QUALIFICATION SPECIFICATION							SECTION A
QUALIFICATION DEVELOPER	BOTSWANA INTERNATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY						
TITLE	Bachelor of Engineering (Honours) in Mining Engineering				**NCQF LEVEL**		8
FIELD	Manufacturing, Engineering and Technology **(Field 10)**				**SUB-FIELD**	Mining Engineering	
New qualification	✓	Review of existing qualification					
SUB-FRAMEWORK	General Education		TVET		Higher Education		✓
QUALIFICATION TYPE	Certificate		Diploma		Bachelor		
	Bachelor Honours	✓	Master		Doctorate/PhD		
CREDIT VALUE					660		

RATIONALE AND PURPOSE OF THE QUALIFICATION

Rationale

The mining industry is very vital to the economy of Botswana as it contributes about 85% of the country's export earnings and 18% of the GDP. Currently, there are over 25 operating large-scale mines in Botswana. Accordingly, there is the need to train competent graduates and prepare them to take up jobs in the mining and allied industries and prepare candidates for postgraduate degrees in mining and related qualifications. The rationale of the qualification takes into consideration documents on the mission and vision of BIUST, key national strategy and policy documents from organisations like HRDC, Ministry of Tertiary Education, Research, Science and Technology, Botswana Chamber of Mines, Vision 2036, ERB etc.

The Priority occupations list for 2019 report (Priority occupations list-2019.pdf (hrdc.org.bw) by Human Resources Development Council for Botswana (HRDC) forecast for occupation needs covering 2019 to 2028 has indicated a demand for Mining and Mineral Processing Plant Operators for the whole period. In addition, among the technical and Soft skills for the top occupations in demand for Botswana in the Mining, Minerals, Energy & Water Resource sector are Mineral Economists and Mining Operators. Mineral Economists require both Technical (Mineral Policies, Mineral Accounting, Geo-statistics Mine valuation Ore reserves/Resource Project Management) and Soft (Teamwork Supervisory Management Safety Health and Environment(SHE)) skills. On the other hand, Mining Operators who require Electrical, Explosives, Load & Haul, Drill & Blast, Plant & Mechanical, Mining Services as technical skills as well as Supervisory and Managerial as soft skills According to the BUIST strategy for 2020-2023, the mandate of Botswana International University of Science and Technology is to provide higher education and training as well as to advance and

disseminate knowledge and skills through teaching, learning and practical skills. This is in line with the National Human Resource Development Plan.
The Mineral sector has been identified as one of the 12 pillars of sustainable economic development of Botswana under the vision 2036 - achieving prosperity for all (https://www.vision2036.org.bw) document. The sector contributes significantly to government revenue, foreign direct investment and foreign exchange. The vision envisages a sustainable vibrant and diversified mineral sector that guarantees social economic activity in mining areas even after mining that enhances efficient and competitive exploitation of the mineral resources using modern technology. Such a vision requires well trained mining engineers.

Purpose

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

- Facilitate the progression of the graduate to become a graduate Mining Engineers.
- Apply scientific and engineering knowledge to mining engineering for modelling Ore bodies, calculating ore reserves and designing both surface and underground mines.
- Produce various engineering designs of mining operations at the different stages of a mine and select the most cost-effective option that conforms to social, legal, health, safety, and environmental standards and regulations.
- Apply knowledge from various subjects and disciplines to solve scientific and mining industry related problems considering ethical, economic and cultural issues.
- Identify and assess the socio-economic impact of mining engineering interventions in society and industry.

ENTRY REQUIREMENTS (including access and inclusion)

Entry into this qualification is through any one of the following requirements:

(i) Certificate IV, NCQF level 4 (General Education or TVET) or equivalent.

(ii) 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) policies.

QUALIFICATION SPECIFICATION SECTION B

GRADUATE PROFILE (LEARNING OUTCOMES)		ASSESSMENT CRITERIA
1.	Apply systematic, extensive, and comparative knowledge to solve mining engineering problems using the concepts and principles of mining engineering.	1.1 Apply, identify, describe, and categorise the core concepts and principles of mining engineering. 1.2 Identify the relationships among the core concepts and principles of mining engineering. 1.3 Assess the range and limits of the applicability of the core concepts and principles of mining engineering.

