BQA NCQF QUALIFICATION TEMPLATE

SECTION A:	QUALIFICATION DETAILS														
QUALIFICATION DEVELOPER (S)	Botswana International University of Science and Technology														
TITLE	Bachelor of Science Honours in Astronomy										**NCQF LEVEL**	8			
FIELD	Natural, Mathematical and Life Sciences										**CREDIT VALUE**	132			
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	X	Post Graduate Certificate		Post Graduate Diploma										
	Masters		Doctorate/ PhD												

RATIONALE AND PURPOSE OF THE QUALIFICATION

RATIONALE:

The Botswana Vision 2036 recognises education and skills development as a foundation for human resource development. According to the Botswana Vision 2036 Pillar 1 and Pillar 2, tertiary education and training providers are mandated to provide citizens with quality academic, technical and vocational skills and competencies to attain their full potential, thereby effectively contributing to economic development. Thus, the use of science, technology, and innovation in social, economic and business sectors are critical to transform Botswana into a globally competitive knowledge-based economy. The Bachelor of Science in Astronomy qualification has been informed by this mandate to realise the National Development Plan (NDP11) which is aligned with Vision 2036 and the Sustainable Development Goals of the United Nations. Several documents have also highlighted the need to

produce high caliber graduates with strong problem-solving skills, in-depth scientific knowledge and transferable skills desirable in industry and research, to transform Botswana from a resource-based to a knowledge-based economy and contribute to the Sustainable Development Goals of the United Nations.

Botswana will be a partner in the Square Kilometer Array (SKA) project, a large project to build an array of radio telescopes in South Africa and Australia, where BIUST will also host some of the antennas (to provide a larger baseline for interferometry). Botswana is also a partner in the HIRAX project, an array of 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 a set of 11m antennas 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).

After obtaining a Bachelor of Science Honours in Astronomy qualification, the graduate will possess intensive research experience within a specific field of Astronomy through a supervised project and advanced knowledge in specialisation areas of Astronomy, including familiarity with contemporary research within various fields of Astronomy. Regarding competencies, the graduate will have an excellent understanding of the role of Astronomy in society and sufficient background to consider ethical problems. Moreover, the graduate will successfully carry out advanced tasks and projects independently and in collaboration with others and across disciplines and borders on their discipline. The graduate will also possess the skills and experience required to model, analyse, and solve advanced problems in astronomy and apply advanced theoretical or experimental methods, including analytical and numerical methods and simulations using appropriate software.

PURPOSE: (itemise exit level outcomes)

The purpose of this qualification is to equip graduates with highly specialised knowledge, skills, and competences to:

1. Analyse and interpret astronomical phenomena, showcasing a comprehensive understanding and mastery of key topics, concepts, and techniques in astronomy, including observational, theoretical, and computational methods.
2. Exhibit proficiency in using astronomical datasets through observation, theoretical development and computation
3. Communicate complex findings to the professional community and the public.
4. Apply critical thinking skills to the current state of knowledge, formulate hypotheses, design experiments and interpret results

MINIMUM ENTRY REQUIREMENTS (including access and inclusion)

1. Bachelor's Degree (NCQF Level 7) qualification in the same or a cognate field of study.

2. Applicants who do not meet the above criteria but possess relevant industry experience may be considered through Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) institutional and national policies.

SECTION B	QUALIFICATION SPECIFICATION
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
1. Analyse current developments in various specialisation areas in Astronomy.	1.1 Review and track recent advancements, discoveries, and innovations in various specialisation areas within Astronomy through academic journals, conferences, and relevant publications. 1.2 Interpret the significance and implications of current research findings and how these advance our understanding of current topics of active research 1.3 Evaluate the strengths and weaknesses of current understanding, including potential limitations and areas of future research 1.4 Utilize the acquired knowledge to design customised research strategies that address specific goals and needs 1.5 Integrate insights gained from current developments to propose new research questions, hypotheses, or applications that advance the understanding or practical use of knowledge within the field
2. Identify and solve complex problems in Astronomy demonstrating ability to analyse information objectively, assess implications and formulate effective solutions	2.1 Formulate, analyse, and solve concrete and abstract problems, in familiar and unfamiliar contexts. 2.2 Apply the knowledge of theory to real-world contexts. 2.3 Integrate knowledge from various subjects and disciplines in solving scientific and industrial problems.

