SECTION A:	***QUALIFICATION DETAILS***																	
QUALIFICATION DEVELOPER (S)	UNIVERSITY OF BOTSWANA																	
TITLE	BACHELOR OF ENGINEERING HONOURS (**ELECTRICAL**)												***NCQF LEVEL***					**8**
FIELD	Manufacturing, Engineering and Technology			***SUB-FIELD***			Engineering and Engineering Trades						***CREDIT VALUE***					**658**
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 Human Resource Development Council has ranked Electrical Engineering among the top occupations and most sought-after skills in Botswana. The programme contributes towards the strategic role of meeting the country's development needs through advancing human resource development and developing research and innovation capacity (Towards a Knowledge Society). (Tertiary Education Policy, 2010; Revised National Policy of Education 1994; Education and Training Sector Strategic Plan, 2015, National Development Plan 11, 2017). Furthermore, this programme is considered to be commensurate with three of the pillars *of Vision 2036* of producing 'sustainable economic development, human and social development and sustainable environment', as well as two key future imperatives of 'innovation and sustainability'. The role of the discipline in research and development, innovation, science and technology, cannot be overemphasized in transforming Botswana into a creative, sustainable and knowledge-based economy.

The Bachelor of Engineering Honours (Electrical) is designed to contribute to the objectives of National Development Plans through technology and innovation in the specialisation areas of Electrical Engineering. The programme ensures that the students' education meets the global standards for continuing education for practising engineering professionals, employment opportunities and attainment of higher education in preparation for careers in academia.

PURPOSE:

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

(i) Demonstrate understanding of Electrical power theories, concepts, principles and systems.
(ii) Plan, design and build Electrical power systems.
(iii) Critically analyse Electrical power systems.
(iv) operate and maintain Electrical power systems.
(v) Demonstrate ability to manage electrical power systems.
(vi) Demonstrate Problem-solving skills for electrical engineering problems.

(v) Demonstrate technical leadership skills in electrical engineering and related areas and make contributions to the economy and national development.

(vi) Register as Professional Engineers with the Engineers Registration Board of Botswana and the Engineering Council of South Africa as well as pursue careers in electrical engineering and related fields.

(vii) Practice electrical engineering based on their thorough grounding in mathematics, natural sciences, engineering sciences, engineering modelling, engineering design and the ability to enable applications in fields of emerging knowledge.

ENTRY REQUIREMENTS (including access and inclusion)

- The normal minimum entry requirement for admission is NCQF Level 4 or its equivalent.
- Entry through Recognition of Prior Learning (RPL) will be considered in line with national and Institutional policies.

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SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
Identify, assess, formulate, analyse and solve complex convergent and divergent engineering problems creatively and innovatively.	1.1 Identify and analyse a problem, propose possible solutions, analyse those solutions and choose the best one. 1.2 Identify and formulate a suitable design process that will satisfy the solution specifications. 1.3 Plan and manage the design process with full awareness of the limitations thereof. 1.4 Use the appropriate tools to analyse, optimise and verify the design. 1.5 Evaluate the efficacy of the solution in solving the problem. Click here to enter text.
Apply mathematics, basic science and engineering sciences from first principles to solve engineering problems	2.1 Apply scientific principles to electrical and electro-mechanical problems and how they can be used to build and/or represent electronic devices and systems. 2.2 Apply appropriate scientific and/or mathematical formulation of problems (such as equations, algorithms, transformations, etc.) as applied to modelling, development, analysis and optimization of circuits and systems to solve problems.

	Click here to enter text.
Perform creative, procedural and nonprocedural design and synthesis of components, systems, engineering works, products or processes.	3.1. Identify and analyse a problem, propose possible solutions, analyse those solutions and choose the best one. 3.2. Identify and formulate a design process that will satisfy certain specifications, plan and manage the design process with full awareness of the limitations thereof, use the correct tools to analyse, optimise and verify the design. Design information is reported in a logical and clear manner. 3.3. Effective use of language, style and structure. Effective use of graphical representations. Effective transfer of information to a target audience. Click here to enter text.