		1.4 Apply the core concepts and principles of mining engineering to solve practical societal and mining industry related problems. 2.4 Analyse and appraise the limitations of basic techniques used in mining engineering. 3.4 Recognise and assess the significance of contested engineering knowledge in a contemporary context. 4.4 Demonstrate an understanding of how engineering information and ideas become generally accepted.
2.	Apply scientific and engineering knowledge to mining engineering	2.1 Perform basic engineering calculations using background knowledge in Math, Physics and chemistry. 2.2 Use software's such as AutoCAD, Solid Works, Surpac, etc. to model and design objects. 2.3 Model Ore bodies calculate ore reserves and design mines
3.	Access, evaluate, synthesise, and analyze scientific information in mining engineering.	3.1 Access information through the library, internet and other data storage and retrieved facilities using SIERRA; a library management system software. 3.2 Analyse quantitative data using data analysis software such as SPSS, Excel, MATLAB 3.3 Apply scientific reasoning to evaluate the quality of information. 3.4 Synthesise information from a variety of sources to improve the efficiency of the mining operations. 3.5 Use of literature material and electronic database in the library to solve problems in assignments and projects. 3.6 Appropriate procedures for generating relevant information are designed, selected and applied with due concern for bias and for any ethical or safety considerations.
4	Generate a scientific information in mining engineering.	4.1 Design, select, and apply appropriate procedures for generating relevant information with due concern for bias and any ethical or safety considerations. 4.2 Apply standard procedures within the discipline of mining engineering to conduct appropriate forms on enquiry. 4.3 Collect and record data accurately, truthfully and in appropriate formats.

		4.4 Analyse and evaluate data and scientific evidence from which valid arguments and conclusions are presented.
5.	Produce engineering design in mining operations (development, planning, operation, closure, and reclamation of mines)	5.1 Acquire the ore reserves statements and spatial and physical characteristics of the deposit and country rock. 5.2 Formulate various options for development, planning, operation, closure, and reclamation of mines. 5.3 Select the cost-effective option that conforms to social, legal, health, safety, and environmental standards and regulations.
6.	Communicate scientific understanding in mining engineering, both verbally and in writing, using visual, symbolic, and/or other forms of representation.	6.1 Apply scientific language correctly to produce clear and coherent written documents, which follow appropriate engineering conventions. 6.2 Present engineering information verbally to engineering and non-engineering audiences at meetings, seminars, conferences, workshops and other such fora. 6.3 Apply appropriate referencing conventions, avoid plagiarism, and respect intellectual property. 6.4 Apply non-verbal forms of representation correctly and appropriately.
7	Solve scientific and mining industry related problems in Mining Engineering.	7.1 Formulate, analyse, and solve concrete and abstract problems, in familiar and unfamiliar contexts. 7.2 Apply the knowledge of theory to real-world contexts. 7.3 Integrate knowledge from various subjects and disciplines in solving scientific and mining industry related problems.
8	Demonstrate effective Information and Communication Technology (ICT) skills in mining engineering.	8.1 Apply tasks related to basic computer literacy skills. 8.2 Critically assess the validity of ICT solutions for problems posed by mining engineering as a discipline. 8.3 Apply ICT that is appropriate to mining engineering as a discipline for simulations and computational applications, pattern recognition, automation, and control, and managing large volumes of data.
9	Work effectively as a member of a team in engineering projects or investigations.	9.1 Demontrate evidence of successful and effective contributions in group work provided. 9.2 Ensure that outcomes of scientific group work are communicated effectively, while respecting the contributions of each group member.

		9.3 Apply organisational skills in managing group work are applied.
10	Apply engineering methods and knowledge to solve societal problems, considering ethical, economic and cultural issues.	10.1 Identify and apply engineering knowledge that is relevant to current societal and mining industrial issues. 10.2 Critically evaluate public information dealing with current engineering related issues 10.3 Appraise ethically and culturally sensitive decisions on the effects of mining engineering based activities on society. 10.4 Identify and assess the socio-economic impact of mining engineering interventions in society and industry. 10.5 Demonstrate that engineering knowledge is applied for the direct benefit of society and to drive socio-economic development through industrialization.
11	Design, manage, and organise learning activities responsibly in mining engineering.	11.1 Demonstrate and assess appropriate study skills (learning from text, note-taking, summarising, analysis and synthesis). 11.2 Ensure effective learning strategies which suite personal needs and context are developed and applied. 11.3 Demonstrate effective time management.
12	Apply the principles of entrepreneurship and innovation in mining engineering as tools for driving socio-economic development.	12.1 Demonstrate understanding of the principles underpinning entrepreneurship for the exploitation of product/service/process opportunities are understood and applied. 12.2 Explain and illustrate models of business innovation and entrepreneurship. 12.3 Develop comprehensive and well-structured business innovation plans.

