SECTION A:	***QUALIFICATION DETAILS***															
QUALIFICATION DEVELOPER (S)	Kitso International College															
TITLE	Diploma in Automotive Electrical Technology													***NCQF LEVEL***		*6*
FIELD	Manufacturing, Engineering and Technology		***SUB-FIELD***		Engineering and Engineering Trades									***CREDIT VALUE***		*385*
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 rationale of the **Diploma in Automotive Electrical Technology (DAET)** is premised on the following national strategic planning documents and annual reporting documents from Botswana's key governance institutions

Botswana National Development Plan 10 and 11 advocated for the development of skills aligned to the country's labour market based on the Human Resource Development Strategy survey administered by the Human Resources Development Council (HRDC). Automotive Engineering was identified as a key area for skills development. The following skills in the Automotive Engineering area are illustrated as in the document found from the HRDC 2016 report Top 20 Occupations[1]. The skills required are Heavy Plant Mechanic,

Hydraulics Mechanic, Diesel Mechanic and Auto Electricians. These skills were identified as top priority skills areas for human capital development. HRDC Report (2016).

According to the Central Statistical Office (CSO) of Botswana Report on Transport & Infrastructure Statistics Report (2017, pg11), the national vehicle stock increased from 256,498 vehicles to 527,901 by 2017. The growth was largely attributed to privately owned vehicles which constitute 97.6% of the total vehicle population which occurred at an average growth of 18243 vehicles per year from 2008 to 2017. The CSO further reported that vehicle accidents that occur constituted vehicle rollover", "side vehicle" collisions accidents, "rear end" and "head on" collusions. An accident-damaged vehicle entails repairing structural and non-structural damages. The skills in Automotive Electrician or Mechanical Technology henceforth form the essential set of skills needed for repairing accident-damaged cars. Skills in Automotive Electrician or Electrical Technology are the skills needed to diagnose, test, service, repair/replace and install any electrical systems, sub-systems, and components on vehicles. This sentiment is also expressed by the Bank of Botswana Annual report (2015, p92) which mentions that "as a landlocked country, Botswana is heavily dependent on efficient transport and communications and where utility provision is relatively expensive and erratic, business face productivity and competitiveness challenges.

Efficient Transport implies the maintenance and installation of functional electrical and electronic systems by Automotive Electrical Technicians. Therefore, the development of human capital that has critical automotive electrical technology skills for the automotive engineering industry is not an option but a must as it is contributory to the economy's vibrancy. This viewpoint is also shared by the Ministry of Trade and Industry as expressed in their Economic Diversification Drive: Medium to Long-term Strategy Plan (2011-2016). Transport plays a critical role in the prioritized economy drive sectors such as agro-processing, leather and ternary, renewable energy, primary production, construction, building, and mining.

Automotive Engineering skills are also playing a very critical role in the country's formal and informal sectors of Botswana's economy. Therefore, training people in Automotive Engineering skills is not only rendering services to the labour market but is also playing a critical role in SME formation and hence employment creation, poverty reduction and economic diversification.

PURPOSE:

The purpose of the diploma in Automotive Electrical Technology qualification is to provide graduates with knowledge, skills, and competence to:

- Assemble, fit, and repair automobile auxiliary harnesses.
- Build auto-electrical circuits.
- Perform basic welding/joining of metals.
- Remove and fit automobile components.
- Select and use vehicle lifting equipment.
- Diagnose and service automobile batteries and battery system components.
- Select, use and care for engineering hand and power tools.
- Comply with safety, health, and environmental requirements in the workplace.
- Understand and apply the fundamentals of engine technology.

ENTRY REQUIREMENTS (including access and inclusion)

Minimum entry requirement for this qualification is a:

Certificate IV, NCQF Level 4, or equivalent, best 6 subjects with a C or better in English, Mathematics, Physics and Chemistry.

Recognition of Prior Learning (RPL):

There shall be provision for entry through Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) in line with institutional and national policies.

SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
LO1: Apply knowledge and understanding of Safety, Health, and Environmental Risk (SHER)	1.1 Observe personal safety for all stakeholders and ensure the applications of the legislative regulatory requirements. 1.2 Identify hazards in the workplace that pose danger to personal health and provide solutions to them in accordance with regulated safety standards per your industry. 1.3 Maintain a register of the occurrence of incidents of accidents in line with organizational requirements. 1.4 Apply appropriate action to control unsafe or unhealthy hazards and propose methods of eliminating them.
LO2: Apply knowledge and skill of machine shop practices to include, human and equipment safety and operation, as it relates to an engineering environment.	2.1 Demonstrate knowledge of metallurgy and properties of other engineering materials. 2.2 Apply hand tools to perform machine shop bench operations. 2.3 Select and use temporary and permanent methods of joining metals and other engineering materials. 2.4 Demonstrate application of machine tools to solve engineering tasks. 2.5 Perform different welding processes and explain their application to engineering materials and components.
LO3: Demonstrate knowledge and skill of diesel engine internal combustion operation, maintenance, and service.	3.1 Demonstrate steps required to change diesel engine oil and filter. 3.2 Diagnose and repair vehicle leaks in fuel, lubrication and cooling systems, and other vehicle liquids.

	3.3 Diagnose and repair diesel engine noises and vibrations.
LO4: Apply knowledge and skill of diesel engine reconditioning processes.	4.1 Demonstrate knowledge and skill in diesel engine disassemble in preparation for reconditioning. 4.2 Demonstrate the application of recommended procedures for diesel engine cylinder block reconditioning. 4.3 Demonstrate the application of recommended procedures for cylinder head, crankshaft, and valve train reconditioning. 4.4 Demonstrate knowledge and skill of diesel engine reassembly. 4.5 Perform cylinder head tests and analyse results.
LO5: Perform diagnosis, service and repair of heavy plant equipment's fuel and engine management systems.	5.1 Test and service diesel fuel injectors, fuel pumps and pump control systems for pressure, regulation, and volume. 5.2 Test and diagnose electronic diesel control modules and power train/engine control modules. 5.3 Perform cylinder power balance tests. 5.4 Demonstrate knowledge and skill in the usage of digital gas analysers and emission control instruments to extract and interpret their readings in diagnosis. 5.5 Retrieve and analyse diagnostic trouble codes, OBD monitor status, and freeze frame data, live/series data. 5.6 Perform active tests of actuators and sensors using digital scan tools.
LO6: Apply knowledge and skill of heavy plant equipment electrical and electronic components and systems.	6.1 Interpret circuit wiring diagrams during diagnosis of electrical and electronic problems. 6.2 Inspect and test sensors, connectors and wiring using electronic (digital) instruments. 6.3 Test heavy plant equipment electrical and electronic circuits according to manufacturer's specifications. 6.4 Diagnose plant equipment electronic circuits using a scan tool.

	6.5 Apply manufacturer-recommended software transfers, and software updates of flush reprogramming on electronic modules. 6.6 Analyse complex heavy plant equipment circuits and diagrams to aid diagnosis and repair.
LO7: Perform diagnosis, repair, and service procedures on heavy plant equipment transmission systems.	7.1 Apply knowledge and skill to repair single, double, and planetary reduction final drives. 7.2 Demonstrate knowledge and skill to service and repair track machines with undercarriages. 7.3 Apply knowledge and skill to service and repair undercarriage working attachments. 7.4 Demonstrate knowledge and skill to service and repair undercarriage components.
LO8: Diagnose, service and repair heavy plant equipment chassis systems.	8.1 Apply knowledge and skill to diagnose, repair and use service procedures on the wheel and track machine steering systems. 8.2 Perform diagnosis, repair and service of wheel and track machine suspension systems. 8.3 Demonstrate knowledge and skill to repair and service tyres, rims and wheels on wheel and track machines.
L9: Demonstrate scientific and mathematical application of techniques in analysing and solving problems on heavy plant equipment.	9.1 Use graphs, tables, and charts to present work-related results. 9.2 Demonstrate skill in the application of scientific laws and principles in trade-related problem-solving. 9.3 Interpret variances in vehicle parameters and data using calculus and differentiation concepts.
LO10: Demonstrate the ability to read, interpret and construct functional component and circuit drawings in solving heavy plant equipment challenges.	10.1 Select the appropriate drawing equipment to be used. 10.2 Produce functional drawings according to the task specifications whilst observing strict adherence to safety, health, and quality standards. 10.3 Analyse drawings to determine appropriate technical decision-making and equipment use.
LO11: Utilize relevant CAD/CAM software to prepare technical graphics appropriate to	11.1 Construct block diagrams of heavy plant equipment components/circuits used in day-to-day life.