Design and conduct investigations and experiments with critical analysis and interpretation of the results.	4.1 Design and conduct experiments in to investigate or demonstrate understanding of electronic/electronic engineering principles. 4.2 Comprehensive problem description and formulation of methodology to develop, analyse and evaluate proposed engineering solutions. 4.3 Develop hypothesis, define the pertinent dependent and independent variables, and establish a sound experimental method that will allow to measure the variables and test the hypothesis. 4.4 Design and conduct scientific electrical engineering experiments as well as analyse and interpret data for open ended investigations

Use appropriate engineering methods, skills and tools, including those based on information to design and analyse electronic circuits, systems and applications such as software.	5.1 Use modern engineering techniques, skills, and tools (including computer-based tools) for analysis and design of electronic engineering circuits and systems. 5.2 Conduct experiments via software simulation during laboratory practical sessions. 5.3 Appropriate and safe use of common and industry standard instruments and tools to design and conduct experiments.

Communicate effectively, both orally and in writing, with engineering audiences and the community at large.	6.1 Communicate orally (through presentations and demonstrations) to both technical and non-technical audience on different aspects of engineering. 6.2 Communicate in writing (through term papers, project reports, technical reports, proposals, poster, manuals, etc.), to both technical and non-technical audience on different aspects of engineering. Click here to enter text.
Be critically aware of the sustainability and impact of engineering activity on the social, industrial and physical environment.	7.1 Comprehension of the role of engineering in society 7.2 Identify and mitigate issues in engineering practice in the discipline such as health, safety and environmental protection 7.3 Assess and manage risks and the impacts of engineering activity: economic, social, cultural, environmental and sustainability. 7.4 Observe safety protocols and procedures.
Work effectively as an individual, in teams and in multidisciplinary environments.	8.1 Learn and work individually with minimal supervision 8.2 Learn and work effectively in a team setting. 8.2 Apply electrical engineering principles in other fields as an individual or part of a multidisciplinary team.

	Click here to enter text.
Engage in independent learning through well-developed learning skills	9.1 Operate independently in complex, ill-defined contexts requiring personal responsibility and initiative. 9.2 Accurately self-evaluate and take responsibility for learning requirements. 9.3 Be aware of social and ethical implications of applying knowledge in particular contexts.
Act professionally and ethically, exercise judgment and take responsibility within own limits of competence.	10.1 Meet the ethical and the professional conduct requirements of an engineer. 10.2 Uphold the role of engineering in society. 10.3 Identify issues in engineering practice in the discipline such as health, safety and environmental protection. 10.4 Establish levels of risks and their impact, recommend and justify control measures to manage the risk (in all aspects for an organisation be it economic, social, cultural, environmental and sustainability).
Apply knowledge and understanding of engineering management principles and economic decision-making.	11.1 Apply basic techniques from economics, business management, project management to one's own work, 11.2 Perform as a member and leader in a team in multidisciplinary environments.

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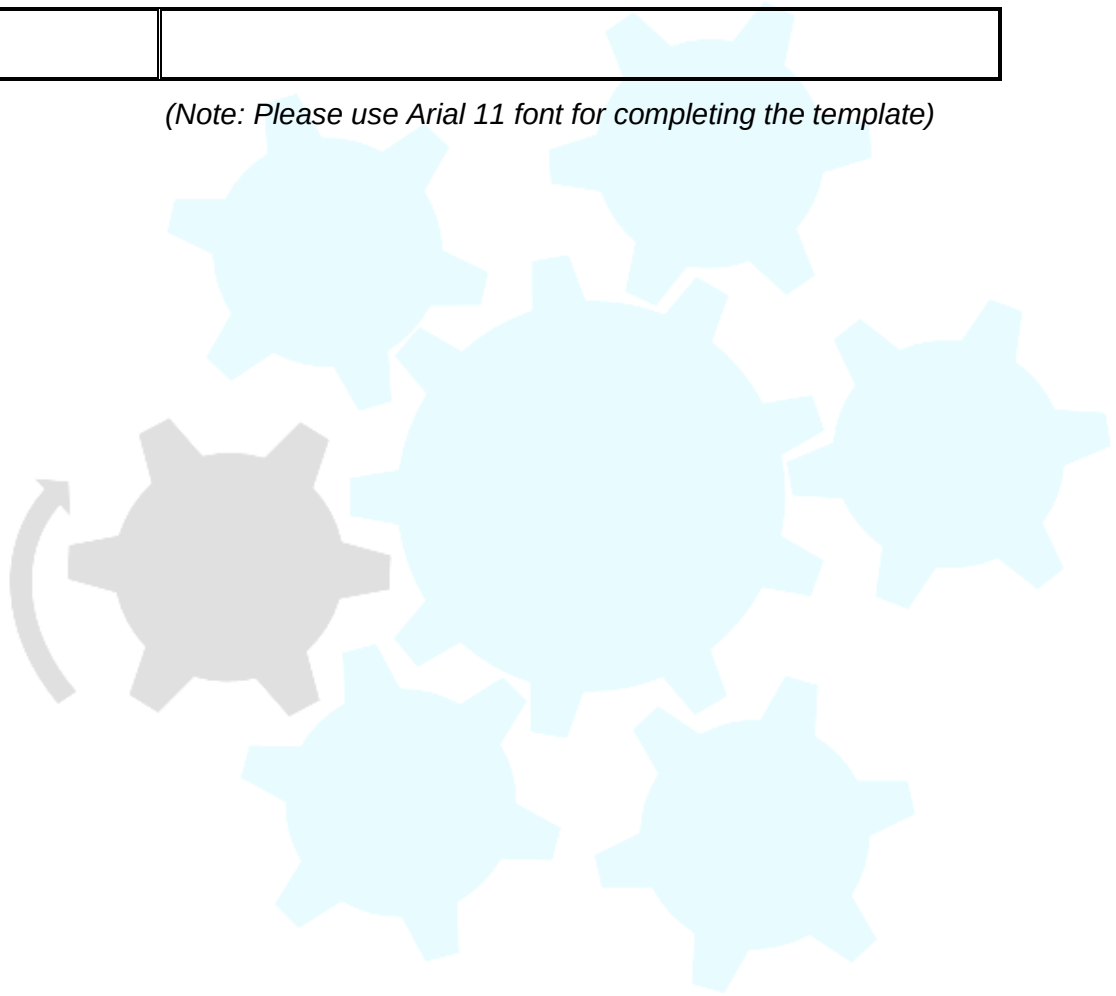

