QUALIFICATION SPECIFICATION							SECTION A
QUALIFICATION DEVELOPER	Botswana International University of Science and Technology						
TITLE	Bachelor of Science Honours (Applied Physics)				**NCQF LEVEL**		8
FIELD	Natural, Mathematical and Life Sciences		**SUB-FIELD**	Physics			
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		

RATIONALE AND PURPOSE OF THE QUALIFICATION

Rationale of the Qualification

The Botswana Vision 2036 recognizes education and skills development as a foundation for human resource development. In accordance with the Botswana Vision 2036 Pillar 1 and Pillar 2, tertiary education and training providers are mandated to provide quality training opportunities for the increasing number of school leavers. The Bachelor of Science Honours (Applied Physics) qualification has been informed by this mandate in contribution to the realization of Vision 2036's National Development Plan (NDP11). This qualification is also supported by the Tertiary Education Policy, as approved by the National Assembly (2008:10). The Human Resource Development Council (HRDC) conducts research and publishes reports on occupations that have been identified by the employers as being in high demand at a national level. In December 2016, the HRDC published a report that indicates Botswana is currently experiencing a shortage of human capital in Physics and related fields[1]. Moreover, several documents have also highlighted the need to produce high caliber graduates with strong problem-solving skills, in depth scientific knowledge and transferrable skills desirable in industry and research to transform Botswana from a resource-based to a knowledge-based economy. These documents include: the National Policy on Research, Science, Technology and Innovation[1], Ministry of Infrastructure, Science and Technology, 2011; the National

Human Resource Strategy[2] (2009 – 2022): Realising our Potentials, Ministry of Education and Skills Development, Republic of Botswana, November 2009; Vision 2036[3]: Achieving Prosperity for All, prepared by the Vision 2036 Presidential Task Team, July 2016; National Development Plan 11[3] (NDP 11, 2017 – 2023), Ministry of Finance and Development Planning, August 2016.

The shortage of Physicists is not only being experienced in Botswana, but also in South Africa as pronounced by the Department of Higher Education and Training of South Africa in 2014 which published a report titled "Skills for and through Strategic Infrastructure Projects" and lists Physicist as one of the scarce human resources in the country in Table 1: Executive Summary of Top Occupations in Demand[2]. This report outlined the processes that were been followed to identify the scarse skills for strategic infrastructure projects and steps that need to be taken if the projected scarcity is to be addressed. Thus, considering this scarcity of human resources in the area of Physics and related fields, the Bachelor of Science Honours (Applied Physics) qualification is designed to equip graduates with required skills competences to prepare them to fill the shortage gaps identified in these reports and in alignment with the national priorities as outlined in the Vision 2036 NDP 11.

At present there is a severe shortage of skilled scientists, engineers, innovators and technologists, in Botswana[2,3], the region[8], and globally[9]. In particular, the Governments of Botswana[10] and South Africa[11] have emphasised the high demand for Applied Physics-based occupations in the region, meaning that these occupations are currently experiencing shortages in the labour market (short term) or will show relatively strong employment growth (long term). While a Bachelor of Science Honours (Applied Physics) degree will put the graduates in a position to discover the next scientific breakthroughs and innovations which are novel, inventive and have an industrial applicability thus leading to patentability. This is not only advantageous for the author of patent, but also for the whole society. and this fits well within the current goals of Botswana as it endeavors to become a knowledge-based economy. In particular, Applied Physics focuses on the engineering aspect of physics meaning that greater emphasis is placed on real life applications through intensive research in preparation for employment and specialist training. However, it differs from engineering in that an applied physicist may not be designing something in particular, but rather is using physics or conducting physics research with the aim of developing new technologies or solving an engineering problem. Thus, it is these technologies which lead to innovative work which may lead to patentability, commercialisation, start-ups and subsequently potentially reduce unemployment, increase in

university-industry partnerships and attract private investment into the research and development. This implies that Applied Physicists are at the heart of modern development and by having the knowledge to discover future technological advances and find applications for scientific discoveries, applied physicists are driving the future and especially towards the knowledge-based economy. Furthermore, the impact of physics in other fields cannot be estimated as articulated in Appendix A: Role and Impact of Physics in Society, Business and Industry.

Moreover, the Bachelor of Science Honours (Applied Physics) qualification will provide students with a solid foundation and working-knowledge of theoretical, experimental, and computational aspects of Applied Physics to be able to: use mathematics to describe the physical world; tackle problems and formulate appropriate solutions; plan, execute and report the results of experiments or investigations; compare results critically with predictions from theory. Furthermore, students will assimilate sought-after, scarce skills (problem-solving, investigation, analytical, communication, innovation, entrepreneurship, Information Technology, good working habits and personality traits, and ethical behaviour) that are immediately transferable to all other scientific, engineering, and non-scientific disciplines[15]. Moreover, this qualification confers graduates with a wide range of transferrable skills such as numeracy and computing, research skills, organisation and interpersonal skills. Particular skills of wide applicability include training in developing models of phenomena, mathematical analysis of models, modelling, and analysis real data, ability to think in graphical terms, ability to think in approximate terms when appropriate, ability in the design of devices, computing skills at high level, ability in statistical analystics, critical analysis of data and a willingness to question fundamentals.