heavy plant equipment in respect of functional operations.	11.2 Generate solid models and 2-D drawings of products conforming to standards. 11.3 Generate part model assembly of various machine components and systems using modelling packages. 11.4 Generate solid models and 3-D drawings for simple components. 11.5 Demonstrate knowledge of various codes and specifications of International Standards (ISO) concerned with engineering drawings. 11.6 Perform computer-aided production planning, numerical control, and Computer Numerical Control (CNC) programming. 11.7 Apply the principle of automation, the drafting and geometric modelling of database structure for graphics modelling.
LO12: Demonstrate knowledge, skill, and overall understanding of office productivity tools.	12.1 Capture data, and sort data into usable meaningful information using Information Communication Technology (ICT). 12.2 Communicate internally, externally, and globally using Information Communication Technology (ICT). 12.3 Apply Information Communication Technology (ICT) to present work in different digital formats. 12.4 Apply Information Communication Technology (ICT) to enhance customer satisfaction and experience. 12.5 Analyse data and information using Information Communication Technology (ICT) to make informed work-related decisions.
LO13: Demonstrate Entrepreneurial and Innovation skills.	13.1 Demonstrate knowledge and understanding of creating a business plan. 13.2 Demonstrate the ability to market one's services and ideas. 13.3 Demonstrate the ability to mobilize people and resources. 13.4 Demonstrate the ability to create value in service provision.

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SECTION C	***QUALIFICATION STRUCTURE***				
COMPONENT	***TITLE***	***Credits Per Relevant NCQF Level***			***Total Credits***
		Level [5]	***Level [6]***	***Level [ ]***	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/Units*	Engineering Mathematics 1	15			15
	Engineering Mathematics 2		15		15
	Engineering Science	15			15
	Engineering Drawing	10			10
	Computer Fundamentals	10			10
	Technical Communication	10			10
	Machine Shop Practice	10			10
	Entrepreneurship		10		10
CORE COMPONENT *Subjects/Courses/ Modules/Units*	Traction Control and Electronic Braking Systems		10		10
	Workshop Organization & Safety Management	10			10
	Vehicle Safety and Security Systems		10		10
	Vehicle Electrical Theory		10		10
	Electronics Control Systems	15			15

	Electrical and Electronics Engineering Materials		10		10
	Electrical Machines		10		10
	Engineering Design and Synthesis		10		10
	Automotive Technology		10		10
	Hybrid and Electric Vehicles Technology		10		10
	On-Board Diagnostics		10		10
	Computer-Aided Design (CAD)		15		15
	Workshop Organization & Safety Management		10		10
	Industrial Placement		50		50
	Workshop Practice		60		60
	Final Year Project		15		15
	Automotive Wiring and Circuit Diagrams		15		15
ELECTIVE/ OPTIONAL COMPONENT *Subjects/Courses/ Modules/Units* ***Choose ONE***	Vehicle Design		10		***10***
	Vehicle Product Features		***10***		
	TOTAL				***385***

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SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	***Credit Value***
5	***95***
6	***290***
TOTAL CREDITS	***385***

Rules of Combination:

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

Rules of Combination:

Compulsory Components Credits

- Complete Core Modules 280 Credits
- Fundamental Modules 95 Credits

Selective Credits:

- Elective Modules 10 Credits

Distribution Rules:

- Level 5 with a maximum of 95 Credits
- Level 6 with a maximum of 290 Credits

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ASSESSMENT ARRANGEMENTS
Formative Assessments shall constitute 50% Weighting on the Final Assessment, whilst Summative Assessments shall constitute 50%.
MODERATION ARRANGEMENTS
There shall be internal and external moderation arrangements done by BQA registered and accredited Moderators.
RECOGNITION OF PRIOR LEARNING
There will be a provision for awarding of the qualification through RPL mode which will be in line with the national RPL Policy.
CREDIT ACCUMULATION AND TRANSFER
There will be a provision for awarding of the qualification through CAT mode which will be in line with the national RPL and CAT Policy.
PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal Articulation of Diploma in Automotive Electrical Technology (AET)