SECTION C			***QUALIFICATION STRUCTURE***				
COMPONENT	***TITLE***		***Credits Per Relevant NCQF Level***				***Total*** ***(Per*** *Subject / Course / Module / Units)*
			L [5]	**L [6]**	**L [7]**	**L [8]**	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/UnitsL*	Materials Science for Engineers			**18**			**18**
	Engineering Mechanics: Statics				**18**		**18**
	Electrical Fundamentals I			**18**			**18**
	Engineering Mathematics I				**16**		**16**
	Engineering and Computer Aided Drawing				**12**		**12**

	Mechanics of Materials			**18**		**18**
	Electrical Fundamentals II			**18**		**18**
	Workshop Technology			**14**		**14**
	Engineering Mathematics II			**12**		**12**
	Dynamics of Particles			**18**		**18**
	Electrical Network Theory			**13**		**13**
	Analogue Electronics Fundamentals				**13**	**13**
	Electrical Instrumentation and Measurements				**13**	**13**
	Computer Programming I				**15**	**15**
	Engineering Mathematics III				**16**	**16**
	Digital Electronics					
	Level 300 Semester 2				**13**	**13**
	Electromagnetics for Engineers				**13**	**13**
	Electrical Engineering Design			**15**		**15**

	Basic Electrical Machines				**13**	**13**
	Engineering Mathematics IV				**12**	**12**
CORE COMPONENT *Subjects/Courses / Modules/Units*	Industrial Training I				**36**	**36**
	Control Systems I				**13**	**13**
	Communications Principles				**13**	**13**
	Power Electronics and Drives				**13**	**13**
	Power Generation and Control				**13**	**13**
	Transmission and Distribution Networks				**13**	**13**
	Electrical Machines Drives Design				**15**	**15**
	Electrical Engineering Laboratory				**15**	**15**
	Power Transmission and Distribution Networks Design				**15**	**15**
	Power System Analysis				**13**	**13**
	Foundations of Engineering Law				**10**	**10**

	Engineering Economics		**14**			**14**
	Industrial Training II				**36**	**36**
	Electrical Design Project I				**13**	**13**
	Self Study Topic				**15**	**15**
	Environmental Management				**13**	**13**
	MMB536 Engineering and Project Management				**13**	**13**
	Electrical Design Project II				**40**	**40**
	Professional Ethics and Practice				**10**	**10**
ELECTIVE/ OPTIONAL COMPONENT *Subjects/Courses / Modules/Units*	**ELECTIVE: Choose one from the following (Each 10 Credits):**		**10**			**10**
	Introduction to Political Science					
	Introduction to Public Administration					
	Introduction to Sociological Concepts and Principles					
	Sociology of Development					

