No. 452 **8 May 2009**

SOUTH AFRICAN QUALIFICATIONS AUTHORITY (SAQA)

In accordance with Regulation 24(c) of the National Standards Bodies Regulations of 28 March 1998, the Task Team for

Radiography and Clinical Technology

registered by Organising Field 09 – Health Sciences and Social Services, publishes the following Qualifications for public comment.

This notice contains the titles, fields, sub-fields, NQF levels, credits, and purpose of the Qualifications. The full Qualifications can be accessed via the SAQA web-site at **www.saqa.org.za**. Copies may also be obtained from the Directorate of Standards Setting and Development at the SAQA offices, SAQA House, 1067 Arcadia Street, Hatfield, Pretoria.

Comment on the Qualifications should reach SAQA at the address below and ***no later than 9 June 2009.*** All correspondence should be marked **Standards Setting – Task Team for Radiography and Clinical Technology** and addressed to

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SOUTH AFRICAN QUALIFICATIONS AUTHORITY

QUALIFICATION:
Bachelor: Nuclear Medicine Technology

SAQA QUAL ID	***QUALIFICATION TITLE***		
66950	Bachelor: Nuclear Medicine Technology		
ORIGINATOR		***PROVIDER***	
TT - Radiography and Clinical Technology			
QUALIFICATION TYPE	***FIELD***	***SUBFIELD***	
Professional Qualification	9 - Health Sciences and Social Services	Curative Health	
ABET BAND	***MINIMUM CREDITS***	***NQF LEVEL***	***QUAL CLASS***
Undefined	480	Level 7	Regular-ELOAC

This qualification does not replace any other qualification and is not replaced by another qualification.

PURPOSE AND RATIONALE OF THE QUALIFICATION
Purpose:

The purpose of this Qualification is to develop a professional Radiographer who will specialise in the field of Nuclear Medicine. This qualification will enable the qualified specialist to work in the public or private health care sectors or operate as an independent practitioner.

This Qualification enables the learner to competently apply an integration of theory, principles, proven techniques, practical experience and appropriate skills to the solution of well-defined and abstract problems in the selected field of Nuclear Medicine. It aims at ensuring reflective practice and life-long learning in the profession, thereby benefiting the community and society. This will be achieved by the learner meeting the following outcomes:

- Providing holistic patient care within the nuclear medicine environment.
- Performing a range of nuclear medicine imaging procedures for purposes of diagnosis and treatment.
- Operating and ensuring quality function of nuclear medicine instrumentation.
- Dispensing and administering radiopharmaceuticals.
- Performing in-vitro and non-imaging nuclear medicine procedures.
- Assuring the quality of nuclear medicine service provided.

Skills in management and research will also be developed allowing the holder of this Qualification to work independently and in a supervisory capacity within a health care team.

Successful completion of this Qualification will enable the graduate to be registered by the relevant Professional Health Council.

Rationale:

Healthcare is set to change in the future from the curative paradigm of the 20th century to a pre-emptive model. Imaging is central to this model and will drive that change to the benefit of the patient. Medical imaging in general plays a key role in understanding complex biological systems and Nuclear Medicine in particular is relevant in tracking changes at a molecular, cellular and organ tissue level. Nuclear Medicine is currently experiencing an expansive growth phase with the advent of Positron Emission Technology (PET)/Computerised tomography (CT)

imaging technology. PET/CT is an invaluable tool in the area of oncology, and is set to be very promising in the areas of neurology and cardiology.

Nuclear Medicine Radiographers are part of an integral team comprising; Nuclear Medicine Physicians, Medical Physicists, Radiopharmacists and Nursing staff who are responsible, in general, for delivering a nuclear medicine service. In particular the Nuclear Medicine Radiographer is responsible for performing the Nuclear Medicine investigation in toto, from preparation and administration of the radiopharmaceutical, to imaging the patient and finally to processing the data acquired. The qualified Nuclear Medicine Radiographer needs to display expertise in the many and varied Nuclear Medicine investigations; predominantly in vivo investigations but also non-imaging (in vitro) and to a lesser extent therapeutic investigations.

Nuclear Medicine facilities in South Africa are located mainly in high population areas both in the public and private sectors. Registration to practice as a Radiographer in the category; nuclear medicine is through the HPCSA.

This Qualification is recognised by the Statutory Health Council as a requirement for registration to practise in the field of Nuclear Medicine Technology. Achievement of this qualification should provide the learner with direct access to a Master's degree.

The Qualification is necessary for employment in both the public and the private sector as part of a team providing a holistic health care service in general and a nuclear medicine service in particular.

The exit level outcomes for this degree describe the foundational, practical and reflexive competencies, which together constitute the applied competence required of Nuclear Medicine Radiographer at this level.

RECOGNIZE PREVIOUS LEARNING?
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LEARNING ASSUMED IN PLACE
- Mathematics at NQF Level 4.
- Communication at NQF Level 4.
- Science at NQF Level 4.
- Biology at NQF Level 4.

Computer Literacy at NQF Level 3 is strongly recommended.

Recognition of Prior Learning:

This Qualification may be achieved in part through the recognition of relevant prior learning and through prior experience as a practitioner in another field of Radiography. Providers are required to develop structured and accredited means of the assessment of individual learners against exit-level outcomes of the qualification on a case-by-case basis. Recognition of prior learning will be conducted in accordance with the institutions' accredited RPL policy and the agreement of the relevant ETQA. Such procedures and the assessment of individual cases are subject to moderation by independent assessors.

Access to the Qualification:

Access to the qualification is open to learners in possession of a Senior Certificate or equivalent NQF Level 4 qualifications and who meet the entry requirements of the institution offering the Qualification, as well as the specifications of the relevant Statutory Health Council.

QUALIFICATION RULES

Fundamental and Core Component:

Exit Level Outcomes 1 to 7 constitute the Fundamental and Core Components of the Qualification and together total 440 credits. They are compulsory for all learners.

The allocation of credits to each Exit Level Outcome can be done by the individual institutions offering the qualification on condition such allocation meets the minimum number of credits for each Exit Level Outcome as stipulated by the relevant Health Council in its curriculum guidelines.

Elective Component:

The Elective Component consists of two parts:

The research Exit Level Outcome (Outcome 8) in which learners may choose any aspect or topic in the field which is relevant to them and for which they are required to produce the outcomes of their research in a manner, format and to a standard acceptable to the institution offering the Qualification (40 credits minimum).

The application of theoretical knowledge and skills in one of the chosen fields as listed below:
- Small and Medium Business Enterprises.
- Paediatric Nuclear Medicine.
- Advanced practice in hybrid imaging systems i.e. PET/CT and PET/MRI.
- Therapeutic use of radionuclides.
- Radioimmunoassays.
- Medical law and bioethics.
- Education in health.

This may be assessed in an integrated way with Exit Level Outcomes 1 to 7 or be incorporated into the research project (Exit Level Outcome 8).

EXIT LEVEL OUTCOMES

1. Apply principles of human rights, ethics and relevant medical law to ensure the well-being of the patient.

2. Perform a range of conventional and specialised nuclear medicine imaging procedures in order to facilitate diagnosis and treatment of the patient.

3. Operate and ensure quality functioning of all nuclear medicine instrumentation to provide the best diagnostic capability of the instruments.

4. Function in a type 'B' radiopharmacy laboratory to safely dispense radiopharmaceuticals for nuclear medicine imaging procedures.

5. Perform a range of in vitro and in vivo non-imaging nuclear medicine procedures in a type 'C' radiopharmacy laboratory.