1. Diploma in Automotive Collision Estimation (ACE)
2. Diploma in Automotive Body Repair and Refinishing Technology (ADR)
3. Diploma in Automotive Mechanical Technology (AMT)
4. Diploma in Heavy Plant Technology (HPT)
5. Diploma in Automotive Control Systems (ACS)
6. Diploma in Automotive Mechatronics

Vertical Articulation for Diploma in Automotive Electrical Technology (AET)

1. Bachelor's in technology (B. Tech.) in Automotive Electrical Technology
2. Bachelor's in technology (B. Tech.) in Automotive Collision Estimation
3. Bachelor's in technology (B. Tech.) in Automotive Repair and Refinishing Technology
4. Bachelor's in Technology (B. Tech.) in Automotive Mechanical Technology

5. Bachelor's in Technology (B. Tech.) in Automotive Diesel Technology
6. Bachelor's in Technology (B. Tech.) in Automotive Control Systems
7. Bachelor's in Technology (B. Tech.) in Automotive Mechatronics

Career Path in Automotive Electrics

1. Automotive Technician
2. Auto Electrical Technician
3. Motor Vehicle Electrical Repair Technician
4. Service Advisor
5. Automotive Entrepreneur
6. Parts Professional

QUALIFICATION AWARD AND CERTIFICATION

Minimum Standards of Achievement for the Award of the qualification

A candidate is required to achieve the stipulated **365** total credits inclusive of the fundamental, core and elective components, to be awarded the Diploma in Automotive Electrical Technology.

Certification

Candidates meeting prescribed requirements will be awarded the **Diploma in Automotive Electrical Technology** in accordance with standards prescribed for the award of the qualification and applicable policies.

REGIONAL AND INTERNATIONAL COMPARABILITY

In the region, we have observed no similarities in most major aspects of the qualifications for comparison. This is an indication that the qualifications in the region differ significantly. This may be attributed to varied levels of skills and competency scales by service and maintenance technicians in their day-today operations. The program duration for all the qualifications is similar.
The qualifications are an average of 3-year duration. The average number of modules per semester is 5 and totals an average of 24 modules over the entire qualification. The Diploma in Automotive Electrical Technology has 24. They do have different names, but the content is on averagely 80% to 90% similar. All qualifications offer internship or industrial attachment or work-based learning. The exit learning outcomes in the programmes

compared, correspond to the modules in the Diploma in Automotive Electrical Technology. There is more coverage of advanced topics of vehicle electrical maintenance and repair.

Though titles of the qualifications vary they deliver almost the same content. They do not feature entrepreneurship, as a mandatory module, which is critical in the Botswana curriculum. All the qualifications have assessment strategies which include key strategies like projects, internships, workshop practice, theoretical evaluations, and work-based assessments. The learning outcomes tend to cover key domain areas like communication skills, teamwork skills, computer literacy skills and technical skills in vehicle electrical and electronic maintenance, service, and repair. Over 90% of the qualifications do internships and projects

All qualifications do not offer electives. The Diploma in Automotive Electrical Technology offers electives to enhance specialization and diversification. The idea is to produce graduates competent in the cost assessment of vehicle body framework, and mechanical and electrical damage. They do have different names, but the content is on averagely 80% to 90% similar. However, the Diploma in Automotive Electrical Technology tends to cover more on vehicle damage cost estimation, insurance, customer care services, entrepreneurship, and workshop management.

In the context of Botswana, the qualification offers Entrepreneurship module(s). The qualification is outcome-based learning therefore and therefore emphasises hands and development of skills and competencies; introduced two modules, workshop practice modules ensure the continuous practice of acquired knowledge and convert to skills and competencies whilst at school. Secondly the study has also included industrial attachment to further support the stated approach.

REVIEW PERIOD

This qualification will be reviewed after a period of 5 Years