	2.4 Apply scientific knowledge that is relevant to current societal and industrial issues. 2.5 Critically evaluate public information dealing with current scientifically related issues. 2.6 Appraise ethically and culturally sensitive decisions on the effects of scientifically based activities on society. 2.7 Identify and access the socio-economic impact of scientific interventions in society and industry. 2.8 Demonstrate that scientific knowledge is applied for the direct benefit of society and to drive socio-economic development through industrialisation.
3. Design, select and apply appropriate research methods to solve Astronomy and industry related problems, and to engage and to critique current research practices and techniques.	3.1 Develop appropriate Astronomy methodologies to solve societal and industry-related problems. 3.2 Compare theoretical predictions with published data to evaluate the significance of the results in context. 3.3 Explain the implications of the findings on the problem under consideration. 3.4 Interpret results of an experiment or other type of research investigation and ensure that valid conclusions are drawn while evaluating the level of uncertainty in these results and expected outcomes. 3.5 Perform and provide appropriate recommendations related to the proposed research problem. 3.6 Develop an analytical ability to manipulate precise and intricate ideas for constructing logical arguments.
4. Undertake supervised research projects to create or expand new knowledge.	4.1 Demonstrate and assess appropriate Astronomy research investigations to produce meaningful results.

	4.2 Ensure appropriate analysis of the data is undertaken, and results are discussed in terms of published scientific literature and presented in the form of a written report or publication
5. Apply the principles of entrepreneurship and innovation in Astronomy as tools for driving socio-economic development.	5.1 Evaluate innovative opportunities in Astronomy, such as the development of space technologies, data analytics tools, or satellite communication systems, that can be leveraged to address socio-economic challenges. 5.2 Create a comprehensive business plan outlining how an astronomy-based innovation can be commercialized, detailing the product or service, target market, financial projections, and the socio-economic impact it aims to achieve. 5.3 Compose, appraise and defend comprehensive and well-structured business innovation plans. 5.4 Apply entrepreneurial strategies and sustainable development practices to scale an astronomy-based project or startup, with measurable contributions to job creation, economic diversification, and community upliftment.

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SECTION C	**QUALIFICATION STRUCTURE**				
	TITLE	**Credits Per Relevant NCQF Level**			**Total Credits**
		Level [6]	**Level [7]**	**Level [8]**	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/Units*					

CORE COMPONENT Subjects/Courses/ Modules/Units	Astrophysics I: Stars			12	
	Astrophysics II: Galaxies and the Interstellar Medium			12	
	Astronomical Optics and Instrumentation			12	
	Observational Astronomy in the optical			12	
	Radio Astronomy			12	
	General Relativity			12	
	Astrophysics of Compact Objects			12	
	Academic Literacy and Social Sciences			6	
	Research Project			30	
ELECTIVE COMPONENT Subjects/Courses/ Modules/Units **One course to be chosen among:**	Quantum Computing and Quantum Information Theory			12	
	Dynamical Systems and Applications			12	
	Software Packages and Computer-assisted Physics			12	
	High Performance Computing and Big Data			12	
	Signal and Image Processing			12	
	TOTAL				132

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	**Credit Value**
6	0
7	0
8	132
TOTAL CREDITS	132

Rules of Combination:

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

The Bachelor of Science Honours in Astronomy constitutes a minimum total number of 132 credits which are distributed as follows (based on the above Qualification Structure) with respect to different university and NCQF levels:

- NCQF Level 8 -number of credits is 132 (100 % of 132 credits)

Elective modules need to be chosen at the appropriate NCQF Level (in consultation with the Department of Physics and Astronomy) subject to the pre-requisite requirements

ASSESSMENT ARRANGEMENTS

- Formative Assessment - The weighting for formative assessment will be 60%.
- Summative Assessment - The weighting for summative assessment will be 40%.