6. Assure quality of all aspects of a Nuclear Medicine investigation and the service provided.

7. Plan, develop and apply total quality management appropriate to the nuclear medicine context.

8. Demonstrate research skills and foster a research climate in nuclear medicine.

9. Apply the principles, specific knowledge, skills and values related to the chosen elective subject.

Range of possible electives:

- Small and Medium Business Enterprises.
- Paediatric Nuclear Medicine.
- Advanced practice in hybrid imaging systems i.e. PET/CT and PET/MRI.
- Therapeutic use of radionuclides.
- Radioimmunoassays.
- Medical law and bioethics.
- Education in health.

Critical Cross-Field Outcomes:

The qualification promotes the critical cross-field outcomes in the following manner:

- Identify health problems in the context of nuclear medicine and suggest and implement a solution or plan of action in order to solve the problem professionally.
- Perform professional duties with confidence in collaboration with other health care professionals and where appropriate assume leadership in tasks or projects all in view to assuring that quality to minimise the risks associated with adverse reactions and radiation accidents for the protection of both patients and the public.
- Keep up with the current trends and changing needs of a nuclear medicine service on a regional, national and international level in relation to both the radiopharmacy legislation and work practices to ensure an efficient functioning and administration of the type 'C' laboratory.
- Contribute towards and facilitate continuing professional development of nuclear medicine staff with the view of ensuring that nuclear medicine equipment and accessories are competently operated in order to provide the best diagnostic capability of the equipment.
- Communicate effectively in the learning and health care environment to ensure that the patients' needs are recognised, assessed and responded to with due regard to human dignity.
- Reflect on and explore a variety of strategies in order to improve nuclear medicine practice by participating in the social, political and academic debate about what research is and how it should be conducted in nuclear medicine technology.
- Demonstrate understanding of nuclear medicine principles in order to solve practical problems within the nuclear medicine context through the application of research methods for nuclear medicine procedures.

ASSOCIATED ASSESSMENT CRITERIA

Associated Assessment Criteria for Exit Level outcome 1:

1.1 Patients physical and psychological needs are recognised, assessed and responded to with due regard for human dignity.
1.2 Patient' rights as a member of society are acknowledged and adhered to according to the Human Rights Bill and Patient Charter.
1.3 Communication is effective and appropriate with both the patient and other members of the health care team in a multicultural context with due regard for human dignity and patient confidentiality.
1.4 Appropriate nursing skills and the ability to act in an emergency and apply first aid are demonstrated during patient intervention.

Associated Assessment Criteria for Exit Level outcome 2:

2.1 Knowledge and skills related to the theoretical, clinical and technical practices and principles of nuclear medicine technology are applied in order to perform, develop protocols and apply research methods for nuclear medicine procedures.
2.2 Comprehensive knowledge of human anatomy, cross-sectional anatomy, physiology, biological processes at a molecular level and related pathophysiology is applied in order to

acquire nuclear medicine scintigrams of optimal diagnostic quality and to recognise normal and abnormal nuclear medicine image patterns.
2.3 Comprehensive knowledge of the physical characteristics and biodistribution of up-to-date radiopharmaceuticals is applied in order to select, administer and evaluate radiopharmaceuticals appropriate to the nuclear medicine investigation.
2.4 Comprehensive theoretical and clinical knowledge of physics, radiation physics, and radiobiology is applied to ensure safety of the patient and the health care team.
2.5 Principles of digital image processing are applied to display qualitative and/or quantitative data in order to facilitate the diagnostic capability of the nuclear medicine investigation.
2.6 Normal and abnormal radiopharmaceutical biodistribution patterns are recognised and verbally communicated or documented in order to manage the investigation or inform other members of the health care team.
2.7 Comprehensive up-to-date knowledge of specialised nuclear medicine imaging procedures is applied in order to perform investigations such as Positron Emission Technology (PET).
2.8 Specialised knowledge and the sensitive handling of the child as a patient is applied in order to perform paediatric nuclear medicine procedures.
2.9Specialised procedures using hand held gamma probes in a surgical environment are performed, as part of a surgical team.

Associated Assessment Criteria for Exit Level outcome 3:

3.1 All nuclear medicine imaging devices and accessory equipment are competently operated in order to provide the best diagnostic capability of the equipment.
3.2 The performance of conventional and specialised gamma cameras is evaluated by performing regular quality control tests and taking corrective action where necessary.
3.3 Up-to-date knowledge of Nuclear Medicine (NM) Computerised Tomographiclimaging devices is integrated into the operation of the instruments and their performance regularly monitored.
3.4 Quality control tests are performed on all counting devices and data meticulously recorded to ensure quality function.
3.5 Operation of all hard copy recording devices and processing units is appropriately applied.
3.6 Underpinning theoretical and technical knowledge is applied during the operation and quality performance of PET cameras.

Associated Assessment Criteria for Exit Level outcome 4:

4.1 Radionuclide generators are operated and maintained in order to ensure quality, sterile PRODUCTS for use in radiopharmaceuticals.
4.2 Detailed knowledge of radiochemistry and physiochemical aspects of radiolabelling compounds and blood components is applied for use in preparation of radiopharmaceuticals.
4.3 Quality control tests are regularly performed in order to ensure the product identity, biological safety and efficacy of the radiopharmaceutical.
4.4 Appropriate dispensing techniques are used in the preparation of radiopharmaceuticals to ensure safety during patient administration whilst minimising radiation hazard to self and other personnel.
4.5 Comprehensive knowledge of factors which will affect the integrity of radiopharmaceuticals is applied and adverse reactions are noted and the event is reported.
4.6 Up-to-date knowledge of radiopharmacy legislation and appropriate work practices is applied for efficient functioning and administration of a type 'B' laboratory.

Associated Assessment Criteria for Exit Level outcome 5:

5.1 Knowledge of current, relevant radiopharmacy legislation and work practices is applied for efficient functioning and administration of a type 'C' laboratory.

5.2 Comprehensive knowledge of radionuclide tracer principles, physiology and biochemical processes is applied in order to perform in vitro and in vivo non-imaging nuclear medicine procedures safely, and accurately.
5.3 Counting systems, statistics and results are evaluated in order to insure quality results which are reliable and valid.
5.4 Normal and abnormal results are correctly interpreted.

Associated Assessment Criteria for Exit Level outcome 6:

6.1 A comprehensive Quality Assurance programme is developed, implemented and audited.
6.2 Quality control tests on nuclear medicine instrumentation are performed according to National Electrical Manufacturers Association (NEMA) standards.
6.3 Quality control tests on radionuclides, radiopharmaceuticals and the radiopharmacy environment and equipment are performed.
6.4 Required procedures are utilised in order to prevent contamination from unsealed sources and any possible contamination is monitored.
6.5 Adverse reactions and radiation incidents are immediately reported to relevant authorities and regulatory bodies.
6.6 Customer-orientated quality service is provided to the nuclear medicine patient.

Associated Assessment Criteria for Exit Level outcome 7:

7.1 Principles of quality assurance and quality control are demonstrated in the development of departmental protocols.
7.2 Equipment and accessories are selected, purchased and maintained within an available budget to provide a cost-effective service.
7.3 Communication and co-operation between all role players are effectively developed and maintained in order to provide optimal service.
7.4 Performance management strategies are developed in a manner which shows an understanding of management principles and current, relevant legislation.
7.5 Departmental records and statistics are accurately maintained in accordance with the departmental and professional council requirements.
7.6 Integrated knowledge of management, technology and current, relevant legislation is demonstrated in the ability to design and equip a new, or alter an existing, ultrasound facility.

Associated Assessment Criteria for Exit Level outcome 8:

8.1 Contributions are made in the debate on social, political and academic matters, the need for research and how it should be carried out in the health sector.
8.2 The research of others is analysed and interpreted to replicate or inform own research.
8.3 Pertinent literature is reviewed in order to design a research project.
8.4 Research principles and methodology in the field of nuclear medicine research are demonstrated in the form of a research project.
8.5 Results of the research project are reported according to scientific norms.