In addition, the knowledge and competencies that Bachelor of Science Honours (Applied Physics) graduates are, but not limited to, the following: ability to learn and familiarity with frontier research fields through independent study; gain readiness applied jobs (i.e. ability to carry out professional activities in the frame of applied technologies, both at industrial and laboratory level, related in general to physics and, in particular, to radiation protection; telecommunication; tele-sensing; remote control with satellite; quality control); participating in the activities of the public and private research centres (including management); acquire deeper knowledge and understanding of physical phenomena (i.e., possess a good understanding of the most important physical theories); experimental and estimation skills (i.e., ability to perform experiments independently, as well as to describe, analyze and critically evaluate experimental data and have become familiar with most important experimental methods); familiarity with basic and applied

research (i.e., acquire an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics, e.g. engineering; be able to design experimental and/or theoretical procedures for: (i) solving current problems in academic or industrial research; (ii) improving existing results); literature search skills (i.e., ability to search for and use physical and other technical literature, as well as any other sources of information relevant to research work and technical project development); managing skills (i.e., be able to work with a high degree of autonomy, even accepting responsibilities in project planning and in the managing of structures) and specific communication skills (i.e., ability to present one's own research or literature search results to professional as well as to lay audiences orally and in written form to describe complex phenomena/problems in everyday language, as appropriate to the audience); be able to work in an interdisciplinary team). Thus, such a range of versatile and top tier skillset differentiates an Applied Physics graduate from an Applied Mathematics, Industrial Mathematics, Financial Mathematics or any other Mathematical Sciences graduate.

Considering these highly sought and diverse skills and competencies, especially the problem solving skills, physicists are in strong demand in many fields for instance aerospace and defence research, nanotechnology, electronics, computer industries, science and telecommunications, meteorology and climate change, energy and renewable energy, education and health and medicine. Interstingly, due to the analytical and problem-solving nature of Applied Physics, will also open a wide range of non-traditional pathways which include: the academic career path such as banking and finance, research at higher specialised education providers; the business career path which involves contract research, process management, project management, and patent law, in the manufacturing industry, high-level management consultancy services, and financial services; the entrepreneurship career path which involves product development and patents in industrial and commercial ventures by self-employed individuals; the research policy and management career path which involves policy research, development, and synthesis, at government institutions. In order for graduates of this qualifcation to gain maximum hands-on skills, this qualifcation is strengthened by work-integrated learning which provides students with industry opportunities where they apply their specialised skills, knowledge and competencies in different workplace environment. Therefore, the Bachelor of Science Honours (Applied Physics) qualification will catalyse the process of transforming Botswana from a resource-based to a knowledge-based economy as expressed by the national policy documents, including the NDP 11 of Vision 2036. This will also assist in diversifying the economy in a sustainable manner, thus minimizing risk associated with national income reliance on mineral resources. Thus, by producing skilled scientists, engineers, and technologists who are highly

employable and entreprenuarial in Botswana, the region, and the world will surely assist in driving the industrial and economic development.

Notably, stakeholders from various specialised sectors in Botswana and the region have been consulted and remained actively engaged in the design of this qualification. The invaluable input from the industry stakeholders also helped the qualification developers to have an insight on the current and future needs in the areas where graduates of this qualification are required. In particular, the Industrial Advisory Board (IAB) of the Department of Physics and Astronomy shaped further this qualification at its meeting held on 22 March 2019 at the Botswana International University of Science and Technology unanimously endorsed the Bachelor of Science Honours (Applied Physics) qualification. The IAB was constituted of members who are renowned industry captains from various industries for instance Dr. Budzanani Tacheba (Director, Botswana Innovation Hub), Mr. Kajane (Manager, Laboratory Services-Industrial Metrology, Botswana Bureau of Standards), Mr. Mongatane (Senior Ore Processing Manager, DEBSWANA), Mr. Makufa (Medical Physicist, Gaborone Private Hospital) and Mr. Otukile (former Director, Radiation Protection Inspectorate). More importantly, these industries have strong links with other industries in the region and the world. In particular, the IAB noted that the Bachelor of Science Honours (Applied Physics) qualification is not simply academic but consists of tailor made courses that are very relevant to the 4th Industrial Revolution and addresses the local, regional and international industry needs. The letter endorsing and recommending this qualification by the IAB is attached in Appendix B, thus confirming and re-affirming the urgent need of this qualification. Owing to the unique interdisciplinary nature of Applied Physics, graduates of this qualification will be ready to take up exciting current and future opportunities related to Applied Nuclear Physics and Technology, Renewable Energy, Square Kilometer Array Project (one of Botswana's key projects), Internet of Things, Quantum Technologies Industry, Electronics and Communications Industry, Technology Development and Innovation, Patent Law, Finance and Big Data Analytics. These are areas and technologies which will provide opportunities for Botswana and the region at large to overcome its obstacles and spur inclusive growth to structurally transform it into a global powerhouse. As far as we are aware, the proposed Bachelor of Science Honours (Applied Physics) qualification is not yet offered by any universities is the region: see Regional and International Comparability section of this document. Thus, the absence of such a 21st Century relevant qualification stresses the need to offer it in Botswana and service the country and the region. Therefore, being responsive to the quest by the HRDC Strategic Plan 2016 and national priorities highlighted in Vision 2036's NDP 11 and subsequent

endorsement by notable industry stakeholders strongly indicate the local, regional and international need for the Bachelor of Science Honours (Applied Physics) qualification.