QUALIFICATION STRUCTURE			SECTION C
	Title	**Level**	**Credits**
FUNDAMENTAL COMPONENT Subjects/Units/Modules/ Courses	Introduction to Technical Communication & Academic Literacy	5	6
	Engineering Graphics	6	12
	General Chemistry I	5	12
	Introduction to Programming	6	12
	Technical and Professional Communication	5	6
	Pre-Calculus	5	12
	Introduction to Mechanics	5	12
	Introduction to Engineering	6	6
	General Chemistry II	5	12
	Introduction to Calculus	5	12
	Introduction to Electricity and Magnetism	5	12
	Introduction to Statistics	5	12
	Object Oriented Programming	6	12
	Engineering Mathematics I	6	12
	Earth and Its Materials	6	12
	Statics	6	12
	Material Science	6	12
	Unit Operations I	6	12
	Land Surveying	6	12
	Engineering Mathematics II	6	12
	Principles of Engineering Geology	6	12
	Strength of Materials	6	12
	Introduction to Mining Engineering	6	12
	Engineering Mathematics III	6	12
	Workshop Practice	6	12
	Electric Circuit Theory	6	12
CORE COMPONENT Subjects/Units / Modules /Courses	Introduction to Entrepreneurship	6	6
	Mineralogy and Petrology	6	12
	Soil Mechanics	6	12
	Fluid Mechanics I	6	12
	Engineering Project Management	6	12
	Rock Mechanics	7	12
	Surface Mining Methods and Equipment	8	12
	Mine Machinery	8	12
	Computer Applications in Mining	6	12
	Mineral Processing	7	12
	Underground Mining Methods and Equipment	8	12
	Explosives and Rock Fragmentation	8	12
	Materials Handling	8	12

	Mine Power and Drainage	7	12
	Mine Health, Safety and Environment	8	12
	Industrial Training	7	36
	Mining Engineering Design Project I	8	12
	Mine Surveying	7	12
	Mine Ventilation	8	12
	Mineral Project Evaluation	8	12
	Operations Research	7	12
	Mining Engineering Design Project II	8	24
	Mine Planning and Design	8	12
	Mineral Resource Estimation	8	12
	Underground Mine Development	7	12
	Environmental Assessment and Management	6	12
	Professional Practices and Ethics	8	12
ELECTIVE COMPONENT Subjects / Units / Modules /Courses	Economics, Business and Entrepreneurship	8	12
	Mining Laws and Regulations	8	12
	Coal Mining	8	12
	Rock Engineering I	8	12
	Mine Backfill	8	12
	Mine Management	8	12
	Mineral Economics	8	12

RULES OF COMBINATIONS, CREDIT DISTRIBUTION (where applicable):

The Bachelor of Engineering (Honours) in Mining Engineering constitutes a minimum total number of 660 credits which are distributed as follows (based on the above Qualification Structure) with respect to different university and NCQF levels:

NCQF Level	Fundamental	Core	Elective	Total
5	96	-	-	96
6	198	78	-	276
7	-	108	-	108
8	-	168	12	180
Totals	**294**	**354**	**12**	**660**

Students need to choose ONE elective out of the seven optional courses listed above.

CREDIT ACCUMULATION AND TRANSFER

Credit Accumulation and Credit Transfer

Credits already obtained in a particular qualification from other Education and Training providers are recognised if the skills acquired are equivalent to the skills the student will acquire in a specific module. The credit transfer is applicable within five years from the time the credits were accumulated.

ASSESSMENT AND MODERATION ARRANGEMENTS

ASSESSMENT ARRANGEMENTS

All assessments, formative and summative, leading/contributing to the award of credits or a qualification should be based on learning outcomes and/or sub-outcomes.

Formative assessment

Formative assessment or continuous assessment contributing towards the award of credits should be based on course outcomes. This can include tests, assignments and projects as well as simulated and real work settings. The contribution of formative assessment to the final grade shall be of 40%.

Summative assessment

Candidates may undergo assessment including written and practical and simulated projects. The final examination for each course contributes 60% of the final mark for that course.

MODERATION ARRANGEMENTS

Pre-assessment moderation will be carried out before administering assessments that contribute towards the award of credits in this qualification and post-assessment moderation will be carried out after the assessment tasks have been marked.