Associated Assessment Criteria for Exit Level outcome 9:

9.1 Apply and integrate the principles and/or philosophy of the subject into related activities.
9.2 Apply the specialised techniques required to achieve the contextual objective.
9.3 Apply quality assurance principles to ensure optimal results within the context of the subject.

Integrated Assessment:

Integrated assessment incorporates an appropriate variety of assessment methods for example; written and oral examinations, problem-solving assignments, projects, presentations, case

studies, portfolios, log books, clinical reports, assessment of clinical competence through simulated and clinical assessment in situ, objective structure clinical examinations (OSCE) and the successful completion of a research project.

The qualification will be awarded to a learner who has provided evidence to the satisfaction of the assessors that the stated competence of the qualification, as detailed in the stated outcomes, has been achieved, either through education and training in a single provider's learning programme or though experience that complies with the stated specific outcomes, i.e., RPL is recognised.

Integrated assessment should have the following characteristics:

- Assess the extent to which the learners can practice Nuclear Medicine Technology competently, effectively and safely in any clinical context nationally and internationally.
- Measure the extent to which learners have integrated knowledge, skills and professional roles as reflected in the course content.
- Provide opportunities for reflection-in-action and reflection-on-action to develop reflexive competence.

INTERNATIONAL COMPARABILITY

The primary reason for designing this Qualification was to meet the needs of the South African community as identified by the National Department of Health. To evaluate how this qualification compares with qualifications offered and competency profiles accredited in other countries, an analysis of nuclear medicine qualifications and competency profiles in countries that are leaders in the field, developing countries and SADC countries was conducted.

Nuclear Medicine in South Africa is registered as one of the four radiography categories. Internationally it is either a stand alone qualification or is linked to Diagnostic Radiography, Radiation Therapy or Medical Physics. Initially individuals with qualifications in related fields were recruited into Nuclear Medicine and as the speciality evolved so too did the availability of de novo qualifications in Nuclear Medicine. Training programmes available globally have not kept pace with the expansive growth of Nuclear Medicine. North American countries are leaders in the field with established training programmes. Developing countries are yet to catch up with International training trends and mostly offer nuclear medicine as a component of or as an 'add on' to a related qualification. The IAEA has done much to address the problem of lack of formal training in Nuclear Medicine technology in developing countries by offering Fellowship Training and Distance Assisted Training (DAT) programmes for Nuclear Medicine Technologists in Asia, Africa and Latin America.

The United States of America (USA) is one of the leaders in the field of Nuclear Medicine. The formal academic nuclear medicine technology education system in the USA is accredited through the Joint Review Committee on Educational Programs in Nuclear Medicine Technology (JRCNMT). The JRCNMT is recognised by the USA Department of Education (USDE) and the Council for Higher Education Accreditation (CHEA). The mandatory requirements and prerequisites for these programmes are outlined in the Essentials and Guidelines for an Accredited Educational Program for Nuclear Medicine Technologists. The tasks detailed align closely with the Exit Level Outcomes as stated in the South African Qualification.

The tasks broadly cover the following;

- Patient care.
- Radiation safety.
- Nuclear Medicine instrumentation-quality control.
- Radiopharmaceuticals.
- Diagnostic procedures (including in-vitro and non-imaging procedures).
- Radionuclide therapy.

Critical Cross field outcomes are made explicit in the Guidelines for learning opportunities to develop personal and professional attributes and values relevant to practice and to a large extent match those of the South African CCFOs. There is no national standard but varying levels of terminal degrees are available in the USA; such as certificates, Associate degrees and Baccalaureate degrees. Baccalaureate programmes generally require additional mathematics, science and liberal arts as part of the pre-professional core curriculum. Accreditation is gained through examinations administered by the Nuclear Medicine Technology Certification Board (NMTCB). Components of Preparedness Statements to achieve accreditation are grouped into; Radiation Safety, Instrumentation, Clinical procedures and Radiopharmacy.

The following section looks at the nuclear medicine education programme as offered by two education institutions, namely, the Cedar Crest College and the University of Findlay. Both these institutions are accredited by the NMTCB and follow the mandatory requirements and prerequisites for these programmes as outlined in the Essentials and Guidelines for an Accredited Educational Program for Nuclear Medicine Technologists.

Cedar Crest College:

This College offers a B.Sc. Degree and a Post-Baccalaureate Certificate in Nuclear Medicine Technology.

The BSc degree spans four years. The first three years are spent in the academic environment where theoretical tuition is offered. The fourth year consists of the clinical component and this is offered at the accredited training centres. This format of education and training of learners differs from the way nuclear medicine education and training is offered in South Africa as the clinical component is structured as Work Integrated learning (WIL), starting from the first year of study. The education institutions offer the theoretical component of the course and learners receive clinical training at the various clinical platforms which have been accredited by the registration council to offer this training.

To be accepted at the Cedar Crest College, learners must have a high school diploma or equivalent. They should have obtained a grade C symbol in Anatomy and Physiology and College Algebra. These entrance requirements compare well with the requirements for the South African Qualification. Cedar College has not however stipulated how RPL is applied or whether they do consider learners with entrance requirements different from that which they have listed.

According to the Cedar Crest College programme, acceptance in the clinical year is competitive and not guaranteed by satisfaction of the minimum requirements. It is based on academic performance with the minimum credits to be accumulated, pitched at gross points average (GPA) of 2.75. The learners are further subjected to an interview by the educational and clinical coordinators. This is different to the South African model where the education institution admits learners to the course with established and accredited clinical platforms for training.

Entrance requirements for the Post-Baccalaureate Certificate are:

- Bachelor's degree in Nuclear Medicine Technology or any other four-year bachelor's degree from an accredited university of college.
- Have completed and received a GPA of 2.75 and a grade "C" or above in Anatomy, Physiology, Physics, Chemistry, Algebra and two English courses.

What is particular about entrance requirements for this Post-Baccalaureate Certificate is that, despite the fact that it is a post basic qualification; the students' academic performance at school is taken into consideration. No mention is made of RPL as it is in South Africa. This makes the

entrance requirements for South African Qualification different from those offered by the Cedar Crest College.

University of Findlay:

The Nuclear Medicine Institute at the University of Findlay offers a One- year-certificate programme in Nuclear Medicine Technology. The course is accepted by most education institutions in the USA as an entrance to the two or four-year degree or associate degree programmes in nuclear medicine.

To be accepted into the one-year certificate course, the student must have successfully completed the postsecondary education with the 70% grade or higher. The following courses are prerequisites to the nuclear medicine programme, namely, human anatomy, human physiology, general chemistry, general physics, college algebra, English composition, basic speech and communication as well as computer operation. In addition, the learner must have successfully completed a cardio-pulmonary resuscitation (CPR) course for adults, children and infants.

These entrance requirements compare reasonably well with those for the South African Qualification except for the CPR course which usually forms part of orientation in South African programmes. In as far as the science subjects are concerned; mathematics is a prerequisite in South Africa and not "Algebra" as it is the case at the University of Findlay.

The course is structured in a way that allows the learner to spend time in both the academic and clinical environments. Classes are held for 28-32 hours per week over one semester. Clinical training is scheduled for 40 hours per week. This is allocated for 35 weeks during the academic programme. At the end of the clinical block, the learner is given a week for review, after which an examination is conducted. During the clinical block, the learners are expected to document successful completion of the specified clinical projects. The university has further specified the contents to be covered during the clinical training period. These have been grouped into Clinical Nuclear Medicine 1 and 2.