	OPTION 1 (Electrical): Choose one from the following (Each 13 Credits):				**13**	**13**
	Power System Economics					
	Switchgear and Protection					
	Power System Simulation					
	Electrical Machines					
	OPTION 2 (Electrical): Choose one from the following (Each 13 Credits):				**13**	**13**
	Power System Operation					
	High Voltage Engineering					
	Power System Planning					
	Electrical Machines Drives					
	TOTAL:		**60**	**154**	**444**	**658**

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SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	***Credit Value***
Level 6	***60***
Level 7	***154***
Level 8	***444***
TOTAL CREDITS	***658***

Rules of Combination:

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

A student shall take courses of specified credits as shown in the components:

Type of Course	No.	Credits
Fundamental Component	20	**298**
Core Component	19	**324**
Elective Component	3	**36**
Total	42	**658**

i. Programme shall consist of 658 notional credits from 42 courses, resulting in 658 credits for the BEng Honours (Electrical) qualification.

ii. The courses shall consist of 20 fundamental courses, 19 core courses and 3 elective courses.
iii. The elective courses must be selected as per prescribed lists:
iv. Courses shall be done over 8 semesters (full time).
v. Industrial Training shall be done after the second semeters of the Level 300 and Level 400 i.e. after the 4th and 6th semesters.

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. **Summative assessment** The Final Examination contributes to **60%** of the final grade. **Formative assessment** Formative assessments contribute to **40%** of the final grade
MODERATION ARRANGEMENTS
Assessment and moderation shall be carried as per the Universities policies and guidelines, which are aligned to BQA/ National policies. Both internal and external moderation shall be carried out. The department shall engage only BQA accredited assessors and moderators to carry out assessment and moderation.
RECOGNITION OF PRIOR LEARNING
Recognition of Prior Learning (RPL) for the award of this qualification will be in line with the Institutional and National policies.
CREDIT ACCUMULATION AND TRANSFER
Credit Accumulation Transfer (CAT) for the award of this qualification will be in line with the Institutional and National policies.
PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

LEARNING PATHWAYS

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

- BEng/BSc Electrical Engineering
- BEng/BSc Electrical and Electronic Engineering
- BEng/BSc Control Systems Engineering
- BEng/BSc Telecommunications Engineering
- BEng/BSc Computer Engineering
- BEng/BSc Biomedical Engineering
- BEng/BSc Mechatronics

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

The graduates of the BEng Honours (Electrical) programme with an appropriate level of achievement, will have the ability to proceed to postgraduate studies in both course-based and research masters programmes, both locally and internationally.

- Post graduate programmes (MSc, MEng, MPhil) in:
  - Electrical and Electronic Engineering
  - Systems Engineering
- Master of Business Administration
- Masters degree in Project Management.
- Research in Electrical and Electronic Engineering.

EMPLOYMENT PATHWAYS

Carrier opportunities for graduates of the BEng Honours (Electrical) programme include:

- Electrical Engineer
- Lecturer

- Researcher
- Generation Engineer
- Transmission Engineer
- Protection Engineer
- Distribution Engineer
- Control Engineer
- Systems Engineer
- Design Engineer
- Project Engineer
- News analyst/reader
- Meteorological Engineer

Signatories of the Accord agree to grant graduates of other accredited programmes the same recognition, rights and privileges as they grant to graduates of their own accredited programmes for the purpose of registration. The Accord further facilitates mobility of graduates between signatory jurisdictions. Graduates of the BEng Honours (Electrical) programme will therefore, be eligible to register and work as professional engineers in

- South Africa
- Other Washington Accord signatory countries

QUALIFICATION AWARD AND CERTIFICATION

Bachelor of Engineering Honours (Electrical) qualification is awarded upon:

- attaining the requisite credits,
- satisfying the programme regulation, and
- satisfactorily meeting all exit level outcomes,

The qualification will meet criterion set by the Washington Accord.

Certification

Upon completion of the above in (i), (ii), and (iii) above, the candidate will be awarded a Bachelor of Engineering Honours (Electrical) in accordance with the applicable institutional policies.

A certificate and transcript will be issued at award.

REGIONAL AND INTERNATIONAL COMPARABILITY

The B.Eng Honours (Electrical) qualification is designed to be acceptable in the 16 regional and international Washington Accord signatory countries. The Accord signatory countries are: Australia, Canada, China, Hong Kong, India, Ireland, Japan, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Sri Lanka, Turkey, United Kingdom and the United States of America.