- Internal Moderation - All assessment instruments shall be subjected to internal moderation by BQA registered and accredited Assessors and Moderators before administering to ensure fairness, validity, reliability and consistency of assessments.
- External Moderation – All assessment instruments shall be moderated by an External Moderator to ensure fairness, validity, reliability and consistency of assessments.

RECOGNITION OF PRIOR LEARNING (if applicable)

Candidates may submit evidence of prior learning and current competence and/or undergo appropriate forms of RPL assessment for the award of credits towards the qualification in accordance with applicable RPL institutional policies and national- policies and legislative framework.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal articulation:

Students may articulate horizontally to:

- Bachelor of Engineering (Honors) in Geological Engineering,
- Bachelor of Engineering (Honors) in Civil and Environmental Engineering
- Bachelor of Engineering (Honors) in Mineral Processing

Vertical articulation:

Students may articulate vertically to:

- Master of Engineering in Mining Engineering
- Master of Engineering in Geological Engineering,
- Master of Engineering in Civil and Environmental Engineering
- Master of Engineering in Mineral Processing

EMPLOYMENT PATHWAYS

The graduates of this qualifications can be employed as:

- Mining Engineer.
- Ventilation Engineer.
- Geotechnical Engineer.
- Mining Inspector.
- Explosives Engineer.
- Drill and Blast Engineer.

QUALIFICATION AWARD AND CERTIFICATION

Minimum standards of achievement for the award of the qualification

A candidate is required to achieve a minimum of 660 credits, inclusive of the fundamental, core and elective components. Candidates meeting prescribed requirements will be awarded the qualification of Bachelor of Engineering (Honours) in Mining Engineering in accordance with standards prescribed for the award of the qualification and applicable policies.

Certification

A certificate and transcript of the award of the degree of Bachelor of Engineering (Honours) in Mining Engineering will be given upon successful completion of the qualification.

REGIONAL AND INTERNATIONAL COMPARABILITY

This comparability matrix presents five (5) qualifications (two (2) in the SADC region, two (2) from the USA and one (1) from Australia), which were used for benchmarking purposes in developing the Bachelor of Engineering (Mining Engineering) qualification at the Botswana International University of Science and Technology. The universities in the SADC region are the University of Witwatersrand and University of Pretoria which offer a Bachelor of Science in Engineering (BSc Eng.) degree in Mining Engineering and Bachelor of Engineering (BEng) in Mining Engineering respectively. The two from the USA, Colorado School of Mines and Missouri University of Science and Technology both offer Bachelor of Science in Mining Engineering. The University of Adelaide which represents one of the universities under Mining Education Australia (MEA) offers a Bachelor of Engineering (Honours) Mining Engineering degree. MEA comprises the University of Adelaide, the University of New South Wales, the University of Queensland and Curtin University which offer a common curriculum for years 3 and 4 of the Bachelor's degree in Mining Engineering.

The **University of Pretoria (South Africa)** offers a four year Bachelor of Engineering in Mining Engineering with a total of 692 Credits at level 8 (SAQA). The exit outcomes are Engineering problem solving, application of specialist and fundamental knowledge, with specific reference to mathematics, basic sciences and engineering sciences, Engineering design and synthesis, Investigation, experimentation and data analysis, Engineering methods, skills, tools and information technology, Professional and general communication, Awareness and knowledge of the impact of engineering activity on society and the physical environment, Work in teams and in multidisciplinary environments, An awareness and ability for lifelong learning as well as An awareness and knowledge of principles of professional ethics and practice. It covers Math & Science, Fundamental Engineering, General education and mining engineering courses. The mining engineering domains covered include mineral economics, surface mining, rock mechanics, explosives engineering, mineral processing, engineering management, mine ventilation, as well as mine planning and design. It uses written tests and examinations, major term projects in the final years as assessment strategies.

Witwatersrand University (South Africa) offers a four-year Bachelor of Engineering (Honours) in Mining Engineering at NQF Level 8, with a minimum 594 credits for graduation. The first year comprises of both science and engineering (mechanics, engineering skills) courses unlike at BIUST where only science courses are covered. Most of the engineering courses are covered from year 2 and the domains covered include 594 credits of engineering courses, 88 credits of science and 38 credits of social sciences. One observation made is that students at WITS only do investigational project unlike at BIUST where students do both investigational and group design projects.