The way the course is offered by this university compares well with the way the nuclear medicine programme is offered in South Africa. Various education institutions have different models for the division of the clinical and academic components. Important to note is that in South Africa the learners can only receive clinical training at the hospitals and clinics which have been accredited to do so by the relevant Professional Council. The Professional Council also expects that the education institutions allow the learners to keep records of their personal clinical training in the form of log books. The Council further specifies the amount of time the learner should spend in the clinical environment to be deemed competent and thus eligible for post graduation registration.

The certificate course offered by the University of Findlay is accepted as an entrance to the degree programme at that university and other education institutions accredited by the JRCNMT to offer nuclear medicine education and training.

Canada:

The Canadian Association of Medical Radiological Technologists (CAMRT) outlines the competency profile of Nuclear Medicine Technologists. The Nuclear Medicine Technology Competency Profile is divided into modules:

- Professional Practice.
- Patient management.
- Radiation Health and Safety.
- Quality Management.
- Radiopharmacy and Laboratory Procedures.

- Modules related to nuclear medicine clinical applications.

Accreditation for entry-level practice is administered and examined by the CAMRT for registration to work. The standards of practice governing registration are guided by the CAMRT Code of Ethics and are reflected in four standards of professional practice namely; knowledge, clinical proficiency, communication and accountability. These characteristics of professional standards of practice are both explicit and implicit in the ELOs outlined in this Qualification.

United Kingdom, Ireland and Europe:

There are no agreed national standards governing Nuclear Medicine basic education, training or professional development in the United Kingdom. Radiographers or Medical Technical Officers (MTOs) typically undergo three years of training in diagnostic and therapeutic radiography followed by one - two years of clinical experience to consolidate knowledge. Thereafter they can sub-specialise. Nuclear Medicine is a sub-speciality leading to a post graduate certificate or Master of Science degree, with curricula varying from centre to centre. No state registration is required. However, the Consortium for the Accreditation of Nuclear Medicine Education (CANME) will assess practical competence on a voluntary basis for validation. Currently hospitals are awarding consultant/advanced practitioner status to those radiographers who are competent in basic aspects of nuclear medicine and in addition:

- Administer radiopharmaceuticals.
- Perform computer analyses of imaging data.
- Demonstrate evidence-based practice.
- Have involvement in training staff.
- Interpret images.
- Manage a team of professionals.

These competencies are inherent in the graduate Exit Level competencies as stated in this document. The situation in Ireland is similar to that in the United Kingdom with variations in legislation and training practice. In Europe the education of nuclear medicine technologists differs considerably from country to country. There is no harmonisation of curricula in Europe and both University-based and non-University based training is offered. In some countries, e.g., Greece and Croatia, there is no established training.

Developing Countries:

No international harmonisation of training exists and structured courses in Nuclear Medicine Technology are mostly non-existent in developing countries despite a nuclear medicine service being offered. This is recognised by the International Atomic Energy Agency (IAEA) in the "Resources Manual in Nuclear Medicine" regarding training of Nuclear Medicine Technologists. The lack of structured training has resulted in a broad range of individuals from school leavers to science graduates being employed in nuclear medicine departments and receiving in-house training. The suggested syllabus outlined in the IAEA Human Resource manual includes:

- Basic nuclear physics.
- Safe handling of radionuclides.
- Nuclear Medicine instrumentation.
- Computers in nuclear medicine.
- Anatomy and physiology.
- Human behaviour.
- Nuclear Medicine applications.

These topics and additional topics have been incorporated into the IAEA Distance Assisted Training (DAT) programme which has been completed by approximately 400 students in 23

countries across Asia, Latin America and Africa. This is a work-integrated distance learning programme consisting of 12 modules, incorporating:

- Basic physics.
- Radiation safety.
- Nuclear Medicine (NM) instrumentation.
- Radiopharmacy.
- Computers in NM.
- Behavioural Science/patient care.
- NM applications according to systems e.g. cardiac, renal.
- Paediatric techniques.
- Radio-immunoassays and non-imaging techniques.
- Human biology and sectional anatomy.
- Literature review.
- SPECT and PET physics.
- Infection and tumour imaging.
- Radionuclide therapy guidelines.

The material has been developed with South African input for use by member states where no training exists. No qualification is awarded. An IAEA certificate of completion is given.

SADC and other African countries:

Technologists working in Nuclear Medicine departments in sub-Saharan African countries do not have access to formal training in Nuclear Medicine. Technologists offering nuclear medicine services have mostly been recruited from related fields of Radiological Technology. The IAEA DAT programme has been used to rectify this situation, with coordinated assistance from South Africa as this country's expertise in the field of nuclear medicine technology training is recognised by the IAEA. Training in North Africa, as in Europe, varies from country to country and no de novo qualification is available. An IAEA initiative to harmonise training in Africa led to the issuing of guidelines for training. These stipulate entry points, possible training pathways, types of assessments and competency standards. These guidelines for training were accepted for implementation in 2000 by each participating country as a basic standard for training and were, to a large extent, based on the South African model.

Central and Latin America:

The University School of Medical Technology in Uruguay is the only Higher Education Institution in South America offering a de novo course in Nuclear Medicine. It is a four-year professional degree. There is, however, no integration of clinical practice as a license from the National Regulatory Authority is required to handle radioactive material. Formal training is a prerequisite for the license. At present candidates from Argentina, Bolivia, Colombia, Cuba, Peru and Venezuela are training through the IAEA/DAT course, coordinated from Uruguay.

Conclusion:

The Bachelor of Nuclear Medicine compares well with countries that are leaders in the field of Nuclear Medicine Technology, such as USA and Canada. Together with the help of the IAEA, South Africa leads the way on the African continent for establishing standards for Nuclear Medicine Technology practice and training.

ARTICULATION OPTIONS

Vertical articulation:

- Master of Radiography: Nuclear Medicine, NQF Level 8.

Horizontal articulation:

- Advanced Diploma: Nuclear Medicine Radiology, NQF Level 7.
- Bachelor of Radiology Nuclear Medicine, NQR Level 7.
- Bachelor of Radiology Honours: Nuclear Medicine, NQF Level 7.

MODERATION OPTIONS

- Internal and external assessment and moderation of learner achievement should be undertaken by those who have qualifications at or above the level of qualification and who have been accredited by the relevant ETQA.

- Assessments are conducted by one or more internal assessors/examiners employed by the relevant provider as well as an by external moderator appointed from industry/other academic institution, in agreement with the relevant ETQA.

- Assessors and moderators are required to be in possession of a professional degree in Nuclear Medicine Technology or equivalent or higher, or appropriate research/teaching/academic/clinical experience and appointed in agreement with the relevant ETQA.

NOTES

All learners for this Qualification are required to be registered as learner radiographers with the Statutory Health Council, for the duration of the period of study in an accredited clinical training centre with accredited mentoring.

UNIT STANDARDS

This qualification is not based on Unit Standards.

LEARNING PROGRAMMES RECORDED AGAINST THIS QUALIFICATION

None

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

QUALIFICATION:
Bachelor of Radiation Therapy

SAQA QUAL ID	*QUALIFICATION TITLE*		
66951	Bachelor of Radiation Therapy		
ORIGINATOR		*PROVIDER*	
TT - Radiography and Clinical Technology			
QUALIFICATION TYPE	*FIELD*	*SUBFIELD*	
Professional Qualification	9 - Health Sciences and Social Services	Curative Health	
ABET BAND	*MINIMUM CREDITS*	*NQF LEVEL*	*QUAL CLASS*
Undefined	480	Level 7	Regular-ELOAC

This qualification does not replace any other qualification and is not replaced by another qualification.

PURPOSE AND RATIONALE OF THE QUALIFICATION
Purpose:

The purpose of the qualification is to develop a professional, who is competent in the knowledge and skills required for Radiation Therapy and has gained experience in applying such knowledge in the appropriate workplace context.

