QUALIFICATION SPECIFICATION SECTION A						
QUALIFICATION DEVELOPER	Botswana International University of Science and Technology (BIUST)					
TITLE	Bachelor of Science (Honours) in Chemistry (Materials and Applied Chemistry)			**NCQF LEVEL**	8	
FIELD	Natural, Mathematical and Life Sciences		**SUB-FIELD**	Materials and Applied Chemistry		
New qualification	✓	Review of existing qualification				
SUB-FRAMEWORK	General Education		TVET		Higher Education	✓
QUALIFICATION TYPE	Certificate		Diploma		Bachelor	
	Bachelor Honours	✓	Master		Doctor	
CREDIT VALUE 126						

1. RATIONALE AND PURPOSE OF THE QUALIFICATION

Rationale of the qualification

The high demand for chemists with required and specialised skills has been indicated by various local, regional and international reports and documents. The Botswana Human Resources Development Council (Top Occupations in high Demand as at December 2016) lists Science and Technology Researchers, Water Chemists and Chemical Technicians as being in demand in Botswana. According to the Department of Research and Technology report (DRST 2019), chemistry professionals are required in the mining, energy, agriculture and health sectors. Physical Scientists and Physical Science Technicians are also in short supply in the education sector. Most of researchers in Botswana hold Bachelors/Masters degrees as opposed to Doctorate degrees (DRST 2009). There is therefore need to upgrade Chemistry researchers to Honours, Masters and PhD levels. Chemists, including chemistry teachers enjoy the highest scarce skill

allowance of 40% to basic salary and are categorized in the same bracket as medical doctors, dentists, engineers, architects, quantity surveyors, pharmacists. Laboratory chemist are also categorized as a profession with acute scarcity (Tsa Badiri Consultancy 2015).

Chemistry is required to support other disciplines such as biology, engineering, pharmacy and medicine. Materials chemistry is a really exciting area to be involved in, as new discoveries such as nanomaterials or new functional materials have the capacity to make major and immediate contributions to society. The proposed qualification will help to diversify the economy as there is potential for growth in the manufacturing industry. Botswana as a cattle country has potential for vibrant soap and leather industries. In addition to this, Botswana has the potential to develop IV fluids and drugs. Botswana can also convert its huge supply of coal into high value petroleum and chemical products. This could replace imported fuels and other chemicals. During the National Development Plan (NDP) 11 the Botswana Government will continue to grow the economy through beneficiation of minerals, various agricultural products and indigenous products / herbs. The proposed programme will produce graduates with relevant skills to work in these sectors.

The high demand for chemistry graduates applies regionally and internationally. The Republic of South Africa has a high demand for Environmental analysts and researchers. Other area of high demand in South Africa which rely on the Chemists include Research and Development Managers, Environmental Managers, Safety, Health, Environment and Quality Practitioners, Air Pollution Analyst, Water Quality Analyst, Physical Science Teachers, Natural Science Teachers, Chemistry Technicians, Physical Science Technicians, Forensic Technicians, Food and Beverage Technicians, Manufacturing Technicians and Water Inspectors (South Africa Government Gazette 2014). Chemists are also required in the oil sector as 11 African countries have proven oil reserves (https://www.sablog.kpmg.co.za/2014/04/african-chemical-industry-hidden-opportunity/). In the United states of America, the demand for Chemists and Chemical Technicians grew by 3.1% and 4.2%, respectively in 2014 (Rovner, 2014). Chemists are in demand in Australia (http://www.visabureau.com/australia/anzsco/jobs/chemist-jobs-australia.aspx). The proposed qualification is in line with vision 2036 as it will promote the following pillars (i) a knowledge based economy - the use of science, technology and innovation to propel economies to high levels of efficiency is key to supporting socio-economic development (ii) promote human capital development as the country will have developed an internationally competitive workforce that is productive and has international exposure and (iii) Education and skills development-Botswana society will be knowledgeable with relevant quality education that is outcome based, with an emphasis on technical and vocational skills as well as academic

competencies and (iv) Ecosystem functions and services-providing research for the identification and development of marketable products. It will also produce chemists (and Chemical Scientists) for the region as well as the international community.

Purpose of the qualification

The purpose of this qualification is to produce graduates who can apply highly specialized knowledge, skills and competences to:

- Develop and synthesize new materials and subsequent processes
- Apply advanced research at industrial levels to improve life
- Apply research skills to conduct applied research to address various materials science problems involving applied chemistry facing the country and the world at large working in multidisciplinary teams.

2. ENTRY REQUIREMENTS (including access and inclusion)

- Bachelor degree, NCQF level 7
- Applicants who do not meet the above criteria but possess relevant industry experience may be considered through the Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer policy for access and inclusion. This consideration will be done following guidelines of the ETP relevant policies inline with BQA/National policies.