Purpose of the Qualification

The purpose of the Bachelor of Science Honours in Applied Physics qualification is to deploy Applied Physics as a vehicle to:

- Produce high caliber applied physics graduates with highly employable and valued, transferable skills (critical thinking, problem solving, as well as communication and presentation skills, and independent working), scarce skills (investigation, analytical, innovation, entrepreneurship, Information Technology, good working habits and personality traits, and ethical behaviour) and leadership potential to drive industrialisation and sustainable socio-economic diversification in Botswana the region and the world at large;
- Empower graduates with a robust and well-rounded working knowledge of applied physics for solving complex and interdisciplinary problems of local importance and global relevance in diverse scientific and non-scientific professions;
- Develop industry-standard skills in data processing, computing and programming including local research expertise in applied physics with specialization in Astronomy and Astrophysics, Materials Science, Applied Nuclear Physics and Technology, Non-linear Dynamics and Complex Systems, Computational Physics, including Big Data Analytics.
- After completion of the qualification, Applied Physics graduates are going to work in professions such as (amongst others): Laser Physicist, Research Associate/Scientist, Quantitative Analyst, Data Analyst, Optical Physicist, Design Physicist, Software Developer, Accelerator Operator, Computational Physicist, Nuclear Physicist, Meteorologist and Patent Attorney.

ENTRY REQUIREMENTS (including access and inclusion)

1. The Minimum Entry to this qualification is a Bachelor's Degree (NCQF Level 7) qualification in the same or a cognate field of study.
2. 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) institutional and national policies.

QUALIFICATION SPECIFICATION		SECTION B
GRADUATE PROFILE (LEARNING OUTCOMES)		ASSESSMENT CRITERIA
1.	Interpret, and analyze forefront research developments in different specialization areas of Applied Physics.	1.1 Appraise the recent developments in specialised areas of Applied Physics.
2.	Solve scientific and industrial problems in the area of Applied Physics.	2.1 Formulate, analyze, and solve concrete and abstract problems, in familiar and unfamiliar contexts. 2.2 Apply the knowledge of theory to real-world contexts. 2.3 Integrate knowledge from various subjects and disciplines in solving scientific and industrial problems.
3.	Apply scientific methods and knowledge in the area Applied Physics to solve problems in society and industry, considering ethical and cultural issues.	3.1 Apply scientific knowledge that is relevant to current societal and industrial issues. 3.2 Critically evaluate public information dealing with current scientifically related issues. 3.3 Appraise ethically and culturally sensitive decisions on the effects of scientifically based activities on society. 3.4. Identify and access the socio-economic impact of scientific interventions in society and industry. 3.5 Demonstrate that scientific knowledge is applied for the direct benefit of society and to drive socio-economic development through industrialization.

4.	Design, select and apply appropriate research methods to solve Applied Physics and industry related problems, and to engage and to critique current research practices and techniques.	4.1 Develop appropriate Applied Physics methodologies to solve societal and industry-related problems. 4.2 Compare theoretical predictions with published data to evaluate the significance of the results in context. 4.3 Explain the implications of the findings on the problem under consideration. 4.4 Interpret results of an experiment or other type of research investigation and ensure that valid conclusions are drawn while evaluating the level of uncertainty in these results and expected outcomes. 4.5 Perform and provide appropriate recommendations related to the proposed research problem. 4.6 Develop an analytical ability to manipulate precise and intricate ideas for constructing logical arguments.
5.	Create new scientific knowledge in Applied Physics through supervised research projects.	5.1 Demonstrate and assess appropriate Applied Physics research investigations to produce meaningful results. 5.2 Ensure appropriate analysis of the data is undertaken, and results are discussed in terms of published scientific literature and presented in the form of a written report or publication.
6.	Apply the principles of entrepreneurship and innovation in the area of Applied Physics as tools for driving socio-economic development.	6.1 Demonstrate understanding of the principles underpinning entrepreneurship

		for the exploitation of product/service/process opportunities. 6.2 Explain and illustrate models of business innovation and entrepreneurship. 6.3 Compose, appraise and defend comprehensive and well-structured business innovation plans.

QUALIFICATION STRUCTURE SECTION C			
	Title	**Level**	**Credits**
FUNDAMENTAL COMPONENT Subjects / Units / Modules /Courses	Mathematics	8	12
	Foundations of Physics	8	24
	SUB-TOTAL:		**36**
CORE COMPONENT Subjects / Units / Modules /Courses			
	Foundations of Physics	8	12
	Applications of Physics	8	12
	Computational Physics	8	12
	Mathematical Methods	8	12
	Physics Research Project	8	30
	SUBTOTAL:		**78**
ELECTIVE COMPONENT Subjects / Units / Modules /Courses	Management and Entrepreneurship Concepts and Principles	8	6
	Mathematical Programming & Game theory	8	6
	SUB-TOTAL:		**12**
	GRAND TOTAL:		**126**

ASSESSMENT AND MODERATION ARRANGEMENTS

ASSESSMENT

All assessments, formative and summative, leading to the award of credits in this qualification shall be based learning outcomes, and the qualification exit-level outcomes.

- Formative Assessment - A formative assessment aligned to the module learning outcomes and exit-level ou be administered continuously throughout the learning period in each module. Remarkably, all formative a will be moderated accordingly since they largely contribute to the award of the credits. The weights of th assessment for each module is left for individual Education Training Providers (ETPs). The weighting fo assessment will 60%.
- Summative Assessment - Learners shall undergo a summative assessment which may include a written e at the end of learning period in each module. Similar to the case of formative assessment, the weights for the assessment is left to the individual ETPs. The weighting for summative assessment will 40%.

