University of Botswana ***SECTION A:***														***QUALIFICATION DETAILS***	
QUALIFICATION DEVELOPER (S)	University of Botswana														
TITLE	Bachelor of Engineering (Honours) Mechanical Engineering													***NCQF LEVEL***	*8*
FIELD	Manufacturing, Engineering and Technology		***SUB-FIELD***		Mechanical Engineering									***CREDIT VALUE***	*600*
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:

The Bachelor of Engineering Honours (Mechanical) qualification is designed with an informed constructive alignment between credit-bearing courses in core engineering knowledge areas, practical skills training, and activities targeting the evolution of appropriate social, cultural and ecological responsibility among its graduates. In particular, the goal of producing creative, competent and motivated professional graduates who are capable of independent critical and innovative thinking for the development of infrastructure and vibrant industries is paramount. The industrial attachment scheme embedded in the qualification further provides the students with basic experience which, upon graduation, enables them to contribute to national strategic goals through real-

life and problem-based practical learning experiences. With these provisions, the degree qualification, in addition to the stated objectives, will:

- Fulfil the needs of the Botswana's industry for degree holders in Mechanical Engineering.
- Contribute to the objectives of National Development Plans (NDP11) and Vision 2036 https://statsbots.org.bw/vision-2036-1) of the National Strategic Plan. It directly contributes towards national strategy of knowledge-based economy, HRDC policy on access to tertiary education, research, Science, and technology, and is a priority area of HRDC

PURPOSE:

The purpose of this qualification is to produce graduates with skills and competencies to:

- Provide technical and innovative solutions in the field of mechanical engineering.
- Solve complex engineering problems creatively and innovatively.
- Apply knowledge of mathematics, natural sciences, engineering fundamentals and an engineering specialty to solve complex engineering problems.
- Perform creative, procedural and non-procedural design and synthesis of components, systems, engineering works, products or processes.
- Design and conduct investigations and experiments.
- Apply engineering methods, skills and tools, including information technology.
- Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

ENTRY REQUIREMENTS (including access and inclusion)

- Minimum of Certificate IV, NCQF Level 4 (General Education or TVET).
- Candidates with Diploma in a related field may be considered through Recognition of Prior Learning in accordance with applicable policies.

SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
1. Apply knowledge of mathematics, basic science and engineering sciences from first principles to solve engineering problems.	1.1 Identify and solve open-ended engineering problems 1.2 Identify and pursue engineering applications. 1.3 Work across engineering disciplinary boundaries through cross disciplinary literacy and shared fundamental knowledge.
2. Demonstrate competence to identify, assess, formulate and solve *convergent* and *divergent* engineering problems creatively and innovatively.	2.1 Analyse and define the problem, identifies the criteria for an acceptable solution. 2.2 Identify necessary information and applicable engineering and other knowledge and skills. 2.3 Generates and formulates possible approaches to solution of problem. 2.4 Models and analyses possible solution(s). 2.5 Evaluates possible solutions and selects best solution. 2.6 Formulates and presents the solution in an appropriate form.
3. Perform creative, *procedural* and *non-procedural* design and synthesis of components, systems, engineering works, products or processes.	3.1 Identifies and formulates the design problem to satisfy user needs, applicable standards, codes of practice and legislation. 3.2 Plans and manages the design process: focusses on important issues, recognizes and deals with constraints. 3.3 Acquires and evaluates the requisite knowledge, information and resources:

	3.4 Performs design tasks including analysis, quantitative modelling and optimization. 3.5 Evaluates alternatives and preferred solution: exercises judgment, tests implementability and performs techno-economic analyses. 3.6 Assesses impacts and benefits of the design: social, legal, health, safety, and environmental. 3.7 Communicates the design logic and information.
4. Demonstrate competence to design and conduct investigations and experiments.	4.1. Plans and conducts investigations and experiments. 4.2. Conducts a literature search and critically evaluates material. 4.3. Performs necessary analyses. 4.4. Selects and uses appropriate equipment or software. 4.5. Analyses, interprets and derives information from data. 4.6. Draws conclusions based on evidence. *4.7.* Communicates the purpose, process and outcomes in a technical report.
5. Use appropriate engineering methods, skills and tools, including those based on information technology.	~~5.1.~~ Select and assess the applicability and limitations of the method, skill or tool. 5.2. Properly apply the method, skill or tool. 5.3. Critically test and assess the end-results produced by the method, skill or tool. *5.4.* Create computer applications as required by the discipline.