3. QUALIFICATION SPECIFICATION SECTION B

GRADUATE PROFILE (EXIT LEARNING OUTCOMES)	ASSESSMENT CRITERIA
3.1 Apply highly specialized knowledge of Applied Chemistry concepts in the analysis of materials	3.1.1 Demonstrate comprehensive understanding of applied chemistry literature knowledge in strengthening or combining materials or developing new materials for applications such as diagnostics.

	3.1.2 Use knowledge understanding for critical assessment of a wide range of ideas and problems in the field of applied chemistry when developing new materials such as ceramics.
3.2 Demonstrate the use of highly specialized knowledge of applied science in the characterization of materials	3.2.1 Use appropriate analytical tools to determine properties of materials such as strength and mechanical properties. 3.2.2 Use specific techniques to determine the suitable application of materials such as energy storage and filtration.
3.3 Use evidence based comparative chemistry approach when analyzing and synthesizing materials	3.3.1 Resolve materials properties for specialized applications such as energy storage and filtration. 3.3.2 Apply green chemistry initiatives in synthesis of new materials.
3.4 Communicate the results of highly specialized academic field studies using main concepts, constructs and techniques to audience	3.4.1 Use scientific language correctly to produce clear and coherent written laboratory and research reports. 3.4.2 Use appropriate referencing conventions avoid plagiarism and observe intellectual property laws in written reports 3.4.3 Conduct seminar presentations to a wider audience 3.4.3 Attend and contribute to internal and external project meetings
3.5 Employ highly specialized problem-solving skills relating to qualitative and quantitative data in Materials and Applied Chemistry	3.5.1 Analyze abstract Materials and Applied Chemistry problems in familiar and unfamiliar contexts in materials development. 3.5.2 Apply the knowledge of applied chemistry in solving identified problems such as processes of materials development.
3.5 Employ highly specialized problem-solving skills relating to qualitative and quantitative data in Materials and Applied Chemistry	3.5.1 Analyze qualitative and quantitative scientific data in familiar and unfamiliar contexts for materials development. 3.5.2 Integrate data analysis results in solving identified problems such as processes of materials development.
3.6 Work effectively as a member of a team in Materials and Applied	3.6.1 Contribute effectively and meaningfully to group work in teamwork assignments.

Chemistry projects and investigation studies	3.6.2 Apply organizational skills in managing teamwork.
3.7 Apply highly specialized scientific knowledge with core ethical virtues in resolving societal issues	3.7.1 Demonstrate sensitivity when dealing with confidential analyzed data in new materials development and processes 3.7.2 Take ethically and culturally sensitive decisions when dealing with sensitive data
3.8 Apply appropriate research methods to solve problems in search for development of new materials and processes	3.8.1 Select appropriate chemistry methodologies, collect accurate and relevant data, evaluate recent literature and discuss and present the results. 3.8.2 Evaluate and critique current research practices and techniques in materials development. 3.8.3 Compare theoretical predictions with published data to evaluate the significance of the results in context. 3.8.4 Explain implications of the research project findings on the problem under consideration. 3.8.5 Analyze and draw conclusions on the results of an experiment 3.8.6 Propose recommendations related to the research problem.
3.9 Apply highly specialized research knowledge, skills and competence in a practical research project aligned to Materials and Applied Chemistry	3.9.1 Select a Materials and Applied Chemistry project and use relevant research methodology to produce meaningful results. 3.9.2 Evaluate literature review on a selected research topic when writing a research report. 3.9.3 Analyze collected research data using appropriate analytical tools such as electron microscopy. 3.9.4 Discuss and present results in the form of a written report and oral presentation to clients and stakeholders.

4. QUALIFICATION STRUCTURE

SECTION C

	Title	Level	Credits
FUNDAMENTAL COMPONENT Subjects / Units / Modules /Courses			
CORE COMPONENT Subjects / Units / Modules /Courses			
	Advanced Applied Inorganic Chemistry, Analytical and Physical Chemistry	8	48
	Advanced Materials Chemistry	8	48
	Advanced Research Project	8	30
ELECTIVE COMPONENT Subjects / Units / Modules /Courses			

4.1 Rules of combinations, Credit distribution (where applicable):

Table 1. Credit Distribution

NCQF Level	Credit Contribution
Level 8	126
Total Credits	126

Table 2. Credit Contribution for Fundamental and Core modules

Component	Credit Contribution
Core modules	126
Total Credits	126

5. ASSESSMENT AND MODERATION ARRANGEMENTS

Formative Assessment

Formative assessment contributes 50% towards final grade.