A benchmarking exercise was carried out to compare current trends in the field, modes of programme offering, programme structure and content, as well as offer clarity in specializations being offered by regional and international universities as follows:

- Five (5) regional universities which are all in South Africa:
  - University of Pretoria, South Africa: LINK https://www.up.ac.za/programmes/programme/12130008/year/2022 ; https://www.up.ac.za/yearbooks/2021/pdf/programme/12130003;
    BEng Electrical Engineering.
  - University of Cape Town, South Africa: http://www.ee.uct.ac.za/bachelor-science-engineering-electrical-engineering; http://www.ee.uct.ac.za/sites/default/files/image_tool/images/228/Staff/2019_EE%20plus%20Course%20Outlines.pdf
    BSc(Engineering)(Electrical Engineering)
  - Stellenbosch University, South Africa: http://www.eng.sun.ac.za/undergraduate-programmes/ https://www.sun.ac.za/english/Documents/Yearbooks/Current/Engineering.pdf
    BEng Electrical and Electronic Engineering.
  - University of the Witwatersrand, South Africa: LINK https://www.wits.ac.za/eie/undergraduate-programmes/ https://www.wits.ac.za/media/wits-university/students/academic-

matters/documents/2022%20EBE%20Rules%20and%20Syllabuses%20Final.pdf ; https://www.wits.ac.za/course-finder/undergraduate/ebe/electrical-engineering/
BSc (Eng).

- University of KwaZulu-Natal, South Africa: LINK https://caes.ukzn.ac.za/wp-content/uploads/2022/01/2022-Handbook.pdf; Bachelor of Science Engineering (Electrical Engineering).

- Two (2) universities outside the region which are in the United Kingdom:
  - Staffordshire University, United Kingdom: https://www.staffs.ac.uk/course/electrical-electronic-engineering-beng-meng#contents
    Bachelor of Engineering (Hons) (Electronic and Telecommunications
  - Glasgow Caledonia University, United Kingdom:
    https://www.gcu.ac.uk/media/courses/psp/ebe/ug/P02866_P02868_BEngMEng_Electrical_and_Electronic_Engineering_20-21_PSP_Extract.pdf
    BEng (Hons) Electrical and Electronic Engineering

University of Pretoria: BEng (Electrical Engineering)

Similarities:

- The duration is four years.
- First and second years are common years.
- There is Project in the Final Year.

Differences:

- There is a community based project at the University of Pretoria while there is none in the proposed qualification.
- There is recess training at year 2 at the University of Pretoria while the proposed qualification has Industrial Training.
- There is recess training and report in the fourth year at the University of Pretoria and Industrial Training at the ends of the second and third years in the proposed qualification.

University of Cape Town: BSc(Engineering)(Electrical Engineering)

Similarities:

- The duration is four years, although the University of Cape Town allows for a duration of five years,
- First and second years are common.

- There is practical training at third year
- There is a final year project
- There are elective courses in the fourth year of the programme.

Differences:

- The University of Cape Town has practical training in the first and third years while the Industrial Training in the proposed qualification is in the second and third years.
- There is provision at the University of Cape Town to opt to extend the duration to five years, subject to satisfying the regulations. The proposed qualification does not have such a provision.

Stellenbosch University: BEng Electrical and Electronic Engineering

Similarities:

- The duration is four years.
- First and second years are common, except that at Stellenbosch University one of the five focus areas, data engineering, has a different arrangement in the second semester.
- Students follow different subject areas from the third year.
- There is a project in the final year.

Differences:

- The first year at Stellenbosch University is a common sciences year while the first year of the proposed qualification is a basic engineering year.
- Stellenbosch University has five focus areas in electrical engineering of electromagnetics and Telecommunication, informatics, energy, robotics and data engineering while the proposed qualification has only one area.
- There are options for students to choose to interrupt their studies and go for industrial training for one year at Stellenbosch University while in the proposed qualification the industrial training is in the long vacations after the second and third years.

University of the Witwatersrand: BEng (Electrical)

Similarities:

- The duration is four years.
- First and second years are common, except that there is one complimentary course for the University of the Witwatersrand.
- There is Vacation Training in the second year.
- Students follow different subject areas from the third year.

- The third year is common to the chosen subject area at the University of the Witwatersrand and in the proposed qualification.

Differences:

- The split to the subject area subjects at the University of the Witwatersrand is made at the third year while in the proposed qualification it is made at the second year.
- There is no Vacation Training in the third year at the University of the Witwatersrand while the proposed qualification has Industrial Training at the end of the third year.
- There are no electives in the third year at the University of the Witwatersrand while the proposed qualification has one elective.
- The fourth year has three electives at the University of the Witwatersrand while the proposed qualification has 2 Electives.