MODERATION

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

Recognition of Prior Learning (RPL) shall be granted where the candidate is able to provide sufficient evidence of their competence in a module or set learning outcomes as determined by the appointed RPL Assessor(s). Credit transfer will be awarded in accordance with applicable CAT policies and guidelines. After meeting all the requirements of the course, the candidate will be awarded the BSc (Honors) in Applied Physics qualification through both the RPL and CAT route.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Articulation

Horizontal articulation: Students may articulate horizontally to:

i. Bachelor of Science Honours (Applied Physics),
ii. Bachelor of Science Honours (Physics),
iii. Bachelor of Science Honours (Applied Mathematics),
iv. Bachelor of Science Honors (Engineering Physics).

Vertical articulation: Students may articulate vertically to:

i. Master of Science (Applied Physics),
ii. Master of Science (Physics),
iii. Master of Science (Applied Mathematics),
iv. Master of Science (Engineering Physics)

Employment

After successful completion of the Bachelor of Science Honours (Applied Physics) qualification, graduates are globally highly sought in a diverse array of fields including: Environmental Physics, Biophysics and Medical Physics, Space Physics, Telecommunications, Nanodevices, 3D manufacturing and Energy. Furthermore, graduates in Physics have rewarding and successful careers because physics methods and insights are widely applicable. Physicists are widely sought in almost every scientific field and beyond, and the possible employment pathways include: Laser Physicist, Research Associate/Scientist, Optical Physicist, Design Physicist, Software Developer, Accelerator Operator, Nuclear Physicist, Meteorologist, Patent Attorney, Energy Physicist, Space Physicist, Environment and Climate Physicist, Nanotechnologist and Data Analyst. Moreover, some of the fields and career opportunities are listed (but not limited to) in the Table 1 below (adapted from a similar table drawn up by the South African Institute of Physics[1]). Graduates with a Bachelor of Science Honours (Applied Physics) qualification need to successfully complete MSc and PhD qualifications in Physics or Applied Physics for progression to the academic path of lecturing and research at higher education providers. The academic career path starts at lecturer level and progresses to full professor in the area of expertise. Table 2 below lists specific career sectors and paths in Botswana for graduates with a Bachelor of Science Honours (Applied Physics) qualification (adapted from a similar table drawn up by the South African Institute of Physics[1]).

QUALIFICATION AWARD AND CERTIFICATION

Minimum standards of achievement for the award of the qualification

Graduates will be awarded the Bachelor of Science Honours (Applied Physics) qualification after successful completion of 126 minimum credits prescribed in the Qualification Structure.

Certification

Graduates meeting prescribed requirements will be awarded the qualification in accordance with standards prescribed for the award of the qualification and applicable policies. A certificate and transcript of the award of the degree of Bachelor of Science Honours (Applied Physics) will be given upon successful completion of the qualification.

REGIONAL AND INTERNATIONAL COMPARABILITY

This Bachelor of Science Honours (Applied Physics) qualification is compliant with and conforms to the Subject Benchmark Statement[1] for Physics published by the Quality Assurance Agency for Higher Education in the United Kingdom and complies with the Benchmark Statement for Physics in South Africa[2]. Furthermore, the exit-level outcomes of the qualification are consistent with the Level Descriptors for the South African National Qualifications Framework[3]. In addition, the skills, achievements, and knowledge of subject matter that are expected from graduates of an accredited Bachelor of Science Honours (Applied Physics) degree are aligned with those published[4] by the Institute of Physics in the United Kingdom.

The Bachelor of Science Honours (Applied Physics) qualification of the education provider has been benchmarked against a sample of similar qualifications offered within the region [BSc Applied Physics Qualification offered by the University of Johannesburg (South Africa)] and abroad [Applied Physics BSc (Hons) offered by the University of Dundee (Scotland); BSc (Hons) Applied Physics Qualification offered by

the Universiti Teknologi Petronas (Malaysia); BSc (Honours) in Applied Physics Qualification offered by the Nanyang Technological University (Singapore)]: see below for details.

University of Dundee (Scotland) – Applied Physics BSc (Hons) Qualification

The University of Dundee (Scotland) offers a four-year Applied Physics BSc (Hons) [5] qualification, accredited Institute of Physics.

DESCRIPTION OF QUALIFICATION

The main exit levels outcomes of the Applied Physics BSc (Hons) qualification are expressed in terms of th Graduate Skills Base[4] upheld by the Institute of Physics in the UK, namely, that the qualification should enhance Pl (How to tackle problems in physics and formulate an appropriate solution, How to use mathematics to describe t world, How to plan, execute and report the results of an experiment or investigation, How to compare results c predictions from theory) and Transferable Skills (Problems-solving skills, Investigative skills, Communication skills skills, IT skills, Personal skills, Ethical behaviour), cover specified content, and include project work in the final yea

The Applied Physics BSc (Hons) qualification covers the following domains in physics: Foundations of Physic Mechanics, Electromagnetism, Thermal and Statistical Physics, Quantum Physics), Mathematical Methods, Exper Computational Physics, Specialisation Topics (Astrophysics, Nuclear and Particle Physics, Materials Science, Photonics), and a Research Project. The qualification also includes non-scientific courses related to Professior Course delivery methods include exposition, workshops, practical classes, tutorials, problem classes, peer-to-pee exam preparation, physics society activities, talks by invited speakers. Assessment methods ecompass ex extended assignments, weekly problems, formal reports, practical laboratory work, in-class presentations as indivic groups, and practical research methods.

Employment includes working in diverse areas such as Telecommunications, Microelectronics, Nuclear Instrumentation, Cryogenics, Astronomy, Geophysics, Materials Science, Computing, Teaching, Business, F Management. Educational pathways include pursuing MSc and PhD degrees.