This qualification enables the professional to competently apply an integration of theory, principles, proven techniques, practical experience and appropriate skills to the solution of well-defined and abstract problems in the selected field of Radiation Therapy. The learner should become a reflective practitioner and a life-long learner in his or her profession, thereby benefiting the community and society.

Appropriate applied skills in management and research will also be demonstrated allowing the holder of this qualification to work independently and in a supervisory capacity within the health care team.

Rationale:

Radiation Therapy is one of the scarce skill professions in South Africa and more Radiographers need to be trained in order to address this shortage. Healthcare is set to change in the future from the curative paradigm of the 20th century to a pre-emptive model. Medical Imaging and Radiation Therapy are central to this model and will drive that change to the benefit of the patient. The Radiation Therapist is involved in the planning and/or dose calculation and accurate administration of various forms of ionising radiation for the treatment and care of patients with malignant and benign neoplasms, according to a prescription of a Radiation Oncologist. Radiation Therapy has grown substantially as an individual allied health science discipline alongside the new ionising radiation and computer technologies that have emerged worldwide since the 1960's. Thus, the practice of Radiation Therapy has required an increasing range of skills and professional scope. The learning required for the practice of Radiation Therapy has grown accordingly from informal, hospital-based training to formal qualifications offered by higher education institutions in partnership with academic hospitals. This has been true in South Africa as well as across the globe.

Radiation therapy plays a key role in understanding the complex biological systems and life sciences. It includes interdisciplinary fields such as Physics, Human Biology, Computer Sciences, Communication and Psychology to extract that information and apply it within the profession.

This qualification requires a minimum of 480 credits, which is normally a full-time programme. It is recognised by the relevant Professional Council as a requirement for registration to practise in the field of Radiation Therapy. The qualification is necessary for employment in both the public and the private sector as part of a team providing a holistic health care service in general and radiotherapy service in particular. All learners for this qualification are required to be registered as learners by the relevant Professional council for the duration of the period of study in an accredited clinical training centre.

RECOGNIZE PREVIOUS LEARNING?
Y

LEARNING ASSUMED IN PLACE
- Mathematics at NQF Level 4.
- Communication at NQF Level 4.
- Science at NQF Level 4.
- Biology at NQF Level 4.

Computer Literacy at NQF Level 3 is strongly recommended.

Recognition of Prior Learning:

This Qualification may be achieved in part through the recognition of relevant prior learning and through prior experience as a practitioner in another field of Radiography. Providers are required to develop structured and accredited means of assessment of learners against Exit-Level Outcomes of the qualification on an individual level. Recognition of prior learning will be applied on an individual basis and will be conducted in accordance with the institutions' accredited RPL policy. Such procedures and the assessment of individual cases are subject to moderation by independent assessors.

Access to the qualification:

Access to the qualification is open to learners who are in possession of a Senior certificate or equivalent at NQF Level 4 qualification and who meet the entry requirements of the institution offering the Qualification, as well as the specifications of the relevant Statutory Health Council.

QUALIFICATION RULES
Fundamental and Core Component:

Exit Level Outcomes 1 to 7 constitute the Fundamental and Core Components of the Qualification and together total 440 credits. They are compulsory for all learners.

The allocation of credits to each Exit Level Outcome can be done by the individual institutions offering the qualification on condition such allocation meets the minimum number of credits for each Exit Level Outcome as stipulated by the relevant Health Council in its curriculum guidelines.

Elective Component:

The Elective Component consists of two parts:

The research Exit Level Outcome (Outcome 8) in which learners may choose any aspect or topic in the field which is relevant to them and for which they are required to produce the outcomes of their research in a manner, format and to a standard acceptable to the institution offering the qualification (40 credits minimum).

The application of theoretical knowledge and skills in one of the chosen fields as listed below:
- Palliative patient care.
- Paediatric Radiation Oncology.
- Fusion imaging use in Radiotherapy.

This may be assessed in an integrated way with Exit Level Outcomes 1 to 7.

EXIT LEVEL OUTCOMES

1. Apply the principles of human rights, ethics and relevant medical law which ensure the well-being of the patient.

2. Demonstrate a critical understanding and application of quality assurance and radiation protection in a Radiation Therapy division.

3. Apply scientific knowledge and technical skills to perform radiation oncology laboratory techniques and procedures.

4. Perform radiotherapy procedures competently to ensure optimal radiation localization and immobilisation for radiation treatment.

5. Perform radiotherapy procedures competently to ensure optimal treatment planning.

6. Apply scientific knowledge and professional skills to perform therapeutic procedures for accurate delivery of the radiation treatment prescribed.

7. Plan, develop and apply total quality management appropriate to the radiation therapy context.

8. Demonstrate research skills and foster a research climate in radiation therapy.

9. Apply the principles, specific knowledge, skills and values related to the chosen elective subject.
- Range of possible electives:
  - Paediatric Radiation Oncology.
  - Palliative patient care.
  - Fusion imaging use in Radiotherapy.

Critical Cross-Field Outcomes:

The following critical cross-field outcomes will be developed in this qualification:

- Identify health problems in the contexts of radiation therapy and suggest and implement a solution or plan of action to solve the problem professionally.
- Perform professional duties with confidence in collaboration with other health care professionals and workers and where appropriate assume leadership in tasks or projects.
- Keep up with the current trends and changing needs of a radiation therapy service on regional, national and international level.
- Contribute towards and facilitate continuing professional development of radiation therapy staff.
- Communicate effectively in the learning and health care environment.
- Reflect on and explore a variety of strategies in order to improve radiation therapy practice.

• Demonstrate understanding of radiation therapy principles in order to solve practical problems within the radiation therapy context.

ASSOCIATED ASSESSMENT CRITERIA

Assessment Criteria for Exit-Level Outcomes 1:

1.1 Psychosocial support is provided with respect to the psychological impact of cancer and its treatment by applying knowledge of applied psychology to facilitate holistic patient care.
1.2 The patient is monitored for changes in their general condition together with dose related radiation reactions by applying knowledge of patient care skills and radiobiology principles in order to provide responsible and effective patient care.
1.3 Knowledge of professional ethics is demonstrated and applied in order to protect the rights of the patient for medico-legal purposes.
1.4 Rights of the patient, as entrenched in the Human Rights Bill and the Patients' Right Charter, are protected to maintain confidentiality and to provide a comprehensive radiotherapy service.

Assessment Criteria for Exit-Level Outcomes 2:

2.1 Quality Assurance programmes are implemented and adhered to in the localization, immobilisation, planning and treatment of patients to ensure optimal radiation delivery.
2.2 Standard operating procedures are implemented and adhered to, to ensure the safe and accurate delivery of ionizing radiation treatment.
2.3 Relevant knowledge and understanding of radiation protection regulations for personnel, public and patient safety is demonstrated and applied within the planning and treatment of patients.
2.4 Quality Assurance and Quality control procedures and data are accurately monitored and recorded for future planning and statistical purposes.

Assessment Criteria for Exit-Level Outcomes 3:

3.1 The capability to perform radiation laboratory technology, appropriate to clinical presentation or request, is demonstrated.
3.2 Quality immobilisation and positioning devices are produced for use during patient's set-up treatment.
3.3 The capability to manufacture beam modification devices appropriate to the radiation treatment prescribed is demonstrated.
3.4 The knowledge and application of different materials used in the construction of devices, as required during radiation treatment, is demonstrated.
3.5 The knowledge and application of isotopes according to clinical requirements laid down by current legislation is demonstrated.
3.6 Appropriate health and safety regulations, ethical principles, guidelines and codes of practice in the performance of mould room techniques are applied to ensure personnel, public and patient safety.
3.7 Radiation Protection regulations are implemented and adhered to in the planning and treatment of patients thus ensuring optimal radiation delivery.