MODERATION ARRANGEMENTS

Internal and external moderation shall be carried out in accordance with ETP moderation policy and BQA requirements.

All assessors and moderators must be qualified in astronomy or cognitive field preferably with a masters degree.

RECOGNITION OF PRIOR LEARNING

Recognition of Prior Learning (RPL) will be applicable and considered for award of this qualification using appropriate RPL policies.

CREDIT ACCUMULATION AND TRANSFER

Credit Accumulation and Transfer (CAT) will be applicable and considered for award of this qualification according to appropriate CAT policies

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Articulation

Horizontal articulation:

1. Bachelor of Science Honours (Applied Physics)
2. Bachelor of Science Honours (Physics),
3. Bachelor of Science Honours (Applied Mathematics),
4. Bachelor of Science Honours (Engineering Physics)

Vertical articulation:

1. Master of Science (Applied Physics)
2. Master of Science (Physics),
3. Master of Science Honours (Applied Mathematics),
4. Master of Science (Engineering Physics),
5. Master of Science Honours (Astrophysics)

Employment

1. Research Associate/Scientist,
2. Quantitative Analyst,
3. Data Analyst,
4. Optical Physicist,
5. Design Physicist,
6. Software Developer,
7. Telescope Operator,
8. Planetarium Educator Computational Physicist.

QUALIFICATION AWARD AND CERTIFICATION

Minimum standards of achievement for the award of the qualification

Candidate(s) will be awarded the Bachelor of Science Honours Astronomy after attaining the stipulated minimum credits of 132 as specified in the rules of combination and credit distribution.

Certification

A certificate of the award of the of Bachelor of Science Honours in Astronomy will be given upon successful completion of the qualification.

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

The developed Bachelor of Science Honours in Astronomy qualification has been compared with the following qualifications[1,2]:

- University of St. Andrews (Scotland)
- University of Kwa-Zulu Natal (South Africa)
- University of Canterbury (New Zealand)
- Australian National University (Australia)

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

The qualification is similar to the compared in terms of duration and scope. All the four institutions compared have an honours degree with 1 year duration either by direct entry after the BSc Astronomy or as a continuation from a normal 3-year BSc Astronomy (University of St. Andrews (Scotland). The usual total credits are 120 which closely compares with out qualification with a credit value of 132. The differences are mainly due to the units assigned to the research project which ranges from 24-32 credits. For this qualification the project is assigned 32 credits. The title of the qualifications are BSc Honours in Astronomy except University of Kwa-Zulu Natal (South Africa) which offer BSc Honours in Astrophysics. Considering the similarity of content, both titles may be used interchangeably.

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 critical investigation, analysis, knowledge generation, independent thinking, synthesis and applications of specialised knowledge to solve problems.

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

All the qualifications including this qualification contain elements of modules in Physics, Mathematics, space science, Astronomy, cosmology and Astrophysics. Al the qualifications including this qualification have a taught component and a research project. There is a lot of emphasis on the

research project and the credits range from 24 – 32 for the research project. Equally we have placed a lot of emphasis on the research project with a credit value of 32.

Assessment strategies and Weightings

The assessment strategies are generic and similar with both formative and summative assessments and a supervised project leading to a dissertation.

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

Articulation and employment pathways for all the programmes including this programme is progression to further education and research or employment in STEM related and technical industries.

Conclusion

The proposed qualification overall compares well with other qualifications which it was benchmarked against.

References

1. Subject Benchmark Statement, Physics, Astronomy and Astrophysics: Draft for Consultation, published by the Quality Assurance Agency for Higher Education in the United Kingdom, April 2016.
2. Benchmark Statement for Physics in South Africa, South African Institute of Physics, http://www.saip.org.za/index.php/sa-physics-benchmark-statement, accessed on 20 April 2019.

REVIEW PERIOD

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

For Official Use Only:

CODE (ID)			
REGISTRATION STATUS	**BQA DECISION NO.**	**REGISTRATION START DATE**	**REGISTRATION END DATE**

LAST DATE FOR ENROLMENT		**LAST DATE FOR ACHIEVEMENT**	