Summative Assessment

Summative assessment contributes 50% of the final grade.

Assessors must be BQA registered and accredited

Moderation Arrangements

Moderators must be BQA registered and accredited. Internal and external moderation will be done in line with both institutional and national policies.

6. RECOGNITION OF PRIOR LEARNING (if applicable)

Recognition of prior learning (RPL) will be implemented for this qualification in accordance with relevant RPL principles and common practices. It will be implemented in accordance with the relevant national RPL guiding instruments such as National Policy and/or guidelines

Credit Accumulation and transfer system will also be implemented for this qualification to recognize previously acquired learning and attainment.

7. PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Learning pathway

This qualifications is designed to facilitate vertical, horizontal and diagonal progression both locally and internationally.

Horizontal Progression

Graduates of this qualification my consider pursuing related qualification for the purpose of multiskilling, retooling and to gain expert knowledge in Chemistry for Materials and Applied Chemistry. Credit transfer, module mapping and exemptions can be exercised in the following programmes:

- Bachelor of Science (Hons) in Materials Science
- Bachelor of Science in (Hons) Polymer Science
- Bachelor of Science Chemistry (Hons) (Materials and Nano Chemistry)
- Bachelor of Science Chemistry (Hons) (Environmental and Analytical Chemistry)

Vertical Progression

Students graduated from this qualification may progress to level 9 qualifications such as:

- Master of Science in Physical Chemistry
- Master of Science in Inorganic Chemistry
- Master of Science in Analytical Chemistry
- Master of Science in Materials Chemistry

Diagonal Progression

Students may progress diagonally between qualifications by presenting a completed qualification or credits towards a qualification in a similar study area, and must meet minimum requirements for admission to the target qualification, which they will often do by virtue of the credits obtained towards an equivalent qualification.

Employment pathways

The qualification will produce highly employable graduates with a broad background in academic chemistry and significant experience of the application of chemistry in contexts relevant to society and industry. Typical roles include:

- Site Chemist
- Materials Chemist
- Research and Development Chemist
- Development Chemist

8. QUALIFICATION AWARD AND CERTIFICATION

A candidate will be awarded a qualification in Bachelor of Science Honours in Chemistry (Materials and Applied Chemistry) upon meeting the minimum of 126 credits as prescribed in the rules of combination.

Certificate and transcript will be issued to graduates upon successful completion of Bachelor of Science Honours in Chemistry (Materials and Applied Chemistry)

9. REGIONAL AND INTERNATIONAL COMPARABILITY

BSc (Hons) in Chemistry with Materials from Heriot Watt University (Edinburgh) is offered under The Scotland Credit and Qualifications Framework, UK at level 10. This is an additional year program after bachelors program and aims to instill in students a sense of enthusiasm for chemistry, an appreciation of its application in different contexts and to involve them in an intellectually stimulating and satisfying experience of learning and studying. It provides students with advanced chemical knowledge and practical skills, and also the ability to apply their chemical/materials knowledge and skills to the solution of theoretical and practical problems in chemistry. Understanding, knowledge and subject-specific skills are assessed by a variety of means, such as web-based tests, coursework assignments, essays, unseen written examinations, laboratory reports, project work and presentations.

The McGill University in Australia offers BSc Hons Chemistry – Materials under Ontario Qualifications Framework, Canada at level 11. Attainment of the Honours degree requires an entry CGPA of at least 3.00 from BSc Chemistry-Materials. This degree leads to a wide variety of professional vocations. The large science-based industries (petroleum refining, plastics, pharmaceuticals, etc.) all employ chemists in research, development, and quality control. Many federal and provincial departments and agencies employ chemists in research and testing laboratories. Graduates may proceed further studies in specialized area of chemistry or multi-disciplinary areas involving chemistry.

Another similar program is offered at the University of Cape Town under South African Qualifications Framework, South Africa at level 8. Bachelor of Science (Honours) in Materials Science degree aims to provide one year of intensive training in Materials Science and Technology. The broad-based instructional approach prepares graduates for careers in a wide range of industrial settings, from small manufacturing companies to large corporations producing bulk commodity products, and research and development laboratories.

The proposed BSc Hons in Chemistry (Materials and Applied Chemistry) compares well with three international programs offered by Heriot Watt University (Scotland), McGill University (Canada) and University of Cape Town (South African) in terms of the comparisons of content scope and learning outcomes hours to be achieved before assessment. These universities follow the guidelines required by the Royal Science of Chemistry and American Chemical Society Guidelines and Evaluation Procedures for Honours Degree Programs.

10. REVIEW PERIOD

The review shall be done after 5 years as per cycle or as and when necessary.