Assessment Criteria for Exit-Level Outcomes 4:

4.1 The localization equipment and accessories are safely operated in order to provide the necessary images for treatment planning.
4.2 The patient is accurately positioned according to departmental standards for radiation treatment by applying anatomical knowledge.
4.3 The localization procedure is planned by interpretation and application of the anatomical, pathological and clinical data, for accurate and safe treatment of the patient.

4.4 Customised patient treatment accessories are prepared and constructed by interpreting, applying and verifying theoretical, clinical and technical knowledge and skills, for accurate and reproducible application of treatment plans.
4.5 Immobilisation procedures are appropriately utilised to ensure reproducibility of treatment position.
4.6 Anatomical and pathological knowledge is applied to assist in localization of the neoplasm and treatment fields (Simulation procedures as well as Computerised Tomography (CT) scanning, Magnetic Resonance Imaging (MRI), Positron Emission Technology (PET) and Ultrasound) in order to facilitate accurate and reproducible treatment set-ups for optimum treatment delivery.
4.7 Pathological, radiobiological and radiation physics, theoretical and clinical knowledge is applied to provide physical care to patients with different neoplasms.
4.8 Appropriate data recording of localization results and immobilisation parameters are implemented to further planning and treatment delivery procedures, and for medico-legal purposes.
4.9 Patients with different neoplasms are provided with physical care by applying pathological, radiobiological and radiation physics, theoretical and clinical knowledge.

Assessment Criteria for Exit-Level Outcomes 5:

5.1 The planning equipment, including accessories, is safely operated in order to optimally and accurately plan a patient using ionizing radiation.
5.2 Anatomical, pathological and clinical data are interpreted and applied in order to plan the treatment.
5.3 Computerised treatment plans (2D and 3D) for optimal treatment delivery, not exceeding prescribed doses for normal tissue, are effectively produced by implementing the information gained from localization procedures.
5.4 Radiation treatment doses and times/monitor units to be given to the patient to ensure the treatment delivery complies with the prescription are calculated by utilising knowledge and skills.

Assessment Criteria for Exit-Level Outcomes 6:

6.1 All radiation treatment equipment, including accessories, is safely operated in order to optimally and accurately treat a patient with ionizing radiation.
6.2 Optimal treatment procedures are performed by using integrated theoretical and clinical knowledge.
6.3 Patients are set up accurately for treatment according to prescription by applying anatomical, technical and pathological knowledge.
6.4 Radiation treatment is accurately and safely delivered by interpreting, using and verifying the correct treatment parameters according to prescription.
6.5 Appropriate data are recorded meticulously for medico-legal purposes.

Assessment Criteria for Exit-Level Outcomes 7:

7.1 Management principles and procedures are applied and implemented to ensure effective integration within the radiotherapy department and within the multi-disciplinary oncology team.
7.2 Management skills within the multidisciplinary team are applied to ensure effective and optimal patient flow.
7.3 Departmental policies and standard operating procedures are implemented and adhered to for effective management of the radiotherapy division.
7.4 Analysis and evaluation of the departmental policies and standard operating procedures are performed for effective management of the radiotherapy division.
7.5 Knowledge and awareness of participation in Continuous Professional Development (CPD) and in-service training is demonstrated to maintain professional knowledge and life-long learning.

Assessment Criteria for Exit-Level Outcomes 8:

8.1 Development and review of protocols/clinical trials are undertaken in order to maintain the required standards of treatment.
8.2 Knowledge production within the profession is understood and participated in to keep abreast of continuing and new developments within the radiotherapy profession.
8.3 Appropriate information technology is used to record, retrieve and communicate patient data.
8.4 An ongoing knowledge of appropriate information technology is maintained in order to keep abreast of modern technology.
8.5 Research principles and methodology in the field of radiotherapy research are applied in order to complete a mini research project.

Assessment Criteria for Exit-Level Outcomes 9:

9.1 Apply and integrate the principles and/or philosophy of the selected subject into related activities.
9.2 Apply the specialised techniques required to achieve the contextual objective.
9.3 Apply quality assurance principles to ensure optimal results within the context of the subject.

This may be assessed in an integrated way with Exit Level Outcomes 1 to 7.

Integrated Assessment:

Integrated assessment takes the form of an appropriate variety of assessment methods for example: Written and oral examinations, problem-solving assignments, projects, presentations, case studies, portfolios, log books, clinical reports, assessment of clinical competence through simulated and clinical assessment in situ, Objective Structured Clinical Examinations (OSCE) and the successful completion of a mini-dissertation.

The qualification will be awarded to a learner who has provided evidence to the satisfaction of the assessors that the qualification, as detailed in the stated outcomes, has been achieved, either through education and training in a single provider learning programme or though experience that complies with the stated specific outcomes i.e. RPL is applied.

However, the integrated assessment needs to have the following characteristics:

- It should assess the extent to which learners can practice competently, effectively and safely in any clinical context nationally and internationally.
- It should measure the extent to which learners have integrated the professional roles, knowledge, practice and skills delivered through the different outcomes reflected in the relevant programme.
- It should provide opportunities for reflection-in-action and reflection-on-action to develop reflexive competence.

INTERNATIONAL COMPARABILITY

The qualification was designed to meet the needs of Radiation Oncology in South Africa as identified by the National Department of Health and all stakeholders. Alignment with international standards has been considered. This degree was evaluated in terms of the minimum standards for developing countries, as presented in the document of the International Atomic Energy Agency (IAEA): A syllabus for the education and training of Radiation Therapists (RTTs) has reference. In addition, comparison with qualifications in developed countries was also made.

South Africa has had many years of experience in the education and training of Radiation Therapists and contributes to the training needs for the African continent. In line with

international trends, the education of Radiation Therapists moved from being a qualification following a qualification in Diagnostic Radiography to being an independent first qualification. Radiation Therapy has a specific knowledge area that requires high level cognitive and work integrated learning at degree level. This move towards degrees has taken place throughout the world.

In Canada, the British Columbia Institute of Technology (BCiT) offers two different programmes of study. One is a full time course of study over four academic terms. Successful candidates receive a Bachelor of Technology credential. The other course, also full time, is of 33 months duration and successful candidates graduate with a Bachelor of Technology in Radiation Therapy and are eligible to take the National Certification Examinations by the Canadian Association of Medical Radiation Therapists (CAMRT).

Academic and clinical training:

The programme includes both theoretical and clinical components. Each term requires 27-28 hours per week of course work. For every course that the student enrols, a minimum of 60% is required to progress to the next level.

Clinical training takes place in accredited facilities over eight to sixteen weeks. For the learner to graduate, a total of 48 weeks should have been spent in the clinical environment. In addition, the learner must meet the full stipulations and requirements for the CAMRT competency profile which includes patient care, communication, professional behaviour and quality of work.

The Radiation Therapy course offered by BCIT compares well with the proposed Bachelor's Degree in South Africa in that the theoretical component is offered by the academic institutions and the clinical training, at accredited training sites. Both stipulate the number of hours a learner needs to spend in the clinical environment to gain competence in performing various radiation therapy procedures. The major difference is that, in South Africa, there is no national examination. Learners who are successful at various accredited education and training institutions are eligible to register with the HPCSA and are awarded professional status and the right to practice within the scope of the Health Professions Council of South Africa.

Entrance requirements:

One year of university level academic studies (30 credits) to include:

- Mathematics (preferably calculus based).
- Physics (Grade 12 or post secondary equivalent).
- English.
- Liberal studies course (should have been completed in the last five years or relevant to the current study).
- Complete a minimum of 40 hours volunteer work in a hospital or have previous experience in healthcare to demonstrate commitment to patient care.