Colorado School of Mines (USA) offers a four-year Bachelor of Science in Mining Engineering with a total of 139.5 Semester hours. The exit outcomes are a sound knowledge

in the required basic sciences and engineering fundamentals; knowledge and experience in the application of engineering principles to the exploitation of earth's resources and construction of earth (rock) systems in an engineering systems orientation and setting; ability to solve complex mining and earth systems related problems; capability for team work and decision making; Appreciation of the global role of minerals in the changing world; desire for continuing education, intellectual and professional development, analysis and creativity; as well as self-confidence and articulation, with high professional and ethical standards. It covers Math & Science, Fundamental Engineering, general education and mining engineering courses. The mining engineering domains covered include rock mechanics, rock fragmentation, plant and mine design, mine ventilation, surveying, valuation, industrial hygiene, mineral law, mine safety, computing, mineral processing, solution mining and operations research. It uses written tests and examinations, major term projects in the final years as assessment strategies**.**

Missouri University of Science and Technology (USA) offers a four-year Bachelor of Engineering (Honours) degree in Mining Engineering. The exit outcomes include solving mining engineering problems, understanding environmental, socio-economic, and the health and safety impacts of mining engineering, proficiency in carrying out professional duties of an entry level mining engineer, performing comprehensive mine design, extraction and mineral beneficiation, ability to outline and conduct experiments, functioning effectively in a team by understanding team, understanding engineering code of ethics and its impact on professional engineering practice, ability to communicate effectively, developing leadership skills as well as acquiring the knowledge and familiarity of the complex relationships among technology, government, society, investors, and the environment and their impact. The domains covered in the qualification include basic sciences, including mathematics, statistics, physics and chemistry, engineering principles in statics and dynamics, mechanics of rock structures, electrical circuits, thermodynamics, fluid mechanics and engineering design; humanities, social sciences and management; mining geology and mineral processing as well as mining Engineering with emphases in Environmental Engineering, Coal mining, Explosives engineering, Quarrying Engineering, Suitable Development, Mining Health and Safety.

The **University of Adelaide (Australia)** offers a four-year Bachelor of Engineering (Honours) Mining Engineering at AQF Level 8 with 96 units. The exit outcomes Engineering discipline and knowledge, Critical thinking and problem solving, Teamwork and communication skills, Career and leadership readiness, Intercultural and ethical competency as well as Self-awareness and emotional intelligence. The degree focuses on engineering problem-solving, analysis and design, optimisation, computer-based methods and research, and communication and management skills. The domains covered in the qualification include foundation studies in engineering, mathematics and science in the first two years and Mining courses in the last two years. Mining domains covered include mine planning and design, mining systems, geology and resource estimation, geotechnical and rock mechanics, mine ventilation, mining economics, management and finance, project

evaluation and environmental considerations. Its assessment strategy is a combination of class work, tutorials, assignments, laboratory work, quizzes, project work and exams.

Similarities	Differences
1. The structure of the qualifications is similar with the first year providing Mathematical and Science courses, followed by Fundamental Engineering Courses in second year, which includes introductory courses in the disciplines. The penultimate and final years deal with detailed core mining engineering courses coupled with some design and research project in the final year. 2. Employability pathways are largely similar; 3. Assessment is generally formative for in class tests and summative for final examinations. 4. Most qualifications have an industrial attachment component 5. All qualifications run for four years 6. All qualifications except for Missouri University of Science and Technology give limited options in the qualification structure. 7. The Employment Pathways are similar.	1. The universities use different systems for credits. While Colorado School of mines and University of Adelaide use semester hours and units respectively, University of Pretoria and Missouri University of Science and Technology use credits. 2. The credit requirement for each qualification does not seem to be compatible. For instance, the credit requirement for University of Pretoria with a three-year qualification at 692 credits is much higher than all with 139.5 semester hours, 96 units and 128 credit hours for Colorado School of mines, Adelaide University and Missouri University of Science and Technology respectively 3. Qualifications awarded vary from continent to continent. The two American Universities; Colorado School of mines and Missouri University of Science and Technology offer BSc in Mining Engineering. University of Adelaide offer BSc (Eng) in mining Engineering and BEng in mining Engineering respectively. 4. Missouri University of Science and Technology allows for specialisations in the final year.

REVIEW PERIOD

The review period of qualification is five years

OTHER INFORMATION

REGIONAL AND INTERNATIONAL COMPARABILITY MATRIX HAS BEEN INCLUDED