COMPARABILITY WITH PROPOSED QUALIFICATION

Our BSc Honours Applied Physics qualification has also been benchmarked relative to the Graduate Skills Base[4] of Physics in the UK, and hence our qualification is very similar to the above degree in terms of the exit leve domains covered, delivery and assessments methods, education and employment pathways, one of the difference

the qualification from the University of Dundee is a four-year degree whereas our degree spans five years advantaged of our qualification is a stronger focus on Computational Physics, High Performance Computing ar analytics, and Non-Linear Dynamics and Complex Systems, which are areas in high demand by industry. Furth qualification includes a dedicated semester for work-integrated learning (not included in the learning qualific University of Dundee), where students gain real life work experience in collaboration with research group institutions, technology parks, business incubators, and physics-based industries in the region and around the wo

Compared to the University of Dundee, our qualification also includes a larger variety of non-science modules fo learners with knowledge and practical skills in: Technical Writing and Academic Literacy; Technical Rep Professional Communication; Technical Communication and Basic Research Methods; Introduction to Entrep Management and Entrepreneurship Concepts and Principles; Project Management; Starting and Sustaining a Economics, Business and Entrepreneurship; Developing a Strategic Business Plan; Risk Management; Intr Accounting and Finance; Innovation, Commercialisation and Intellectual Property; Organisational and Management. The latter modules equip students with much-needed soft-skills that are required by industry and bu

Universiti Teknologi Petronas (Malaysia) – BSc (Hons) Applied Physics Qualification

The Universiti Teknologi Petronas (Malaysia) offers a four-year BSc (Hons) Applied Physics[6] qualification which is by the Malaysian Qualification Agency.

DESCRIPTION OF QUALIFICATION

The educational objective of the BSc (Hons) Applied Physics qualification is to produce scientific workforce in Applied Physics with the potential to become leaders in industries and Research and Development with specialis and Gas, Renewable Energy and Nanotechnology. Upon completion of the qualification, graduates should be ab knowledge of Applied Physics; plan and conduct experiments, as well as to analyze and interpret scientific data; solve applied physics problems and challenges in industries; use the techniques, skills and latest scientific and tec necessary for innovative, creative and professional practice; conduct applied physics research project effe independently or in teams in a professional and ethical manner; communicate effectively with community at large; d business acumen and entrepreneurship skills; recognise the importance to undertake life-long learning.

The BSc (Hons) Applied Physics qualification covers the following domains in physics: Foundations of Physic Mechanics, Electromagnetism, Thermal and Statistical Physics, Quantum Physics), Mathematical Methods, Exper Computational Physics, Specialisation Topics (Oil and Gas Exploration, Renewable Energy, Nanotechnology)

Project, and an Industrial Internship. The qualification also includes non-scientific courses such as Acader Professional Communication Skills, Business Accounting, Management and Organisational Behaviour, Principles Principles of Marketing, and Small Business and Entrepreneurship. Course delivery methods include traditio methods, (classroom lectures, labs and tutorials), Blended Learning/Flipped Classroom, and Problem-Based Lea / Project Based Learning. A select of few of the courses are delivered online through massive open online course Assessment methods[7] ecompass formative and summative assessment as specified by the lecturer. Students ar throughout the semesters via coursework (tests, assignments, laboratory works, oral presentations, worksho projects and others as specified by the lecturer) and final written examinations. There are courses whereby s assessed throughout the semester without having to sit for final examinations.

Employment involves working as a physicist at any industrial or research establishments, such as those c semiconductor devices, solar cells, electronics and product processing, and involves supervision of equipment op maintenance, troubleshooting operational problems related to process, and undertaking modification work for p safety improvement. Educational pathways include pursuing MSc and PhD degrees.

COMPARABILITY WITH PROPOSED QUALIFICATION

Our qualification is very similar to the above qualification in terms of the exit level outcomes, domains covered education and employment pathways, industrial internships (work-integrated learning), and non-science courses communication and business. An added advantaged of our qualification is a stronger focus of Computational Ph Performance Computing and Big Data analytics, and Non-Linear Dynamics and Complex Systems, which are a demand by industry. Furthermore, our qualification offers a five specialisation tracks compared to the three specialis offered by the Universiti Teknologi Petronas.

Nanyang Technological University (Singapore) – BSc (Honours) in Applied Physics Qualification

The Nanyang Technological University (Singapore) offers a four-year BSc (Honours) Applied Physics[8] qualificatio

DESCRIPTION OF QUALIFICATION

Upon the successful completion of the BSc (Honours) in Applied Physics qualification, graduates able to: demonstrate a rigorous understanding of the core theories and principles of physics involving (but not limit such as classical mechanics, electromagnetism, thermal physics and quantum mechanics; read and undergraduate level physics content independently; make educated guesses / estimations of physical quantities apply fundamental physics knowledge, logical reasoning, mathematical and computational skills to analyse, mod

problems; develop theoretical descriptions of physical phenomena with an understanding of the underlying assur limitations; critically evaluate and distinguish sources of scientific/nonscientific information and to recommend decisions and choices when needed; demonstrate the ability to design and conduct experiments in a Physics la make measurements, analyse and interpret data to draw valid conclusions; propose valid approaches to tackle problems in unexplored domains; offer valid alternative perspectives/approaches to a given situation or proble physical phenomena with scientifically sound principles; communicate (in writing and speaking) scientific and r ideas effectively to professional scientists and to the general public; communicate effectively with team members wh in a group; uphold absolute integrity when conducting scientific experiments, reporting and using the scientific res pick up new skills, particularly technology related ones, to tackle new problems; contribute as a valued team me working in a group; put together the skills and knowledge into their work in an effective, responsible and ethical ma benefits of society.