These entrance requirements compare favourably with the South African qualification in that both have Maths, Physics and English at secondary school level. Some of the South African Higher Education Intuitions which offer the Radiation Therapy course do recommend that learners visit the hospital environment before enrolling for the course, but do not specify how much time should be spent there.

Accreditation:

Canadian Medical Association Conjoint Committee for Accreditation.

Course content for the Bachelor of Technology, Radiation Therapy:

• Anatomy and Physiology 1: Introduces the learner to cytology, histology, skeletal and muscular system.
• Applied Social Science 1: Assists learners to develop communication and coping skills needed in healthcare. Also includes ethics, conflict resolution and other diverse cultural issues in the workplace.
• Anatomy and physiology 2: Higher level and includes cardiovascular, nervous, digestive and urinary systems together with concepts and applications for sectional and relational anatomy.
• Applied Social Science 1: Continues the exploration of the psychological and sociological issues that may impact cancer patients.
• Pathology: This includes principles of pathology and fundamental diseases at cellular, local and systemic levels. Learning includes cell injury and death which may be the result of cancer or incorrect treatment procedures.
• Management Skills and Application: This provides the learner with knowledge and skills needed in decision making, planning, organising, leading and controlling various resources in the department.
• Communication 1: This course enables learners to develop communication skills necessary for assignment writing and presentations as well as effective communication with supervisors, colleagues and other students. It may include report writing.
• Communication 2: Builds on communication 1 and helps the learner develop skills to use complex patterns for oral and written communication in preparation for the work environment.
• Canadian Health System: Enables the learners to develop critical thinking and evaluative skills in analysing the Canadian Health System in relation to other systems worldwide.
• Critical Reading and Writing: Helps learner develop advanced skills in critical analysis, to be able to evaluate materials from various sources like videos or music.
• Applied Ethics: Fosters abilities and values required for ethical decision making in the working environment.
• Imaging Technology I: Explores the fundamental principles of computed tomography and magnetic resonance imaging and their application to Radiation Therapy.
• Patient Care: Provides a solid theory base for safety and comfort aspects to be considered during radiation therapy procedures, in relation to the equipment in the patients' environment.
• Physics and Radiation Therapy 1: Introduces fundamental physics and mathematical concepts to the therapeutic use of ionising radiation.
• Physics and Radiation Therapy 2: Provides fundamental principles and concepts of dosimetry in the application of beam data to obtain the optimal treatment plan for each patient.
• Clinical Orientation: Learners spend a week in the clinical environment where they are introduced to treatment and planning procedures.
• Radiation Therapy: Provides for the introduction to the medical terminology in the discipline of oncology.
• Treatment Planning: Includes treatment delivery, roles and responsibilities of various members of the treatment planning team.
• Clinical experience 1: An eight week clinical practicum which enables participation in the patient care activities.
• Radiation Therapy 2: Examines the characteristics of the healthcare practitioner and how these characteristics are incorporated in clinical performance. Medico-legal issues of informed consent are an example.
• Treatment Planning 2: Quality assurance concepts and application to radiation therapy planning and treatment delivery.
• Clinical Techniques: 16 week period in treatment and planning units to gain exposure and experience in therapy techniques.
• Project Research 1: Provides guidance for the student to develop a suitable research project for radiation therapy.
• Radiation Biology and Safety: Provides an in-depth examination of the effects of radiation on living cells at both low and therapeutic doses.
• Clinical Oncology 1: Provides a foundation of knowledge for diagnosis, staging and treatment of malignancies affecting mostly female patients.

• Treatment Planning 3: Delivers clinical application of dosimetry and treatment planning in order to obtain optimal beam arrangements.
• Research Project 2: Enables completion of research project.
• Clinical experience 3: Continues the development and practice of patient care and technical skills. A period of eight weeks is allocated for this.
• Clinical Experience 4: taken in the last term of the study programme. Learner should demonstrate competent performance of all the techniques and procedures outlined in the CAMRT Summary of Clinical Competence.
• Care of the Oncology patient: Provides a holistic model which integrates the approach to healing and optimal outcomes for oncology patients.
• Clinical Oncology 2: Provides foundation and knowledge for the diagnosis, staging and treatment of childhood tumours.
• Treatment Planning 4: S Learners are exposed to manual methods performed to produce composite isodose distributions and the ability to manage digital information.
• Total quality Management: Theory and practice of quality management in healthcare setting.

All the subjects offered at BCIT except for Liberal Studies (Critical Reading and Writing) are in line with the way the South African qualification has been designed. They relate very well to the expected learning outcomes and assessment criteria. This then gives reassurance that the South African qualification is in line with the leaders in the world. The BCIT clinical training is offered throughout the study years at accredited training centres and this is similar to the way radiation therapy is offered by most education institutions in South Africa. The other institution in Canada that offers education and training for Radiation therapists is Alberta Cancer Board.

Alberta Cancer Board offers a training programme which runs for 28 months. Successful completion of the programme allows the learner to be awarded a Diploma in Radiation Therapy, authorised signature as required in the CAMRT clinical summary and endorsement to write the National CAMRT certification examination. This diploma is also recognised by the Athabasca University and the candidates are credited with 30 credits towards the Bachelor of General Studies or Bachelor of Science degree programme.

Entrance requirements are:

• English.
• Physics.
• Statistics.
• Psychology/Sociology.
• Anatomy and Physiology.

Theoretical subjects include the following:

• Radiation protection.
• Anatomy and physiology.
• Treatment planning and dosimetry.
• Professional practice.
• Physics and apparatus.
• Radiobiology.
• Research methodology and Health Administration offered by the Athabasca University as distance learning courses.

The learner is expected to demonstrate gradual increase in levels of knowledge and skills throughout the study programme. Clinical training takes place at accredited hospitals and the learners are allocated on rotational basis.

The content of these study programmes also compare favourably with the SA qualification and would well match an earlier exit level. This is not accommodated in the proposed qualification

even though the current education programmes are similar to Alberta radiation therapy programme.

This further strengthens the fact that the radiation therapy programmes, as offered in South Africa currently or in future, are well in line with the international programmes by leaders in the field. To further demonstrate how South Africa compares with international states, the next section looks at the qualification offered in New Zealand.

The New Zealand University of Otago offers a Medical Radiation Therapy programme on full-time basis over three years. There is an opportunity to study further for a year in an honours programme. The study programme here also compares favourably with the Canadian and South African qualifications because it incorporates clinical training throughout the study years. Entrance requirements and subjects taught are also comparable. What is different from the South African education programme is that learners are not expected to have a First Aid certificate as an entrance requirement. In Otago, students need this before they can be accepted to the course. The students are further required to keep their certification in first aid current throughout their study programme. In South Africa, learners are offered the opportunity to attend training and pass the examination while registered for the radiation therapy or any radiography programme. The learner is expected to pass first aid before a diploma or degree can be awarded on completion of their study years.

With regard to clinical training, learners are allocated to spend three weeks in the oncology department during the first year, the full first semester during the second year and during the third year; they spend the full second semester in the clinical department. The other important factor of the clinical training is that there is a major training centre as well as other centres where learners are rotated to gain clinical experience. This is similar to the situation in South Africa where the registration council stipulates that learners should be given the opportunity to gain all the experience needed for them to be clinically competent. It is made the responsibility of the education institution to ensure that learners rotate to various clinical training centres during their study years.

Learners are awarded a degree in Medical Radiation Therapy-BhealSc (MRT) on completion of the study programme. This offers them an opportunity to specialise either in the area of treatment delivery or planning, or to become an educator. There are also options to follow the Honours route. On graduating, the candidates are eligible to register with New Zealand Medical Radiation Technologists Board, which confers the professional status to take employment either in state or private healthcare institutions. This registration requirement is the same as in South Africa in that successful candidates from various accredited institutions in South Africa are required to register with the HPCSA before they can practice either in state or private healthcare institutions.

