomy,
- MSc in Applied Mathematics
- MSc in Engineering Physics

Vertical articulation

- PhD in Physics
- PhD in Astronomy
- PhD in Applied Mathematics
- PhD in Engineering Physics.
- PhD in Astrophysics

Employment pathways:

- Research Associate/Scientist,
- Quantitative Analyst,
- Data Analyst,
- Optical Physicist,
- Design Physicist,
- Software Developer,

- Telescope Operator,
- Lecturers,
- Computational Physicist,
- Process controllers.

QUALIFICATION AWARD AND CERTIFICATION

Minimum standards of achievement for the award of the qualification

Candidate(s) will be awarded the degree of Master of Science in Astrophysics after attaining the stipulated minimum credits of 240 as specified in the rules of combination and credit distribution.

Certification

A certificate and transcript of the award of the degree of Master of Science in Astrophysics will be given upon successful completion of the qualification.

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

The developed Bachelor of Master of Science in Astrophysics qualification has been compared with the following qualifications:

1. University of Namibia (Namibia)
2. Australian National University (Australia)
3. University of Oslo (Norway)
4. University of Ankara (Turkey)

Title of Qualification, NQF Level & Credit Value or Duration (where applicable)

The titles ranges from MSc in Astronomy, Astronomy and Astrophysics or Astronomy and Space Science; considering the content, it can be concluded that the qualifications are similar because they all contain modules in Astronomy, astrophysics and space science. University of Namibia offers MSc Physics with a specialisation stream in Astronomy and Astrophysics. The qualification is similar to the compared qualifications in terms of duration and scope. The NQF level of 9 compares well with University of Namibia (Namibia) and Australian National University (Australia) all at level 9, All the four institutions compared have a MSc degree with 2-year duration. Despite the different credit system, the usual total taught module load is 10-12 modules and a research project which compares well with the total module load of 10 during the first year for this qualification.

Main Exit Outcome(s)

The learning outcomes of the qualifications benchmarked compare well with this qualification and display the same degree of complexity for the level including demonstrate high level knowledge in Astronomy & Astrophysics, analyse/critique published literature, construct instruments, show masterly of communication and presentation skills, critically investigate, analyse and interpret data and knowledge generation, Plan and manage research projects.

Domains/Modules/Courses/Subjects covered (Fundamental, core & electives)

The research and taught component carry equal weighting of 50:50% for all the sampled modules which is the same with this qualification which has a 50:50% weighting pointing to the emphasis in the research component. All the qualifications including this qualification contain elements of

advanced modules in Physics, space science, Astronomy, cosmology and Astrophysics. There are core and elective modules.

Assessment Strategies and Weightings

The assessment strategies are generic and similar to both formative and summative assessments and a supervised research project leading to a dissertation. Similarly, students must accumulate all core credits and pass the research project. The research and taught component carry equal weighting of 50:50%.

Qualification rules and minimum Standards for the award of the qualification

Entry into all the compared qualifications is similar to this qualification and is a BSc in Astronomy or equivalent. To be conferred, the learners have to pass core and prescribed elective modules and a research project to accumulate a minimum number of credits.

Education and Employment Pathways

1. Vertical articulation leading to a PhD in the field.
2. Horizontal articulation translates into MSc qualifications in other related areas of science.
3. Further education and research or employment in STEM-related and technical field such as:
    - Metrology
    - Radar station managers
    - Associate/Scientist,
    - Quantitative Analyst,
    - Data Analyst,
    - Optical Physicist,
    - Design Physicist,
    - Software Developer,
    - Telescope Operator,
    - Lecturers,
    - Computational Physicist,
    - Data analysts and data scientists,
    - Coders of specialised software.

Furthermore, the Master of Science in Astrophysics qualification compares well with the qualifications examined in terms of exit level outcomes, domains covered, methods, education and employment pathways.

REVIEW PERIOD

The review period of the qualification shall be five (5) years.

For Official Use Only:

BOTSWANA Qualifications Authority	**BQA NCQF QUALIFICATION TEMPLATE**

CODE (ID)			
REGISTRATION STATUS	**BQA DECISION NO.**	**REGISTRATION START DATE**	**REGISTRATION END DATE**
LAST DATE FOR ENROLMENT		**LAST DATE FOR ACHIEVEMENT**	