The BSc (Honours) in Applied Physics qualification covers the following domains in physics: Foundations of Physic Mechanics, Electromagnetism, Thermal and Statistical Physics, Quantum Physics), Mathematical Methods, E Physics, Specialisation Topics (Nanotechnology, Optical Technology, Semiconductor), Research Project or a Internship. The qualification also includes so-called general education electives (non-scientific courses) such a Communication, Business and Management, Ethics and Moral Reasoning, Enterprise and Innovation, Research w Physical and Mathematical Sciences. Information pertaining to course delivery and assessment methods is available on the website of Nanyang Technological University.

Applied Physics graduates are equipped with a flexible skillset that includes the ability to formulate models an against data, familiarity with cutting-edge technical equipment, and experience in using experimental and theoreti to tackle open-ended problems. This makes them highly suitable for a broad range of fulfilling occupation engineering and R&D (research and development) in industry and academia, education, finance, software develo professional positions. Additionally, physicists are also employed in Science and Engineering professions (su Service Engineer, Process Engineer, Lab Executive, Medical Dosimetrist, Product Engineer, Manufacturing Mechanical Engineer, Test Engineer), Information Technology (such as Data Scientist, Applications Consultan Engineer, Quality Assurance Analyst, Software Developer, Programmer Analyst, Games Developer), Public Adm and Finance and Banking. Educational pathways include pursuing MSc and PhD degrees, and working as a Resea Teacher, Research Scientist, or University Instructor.

COMPARABILITY WITH PROPOSED QUALIFICATION

Our qualification is very similar to the above qualification in terms of the exit level outcomes, domains covere education and employment pathways and non-science courses. The Final Year Project and Professional Int regarded as elective modules. An added advantaged of our qualification is a stronger focus of Computational Ph Performance Computing and Big Data analytics, and Non-Linear Dynamics and Complex Systems, which are a demand by industry. Furthermore, our qualification offers a five specialisation tracks compared to the three specialis offered by the Nanyang Technological University. Furthermore, our qualification includes both a final year research work-integrated learning, whereas Nanyang Technological University includes either a final year research proje integrated learning.

University of Johannesburg (South Africa) – BSc Applied Physics Qualification

The University of Johannesburg (South Africa) offers a four-year BSc Applied Physics[8] qualification at NQF level 8 to Honours), accredited by the Department of Higher Education and Training, South Africa.

DESCRIPTION OF QUALIFICATION

Upon completion of this BSc Applied Physics qualification at NQF level 8, graduates will be able to: plan, desig and construct accurately alternative energy sources of measurable yield using the acquired knowledge; co develop, research and exhibit functional optoelectronic devices using the learnt skills; Integrate, research, apply, a optical techniques applicable to the optical fibre communication field using the learnt concepts; design, research and analyse nanotechnology device relevant to the electronic field using the learnt principles, apply, research, quantify graphically spectroscopic properties of materials using applied spectroscopy and experimental competer and submit well-written, scientifically and technologically sound research reports; hypothesise, appraise and co credible research findings with relevant peer scientific audiences and communities.

The BSc Applied Physics qualification covers the following domains in physics: Foundations of Physics (Classical Electromagnetism, Thermal and Statistical Physics, Quantum Physics), Chemistry, Mathematical Methods, E Physics, Specialisation Topics (Renewable Energy, Nanotechnology, Optical Techniques, Optoelectronics, a Spectroscopy), Research Project, and Work-integrated Learning. The qualification also includes non-scientific co as Computer Literacy, Quality Assurance, Business Practice, Plagiarism and Copyright. Course delivery methods i to-face contact sessions (lectures), tutorials, practical demonstrations, practical work, group work, and group d Assessment methods ecompass tests, assignments, practicals, and examinations.

Employment includes working in organisations specialising in Renewable energy, Optoelectronics, Applied Spectr Nanotechnology our envisaged prospective employment pathways for our graduates would be academic government research organisations and industries in South Africa such as Eskom, NECSA, DENEL, PHILIPS, AT DELL, and Telkom amongst others. Educational pathways include pursuing MSc and PhD degrees.

COMPARABILITY WITH PROPOSED QUALIFICATION

Our BSc Honours Applied Physics qualification has also been benchmarked relative to the the Level Descriptors fo African National Qualifications Framework[3], and hence our qualification is very similar to the above degree in term level outcomes, domains covered, delivery and assessments methods, education and employment pathways advantaged of our qualification is the compulsory nature of a Research Project and Work-integrated Learning, bo are considered as electives at the Nanyang Technological University, and a stronger focus of Computational Ph Performance Computing and Big Data analytics, and Non-Linear Dynamics and Complex Systems, which are a demand by industry. Furthermore, our qualification offers a five specialisation tracks compared to the three specialis offered by the University of Johannesburg.

Comparability Matrix

The comparability between the different qualifications is summarised in the table below in terms of the: name of th body (and country); title of the qualification, NQF level and credit; main exit outcomes; domains covered; qualifi and minimum standard for the award of the qualification; education and employment.