6. Demonstrate subject specific skills through hands on engagement in Mechanical engineering	6.1 Use appropriate equipment and tools in designing products, services and systems. 6.1. Handle and manipulate appropriate materials and technologies in designing products, systems and services. 6.2. Apply simulation-based methodologies ~~to~~ optimize factory conditions~~.~~
7. Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments.	7.1. Identifying and executing tasks effectively 7.2. Make individual contribution to team activity
8. Communicate effectively, both orally and in writing, with engineering audience and the community at large.	8.1 Use structure, style and language appropriate for purpose and audience8.2 Use effective graphical support. 8.2 Use appropriate structure, style and language. 8.3 Use appropriate visual materials. 8.4 Deliver fluently. *8.5* Meet the requirements of the intended audience.
9. Demonstrate discipline specific responsibilities relevant to society.	9.1. Demonstrate understanding of the societal, health, safety, legal and cultural issues. 9.2. Demonstrate understanding of consequent responsibilities relevant to engineering practice.
10. Apply ethical principles and commit to professional ethics, responsibilities and norms of engineering technology practice.	10.1 Demonstrate understanding of professional ethics and responsibilities and norms of engineering practice. 10.2 Demonstrate commitment to professional ethics, responsibilities and engineering practice.

	10.3 Demonstrate responsibility for own work, use of resources, and accountability for own decisions and actions. 10.4 Apply ethical considerations when designing sustainable products, services and systems and also while doing assignments, projects, tests and examinations. *10.5* Identify and address ethical issues based on critical reflection on the suitability of different ethical value systems to specific contexts.
11. Interact with the planet to maintain natural resources	11.1 Demonstrate understanding of the impact of engineering solutions in a societal context and 11.2 Demonstrate knowledge of and need for sustainable development.
12. Demonstrate the knowledge on business management and finance.	12.1 Demonstrate knowledge of management and business practices, such as risk and change management, and understand their limitations. 12.2 Demonstrate understanding of management and business practices, such as risk and change management, and understand their limitations.
13. Engage in independent and lifelong learning through well-developed learning skills.	13.1 Recognize the need for and have the ability to engage in independent and lifelong learning.

SECTION C	***QUALIFICATION STRUCTURE***				
COMPONENT	***TITLE***	***Credits Per Relevant NCQF Level***			***Total*** ***(Per** Subject/ Course/ Module/ Units)*
		Level [6]	***Level [7]***	***Level [8]***	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/Units*	Engineering Mathematics	*16*	*16*		*32*
	Materials Science for engineers		*14*		*14*
	Engineering Mechanics: Statics		*14*		*14*
	Workshop Technology		*13*		*13*
	Electrical fundamentals	*12*	*12*		*24*
	Engineering and Computer Aided Drawing		*12*		*12*
	Mechanics of Materials		*13*		*13*
	Dynamics of particles		*12*		*12*
	Computer Programming, I		*14*		*14*
	Industrial Training		*40*		*40*
CORE COMPONENT	Engineering Mathematics III			*16*	*16*
	Measurement and Instrumentation			*12*	*12*

Subjects/Courses/ Modules/Units	Materials in Engineering			*14*	*14*
	Mechanics of Solids			*28*	*28*
	Dynamics of Rigid Bodies			*14*	*14*
	Electrical Machines			*14*	*14*
	Thermodynamics			*24*	*24*
	Fluid Mechanics		*12*	*12*	*24*
	Theory of Machines			*12*	*12*
	Industrial Attachment			*40*	*40*
	Foundation of Engineering Law			*10*	*10*
	Machine Design			*28*	*28*
	Heat Transfer Processes			*12*	*12*
	Manufacturing Processes			*12*	*12*
	Systems & Control Engineering I			*12*	*12*
	Engineering Economics			*12*	*12*
	Environmental Engineering			*12*	*12*
	Mechanical Engineering Project			*48*	*48*
	Thermal & Fluid Systems Design			*12*	*12*
	Engineering and Project Management			*12*	*12*

	Maintenance Engineering			*12*	*12*
	Professional Ethics and Practice			*10*	*10*
ELECTIVE/ OPTIONAL COMPONENT *Subjects/Courses/ Modules/Units*	Introduction to Sociological Concepts and Principles	*10* *(1 out of 4)*			*10*
	Sociology of Development				
	Introduction to Public Administration				
	Introduction to Political Science				
	Systems & Control Engineering II			*12* *(1 out of 6)*	*12*
	Advanced Manufacturing Processes				
	Industrial Tribology				
	Building Services Engineering				
	Mechatronics Engineering				
	Pneumatics & Hydraulics Systems				

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	***Credit Value***

6	***38***
7	***172***
8	***390***
TOTAL CREDITS	***600***

Rules of Combination:

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

The Bachelor of Engineering Honours (Mechanical) qualification is composed of mechanical engineering courses. To attain this qualification, students should fulfil the requisite learning outcomes in fundamental, core, and electives courses.