University of KwaZulu Natal: BSc Engineering(Electrical Engineering)

Similarities:

- Years one and two of study are common years.
- Some courses are from outside the department.
- There is a Design Project in the final year at University of KwaZulu Natal while the proposed qualification has a Final Year Project I and Final Year Project II.
- There are elective courses in the final year at the University of KwaZulu Natal as well as in the proposed qualification.
- There is a self study course at the University of KwaZulu Natal as well as in the proposed qualification.

Differences:

- Year 3 is common at the University of KwaZulu Natal while Year 3 has an Elective in the proposed qualification.
- Some electives are taken from outside the College at the University of KwaZulu Natal.
- Some elective modules are taken from the Mechanical Engineering at the University of KwaZulu Natal.
- There is Vacation Work in the final (4^{th}) year at the University of KwaZulu Natal while the proposed qualification has Industrial Training at the ends of the second and third years.

Benchmarking with International Universities

Staffordshire University: BEng(Hons)(Electronic & Telecommunication)

Similarities:

- Second year is common.

- There is a final year project

Differences:

- The duration at Staffordshire University is three years while that of the proposed qualification is four years.
- Th Staffordshire University does not have Industrial Training while the proposed qualification has Industrial Training at the ends of the second and third years.
- Staffordshire University offers two options on mathematics (for those with or without A-Level mathematics) in the first year while the proposed qualification does not offer such options.
- Staffordshire University has no electives in the third and final years, while the proposed qualification has two electives.

Glasgow Caledonian University: BEng (Hons) Electrical and Electronic Engineering

Similarities:

- Duration is four years.
- Year 1 is common.
- Year 3 has one option and Year 4 has two options.
- There is a final year project

Differences:

- The second year has one option.
- Glasgow Caledonian University has an option of Industrial Practice after third year and the candidate is awarded a sandwich qualification while the proposed qualification has Industrial Training at the end of the second and third years.
- Glasgow Caledonian University gives eligible students an option of a European Exchange Placement After successful completion of Level 3 Trimester 1 in which they undertake an optional study exchange during Trimester 2 at an appropriate host Institution outside the UK, provided the agreed programme of activity is equivalent to the curriculum and intended student experience normally undertaken in Level 3 Trimester 2. Successful completion of the study exchange is credit bearing to 60 credits. The proposed qualification does not have such an option.
- Glasgow Caledonian University has no electives in the third and final years, while the proposed qualification has two electives.

Overview of the Similarities and Differences

Similarities

- All the qualifications have fundamental, core and electives subjects/courses and they are fashioned against a National Qualification Standard.

- They all in general have design/projects and laboratory subjects which require submission of reports for examination. In addition they have industrial attachments that expose the students to industry.

Differences

- It is observed is that the entry into electrical engineering in some universities is in some cases after A levels and the duration is reduced to three years.
- The duration of the proposed qualification is 4 years (after a university level sciences year), those in South Africa are four years and the one used in UK is 3 years.

Another difference is that the learning outcomes specified for IET accredited qualifications have been developed to provide for variety and flexibility in the design of qualifications and encourage innovation while maintaining a core understanding of engineering principles.

Conclusion

The similarities are that the qualifications have fundamental, core and electives subjects/courses and that they are fashioned against a National Qualification Standard. They all in general have design/projects and laboratory subjects which require submission of reports for examination. In addition they have industrial attachments that expose the students to industry.

The main difference observed is that the entry into electrical engineering is in some cases after A levels and the duration is reduced to three years. There are also in some of the international qualifications preparation of the candidates for postgraduate studies. Another difference is that the learning outcomes specified for IET accredited qualifications have been developed to provide for variety and flexibility in the design of qualifications and encourage innovation while maintaining a core understanding of engineering principles. Details of the learning outcomes expected are specified per theme like electrical engineering.

Comparability and articulation of the proposed qualification with the ones examined

The proposed qualification is in line with those qualifications that are accredited to the Washington Accord through the Engineering Council of South Africa (ECSA). The proposed programme satisfies the national qualification standard of South Africa that incorporates the ECSA accreditation requirements. In addition the proposed qualification has similarities with the qualifications accredited through the Institution of Engineering and Technology (IET) of the United Kingdom.

REVIEW PERIOD

- Every five (5) years