Area of Comparison	Education and Training Provider				
	Botswana International University of Science and Technology	**University of Dundee (Scotland)**	**Universiti Teknologi Petronas (Malaysia)**	**Nanyang Technological University (Singapore)**	**Unive Johar (Sout**
Awarding Body	Botswana Qualifications Authority	UK Institute of Physics	Malaysian Qualification Agency	Ministry of Education, Singapore	Depar Highe Educa Traini Africa
Qualification	BSc Honours Applied Physics	Applied Physics BSc (Hons)	BSc (Hons) Applied Physics	BSc (Honours) in Applied Physics	
NQF Level	Eight (8)	Scottish Qualification Framework Level (SCQF) 10 (Year 4)	Eight (8)	Eight (8)	Eight
Credit Value	BSc Applied Physics (480 notional credits) plus BSc Honours in Applied Physics (120 notional credits)	480 credits	128 credits	135 academic units	505 credit
Main Exit Outcome(s)	Exit levels outcomes consistent with Graduate Skills Base[4] upheld by the Institute of Physics in the UK. Apply systematic, extensive, and comparative knowledge to solve Applied Physics problems using the concepts and principles of Physics; Describe, interpret, and analyse forefront research developments in different specialization areas of Applied Physics; Access, evaluate, synthesise, and analyse scientific information in the area of Applied Physics; Generate	The main exit levels outcomes of the Applied Physics BSc (Hons) qualification are expressed in terms of the so-called Graduate Skills Base[4] upheld by the Institute of Physics in the UK, namely, that the qualification should enhance Physics Skills, namely (How to tackle problems in physics and formulate an appropriate solution; How to use mathematics to describe the physical world; How to plan, execute and report the results of an experiment or investigation; How to compare results critically with predictions from theory; and Transferable Skills (Problems-solving skills, Investigative skills,	Produce scientific workforce in the field of Applied Physics with the potential to become leaders in industries and Research and Development with specialisation in Oil and Gas, Renewable Energy and Nanotechnology. Upon completion of the qualification, graduates should be able to: apply knowledge of Applied Physics; plan and conduct experiments, as well as to analyze and interpret scientific data; identify and solve applied physics problems and	Demonstrate a rigorous understanding of the core theories and principles of physics involving (but not limited to) areas such as classical mechanics, electromagnetism, thermal physics and quantum mechanics; read and understand undergraduate level physics content independently; make educated guesses / estimations of physical quantities in general; apply fundamental physics knowledge, logical reasoning, mathematical and computational skills to analyse, model and solve problems; develop theoretical descriptions of physical phenomena with an understanding of the underlying assumptions and limitations; critically evaluate and distinguish sources of scientific/nonscientific information and to	Gradu be ab desig resea const accur altern energ of m yield acqui knowl conce devel resea exhibi functi optoe device the le Integr resea and optica techn applic optica comm field learnt desig resea synth analy

	scientific information in the area of Applied Physics; Demonstrate key scientific reasoning skills in Applied Physics; Communicate scientific understanding in Applied Physics, both verbally and in writing, using visual, symbolic and/or other forms of representation; Solve scientific and industrial problems in the area of Applied Physics; Demonstrate effective information and communication technology (ICT) skills in Applied Physics; Work effectively as a member of a team or group in scientific projects and investigations in the area of Applied Physics; Apply scientific methods and knowledge in the area Applied Physics to solve problems in society and industry, considering ethical and cultural issues; Design, manage and organise learning activities responsibly in the area of Applied Physics; Design, select and apply appropriate research methods to solve Applied Physics	Communication skills, Analytical skills, IT skills, Personal skills, Ethical behaviour), cover specified content, and include project work in the final year.	challenges in industries; use the techniques, skills and latest scientific and technical tools necessary for innovative, creative and professional practice; conduct applied physics research project effectively both independently or in teams in a professional and ethical manner; communicate effectively with community at large; demonstrate business acumen and entrepreneurship skills; recognise the importance to undertake life-long learning.	recommend appropriate decisions and choices when needed; demonstrate the ability to design and conduct experiments in a Physics laboratory, to make measurements, analyse and interpret data to draw valid conclusions; propose valid approaches to tackle open-ended problems in unexplored domains; offer valid alternative perspectives/approaches to a given situation or problem; describe physical phenomena with scientifically sound principles; communicate (in writing and speaking) scientific and nonscientific ideas effectively to professional scientists and to the general public; communicate effectively with team members when working in a group; uphold absolute integrity when conducting scientific experiments, reporting and using the scientific results; readily pick up new skills, particularly technology related ones, to tackle new problems; contribute as a valued team member when working in a group; put together the skills and knowledge into their work in an effective, responsible and ethical manner for the benefits of society.	nanot devic to the field learnt apply explo quant graph spect prope mater applie spect and exper comp prese subm writte scient techn sound report hypot appra comm credib resea findin releva scient audie comm

	and industry related problems, and to engage and to critique current research practices and techniques; Create new scientific knowledge in Applied Physics through supervised research projects; Apply the principles of entrepreneurship and innovation in the area of Applied Physics as tools for driving socio-economic development.				
Domains Covered (Number Credits or Units)	Foundations of Physics (120); Applications of Physics (96); Mathematical Methods (120); Experimental and Computational Physics (36); Specialisation Topics (36); Project (24); Work-Integrated Learning (60); Non-science modules (48); Science and Engineering Electives (48); Non-Physics Core Science Modules (120)	Foundations of Physics (160); Applications of Physics (50); Mathematical Methods (35); Experimental and Computational Physics (45); Specialisation Topics (60); Project (50); Work-Integrated Learning (0); Non-science modules (0); Science and Engineering Electives (0); Non-Physics Core Science Modules (80)	Foundations of Physics (23); Applications of Physics (15); Mathematical Methods (6); Experimental and Computational Physics (16); Specialisation Topics (12); Project (0); Industrial Internship (14); Non-science modules (23); Non-Physics Core Science Modules (18)	Foundations of Physics (31); Applications of Physi++cs and Specialisation Topics (27); Mathematical Methods (0); Experimental and Computational Physics (20); Project (elective); Work-Integrated Learning (elective); Non-science modules (33); Science and Engineering Electives (15); Non-Physics Core Science Modules (14)	Found and Applic Physi Mathe Metho Exper and Comp Physi Speci Topic Proje Work- Learn Non-s modu Scien Engin Electi Non-P Core Modu
Assessment Methods	Formative and summative (continual) assessment tools, including (but not limited to): unseen closed-book and/or open-book written examinations; unseen closed-book and/or	Assignments, weekly problems, formal reports, practical laboratory work, in-class presentations as individuals and/or groups, and practical research methods, examinations.	Formative and summative assessment as specified by the lecturer; Students are assessed throughout the semesters via coursework (tests, assignments, laboratory works,	Information not publicly available on the website of Nanyang Technological University.	Tests assign practi exam