Students should complete minimum of 600 credits.

At least two third of the total credits must come from fundamental and core courses prescribed in the qualification, and the total credits from elective courses shall not exceed one third of the total credits.

Where there have been exemptions for the credits (grade points from other institutions are not transferable) the cumulative GPA shall be computed on the basis of work done in the intuition only.

NCQF exit level 8

Minimum total number of credits following Certificate IV 600

Minimum total number of credits at the exit level (Level 8) 390

Maximum number of credits at level 6 38

Maximum number of credits at level 7 172

Total Credits = 600

The credit combination for this qualification is from 188 fundamental components, 390 core components and the remaining 22 is from elective components.

ASSESSMENT ARRANGEMENTS

Formative assessment

Formative assessment or continuous assessment will contribute 40% towards the final grade.

The contribution of formative assessment to the final grade is 40%

Summative assessment

The contribution of summative assessment to the final grade is 60%

MODERATION ARRANGEMENTS

Both internal and external moderation shall be done in accordance with applicable policies and regulations and shall be carried out by BQA registered and accredited moderators.

RECOGNITION OF PRIOR LEARNING

There will be provision of awarding this qualification through Recognition of Prior Learning BQA RPL policy and the well-established ETP RPL Policy.

CREDIT ACCUMULATION AND TRANSFER

There will be provision of awarding this qualification through Credit accumulation and Transfer in line with BQA RPL policy and the well-established ETP RPL Policy.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal Articulation (related qualifications of similar level that graduates may consider):

- BEng Manufacturing Engineering
- BEng Production Engineering
- BEng Industrial Systems Engineering
- BEng Mechatronics
- BEng Aeronautical Engineering

Vertical Articulation (qualifications to which the holder may progress to):

- MSc Mechanical Engineering
- MEng Mechanical Engineering
- MSc Project Management
- MSc Manufacturing
- MPhil Mechanical Engineering
- MPhil Mechanical engineering

Diagonal pathways (qualifications to which the holder may progress to):

- MEng Logistics and Supply chain management
- MSc Project Management

Possible jobs or employment which the holder of this qualification may take up:

- Production Manager
- Manufacturing Manager
- Production supervisor
- Manufacturing Supervisor
- Plant Manager Technical Manager
- Quality Assurance Manager
- Maintenance Manager
- Projects Manager

QUALIFICATION AWARD AND CERTIFICATION

Minimum standards of achievement for the award of the qualification

The candidate must have met the following requirements:

- All exit level outcomes
- Minimum credit requirements
- All qualification requirements including core, optional, electives, general education courses and Mechanical training attachment Certification

Upon completion of the qualification, the candidate will be awarded a Bachelor of Engineering (Mechanical) degree. *(Award the degree upon completion of the qualification)*

REGIONAL AND INTERNATIONAL COMPARABILITY

The Department compared current qualification with similar qualifications regionally and internationally to incorporate best practices. The department benchmarked with similar qualifications from the University of Cape Town (RSA), Georgia Tech, The George W. Woodruff School of Mechanical Engineering (USA) and McGill University (Canada). Summaries of similarities and differences in qualifications are presented below, and this is based on information available on public domain, where some information is unavailable for some desired comparisons:

Similarities:

The main similarities observed include: Title of proposed qualification is the same with benchmark institutions i.e., Bachelor of Science, Mechanical Engineering; Learning outcomes are largely similar and include problem solving, engineering design and synthesis; investigation, experimentation and data analysis, engineering methods, and information technology and communication skills.

Differences:

The Current qualification (a professional qualification level of honours) has NQF level 8 with 600 credits, while University of Cape Town offers NQF level 8, 576 Credits; The George W. Woodruff School of Mechanical Engineering (USA) offers a 129-credit programme; and McGill University (Canada) offers OQF level 10 with 129 credits. Information on assessments is not available for all bench marking programmes, but the current qualification is assessed in terms of tests, assignments, quizzes, mini-projects, projects and oral presentations.

REVIEW PERIOD

This qualification will be reviewed after 5 years upon registration.