	open-book written tests or quizzes; written assignments and/or essays; laboratory reports; project reports and software developed; portfolios and personal development plans; poster and oral presentations; as well as oral examinations.		oral presentations, workshop practices, projects and others as +specified by the lecturer) and final written examinations. There are courses whereby students are assessed throughout the semester without having to sit for final examinations.		
Qualification Rules	Minimum total number of 612 credits distributed as follows: NQF Level 5, minimum 264 credits; NQF Level 6, minimum 126 credits; NQF Level 7, minimum 102 credits; NQF Level 8, minimum 120 credits.	Total Cedit Award required: 480 credits with a minimum of 120 credits at Level 3 (SCQF level 9) and a minimum of 90 credits at Level 4 (SCQF level 10)	Minimum total number of 128 credit hours distributed as follows: credits distributed as follows: National Requirement 14 credits; University Requirement 9 credits; Common Science 18 credits; Core disciplines 61 credits; Core Industrial Internship 14 credits; Core Specialisation 12 credits.	Minimum total number of 135 academic units. To complete the degree requirements within the normal specified period of 4 years, students are expected to carry an academic load of 16-18 academic units per semester. A full course load per semester is 17 academic units. At least 10 academic units of prescribed electives must be at year 4 level, excluding a Final Year Project and Professional Internship.	Minim numb acade
Education / Employment	Career sectors and paths in business, communication, entrepreneurship, basic and applied research, engineering, medicine and biology, computer science, industry, environmental science, education, military, consulting. Educational pathways include pursuing MSc and PhD	Employment in diverse areas such as Telecommunications, Microelectronics, Nuclear Power and Instrumentation, Cryogenics, Astronomy, Geophysics, Materials Science, Computing, Teaching, Business, Finance and Management. Educational pathways include	Employment as a physicist at any industrial or research establishments, such as those dealing with semiconductor devices, solar cells, electronics and product processing, and involves supervision of equipment operation and maintenance, troubleshooting operational problems related	Graduates are highly suitable for a broad range of fulfilling occupations, including engineering and R&D (research and development) in industry and academia, education, finance, software development, and professional positions. Additionally, physicists are also employed in Science and Engineering professions (such as Field Service Engineer, Process Engineer, Lab Executive, Medical Dosimetrist, Product Engineer,	Emplo organ specia Renew energ Optoe Applie Spect and Nanot our prosp emplo pathw our would acade institu gover resea

	degrees, working as a research assistant and teacher.	pursuing MSc and PhD degrees.	to process, and undertaking modification work for product and safety improvement. Educational pathways include pursuing MSc and PhD degrees.	Manufacturing Engineer, Mechanical Engineer, Test Engineer), Information Technology (such as Data Scientist, Applications Consultant, Software Engineer, Quality Assurance Analyst, Software Developer, Programmer Analyst, Games Developer), Public Administration, and Finance and Banking. Educational pathways include pursuing MSc and PhD degrees, and working as a Research Fellow, Teacher, Research Scientist, or University Instructor.	organ and ir South such NECS DENE PHILI SHEL and amon Educa pathw includ MSc degre

REFERENCES

1. Subject Benchmark Statement, Physics, Astronomy and Astrophysics: Draft for Consultation, published by the Quality Assurance Agency for Higher Education in the United Kingdom, April 2016.
2. Benchmark Statement for Physics in South Africa, South African Institute of Physics, http://www.saip.org.za/index.php/sa-physics-benchmark-statement, accessed on 20 April 2019.
3. The South African Qualifications Authority, Level Descriptors for the South African National Qualifications Framework, November 2012.
4. The Physics Degree: Graduate Skills Base and the Core of Physics, Institute of Physics, September 2011.
5. Information pertaining to the Applied Physics BSc (Hons) qualification offered by the University of Dundee; https://www.dundee.ac.uk/undergraduate/applied-physics/, accessed on 10 July 2019.
6. Information pertaining to the BSc (Hons) Applied Physics BSc qualification offered by the Universiti Teknologi PETRONAS, https://www.utp.edu.my/Pages/Admission/Undergraduate/Bachelor-of-Science-(Hons)-Applied-Physics.aspx, accessed on 10 July 2019.
7. Universiti Teknologi PETRONAS, Undergraduate Programme: A Guide to University Academic Guidelines and Procedures.

8. Information pertaining to the BSc (Honours) in Applied Physics qualification offered Nanyang Technological University (Singapore), https://spms.ntu.edu.sg/PhysicsandAppliedPhysics/Undergraduates/Pages/Overview.aspx, accessed on 10 July 2019.

REVIEW PERIOD

The review period of the qualification shall be five (5) years.