Hong Kong Polytechnic University offers a BSc Honours in Radiography which has two main streams, namely diagnostic radiography and radiation therapy. The course is offered on a full-time basis over three years. It includes both theoretical and clinical components. The first year of study provides a foundation for the following two years where the integration of theory and practice takes place. The choice of the two fields to follow is made in the second year.

Learners are introduced to Clinical Research during semester two of the second year of study. They then continue with a research project which should be completed before the degree can be awarded. Successful learners are employed in state, private hospitals and clinics, as well as by the commercial sector. The qualification is recognised internationally and as such graduates do not have a problem finding employment in other countries worldwide.

The Hong Kong qualification differs from that in South Africa with regard to the duration of study. With regard to subjects taught and mode of integrating theory and practice, they compare fairly well. The other similarity is that both qualifications are a prerequisite for registration to practice. In Hong Kong, qualified radiographers register on Part Two of the Register for the Hong Kong

Radiographers' Board. There are also opportunities for further study into either a full- or part-time Master's programme, as is the case in South Africa.

The African Context:

South Africa is a leader in the education and training of RTTs in Africa. Hence this country played a significant role in developing minimum training requirements for this specialised group of health care practitioners. Learners from across Africa attend at South African institutions for training. Academics from South Africa have contributed to implementing training in Ghana, Nigeria, Ethiopia and Uganda and act as external examiners at the universities in Ghana and Zimbabwe. In terms of comparability the South African Qualification, together with Zimbabwe (3-year degree and diploma qualification) and Ghana (3-year degree programme), exceeds the minimum standards as presented by the IAEA.

A brief view of the emerging world:

Cancer incidence is rising in the emerging world economies, which according to Adams, Yang & Rosenman (2005: 83-89) could include countries in South and Central America, North African countries, South Africa, Russia, China and India. These emerging countries have a concern for public health and can afford to buy access to better radiation technology in order to allow more patients the appropriate radiation therapy for cancer treatment. The increase in radiation technologies i.e., linear accelerators, digital imaging and planning, highlights the need for appropriately-trained RTT's in what is becoming an increasingly sophisticated and specialised work. South Africa and other African countries use Cobalt-60 treatment units fairly extensively. Linear accelerators, sophisticated digital imaging and increasingly specialised radiotherapy planning and treatment methods are being used in South Africa, in both the public and private sector. Therefore the curriculum content and Qualification should reflect and accommodate the required increase in skills levels in radiation therapy practice and research opportunities.

Conclusion:

Qualifications for RTTs exist in only 4 countries in Africa, with several other countries in the process of developing programmes for this category of health care professionals. The new qualification developed for South Africa is in line with what is being offered by leading and developing countries in the world. South Africa must continue to take the lead in Africa by offering a qualification that is comparable to international standards while accommodating the needs of the community for radiation oncology services in the local context.

ARTICULATION OPTIONS

Vertical articulation:

- Master of Radiography: Radiation Therapy, NQF Level 8 and above.
- Master of Medical Science: Radiation Oncology, NQF Level 8 and above.
- Master of Medicine Radiation Oncology, NQF Level 8 and above.
- Master of Radiography: Radiation Therapy, NQF Level 8 and above.

Horizontal Articulation:

- Bachelor of Radiography: Radiation Therapy, NQF Level 7.
- Bachelor of Technology: Radiography, NQF Level 7.
- Bachelor of Radiography: Diagnostics, NQF Level 7.
- Bachelor of Radiography: Diagnostic Ultrasound, NQF Level 7.
- Bachelor of Radiography Honours, NQF Level 7.
- Bachelor of Radiography Honours: Diagnostics: General, NQF Level 7.
- Bachelor of Radiography Honours: Radiation Therapy, NQF Level 7.

MODERATION OPTIONS
Internal and external moderation of learner achievement should be undertaken by those who have qualifications at or above the level of qualification.

CRITERIA FOR THE REGISTRATION OF ASSESSORS
Assessments are conducted by one or more internal assessors/examiners employed by the relevant provider as well as an external moderator appointed from industry/other academic institution. Practising practitioner, registered with the relevant Professional Council, with a Bachelor of Radiation Therapy, or equivalent, or higher, or appropriate research/teaching/academic/clinical experience in the category is appointed.

NOTES
Successful completion of this qualification will enable the applicant to be registered by the relevant Statutory Health Council.

UNIT STANDARDS
This qualification is not based on Unit Standards.

LEARNING PROGRAMMES RECORDED AGAINST THIS QUALIFICATION
None

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

QUALIFICATION:
Bachelor of Diagnostic Radiography

SAQA QUAL ID	*QUALIFICATION TITLE*		
66949	Bachelor of Diagnostic Radiography		
ORIGINATOR		*PROVIDER*	
TT - Radiography and Clinical Technology			
QUALIFICATION TYPE	*FIELD*	*SUBFIELD*	
Professional Qualification	9 - Health Sciences and Social Services	Curative Health	
ABET BAND	*MINIMUM CREDITS*	*NQF LEVEL*	*QUAL CLASS*
Undefined	480	Level 7	Regular-ELOAC

This qualification does not replace any other qualification and is not replaced by another qualification.

PURPOSE AND RATIONALE OF THE QUALIFICATION
Purpose:

The purpose of the qualification is to develop a competent learner who has a thorough grounding in the knowledge and skills required for the Diagnostic Radiography profession and who has gained experience in applying such knowledge and skills in the appropriate workplace context.

This qualification enables the learner to competently apply an integration of theory, principles, proven techniques, practical experience and appropriate skills to the solution of well-defined and abstract problems in the selected field of Diagnostic Radiography. The learner should become a reflective practitioner and a life-long learner in his or her profession, thereby benefiting the community and society.

Skills in management and research will also be demonstrated allowing the holder of this qualification to work independently and in a supervisory capacity within the health care team.

Successful completion of this qualification will enable the learner to register with the relevant Professional Council as a Specialist Radiographer.

Rationale:

Diagnostic Radiography is one of the identified scarce skills in South Africa. Healthcare is set to change in the future from the curative paradigm of the 20th century to a pre-emptive model. Imaging is central to this model and will drive that change to the benefit of the patient. Medical imaging in general plays a key role in understanding complex biological systems and is dependent on interdisciplinary fields (e.g. physics, human biology, computer sciences) to extract that information.

The Qualification is necessary in both the public and the private sectors as part of a multidisciplinary team providing a holistic health care service in general and a diagnostic radiography service in particular.

This Qualification is recognised by the relevant Professional Health Council as a requirement for registration to practice in the field of Diagnostic Radiography.

The Exit-Level Outcomes for this Qualification describe the foundational, practical and reflexive competencies, which together constitute the applied competence required of Diagnostic Radiography service at this level.

RECOGNIZE PREVIOUS LEARNING?
Y

LEARNING ASSUMED IN PLACE
- Mathematics at NQF Level 4.
- Communication at NQF Level 4.
- Science at NQF Level 4.
- Biology at NQF Level 4.

Computer Literacy at NQF Level 3 is strongly recommended.

Recognition of Prior Learning:

This qualification may be achieved in part through the recognition of relevant prior learning and through prior experience as a practitioner in another field of radiography. Providers are required to develop structured and accredited means of the assessment of individual learners against Exit-Level Outcomes of the Qualification on a case-by-case basis. Recognition of Prior Learning will be applied on an individual basis and will be conducted in accordance with the institutions' accredited RPL policy. Such procedures and the assessment of individual cases are subject to moderation by independent assessors.

Access to the Qualification:

Access to the Qualification is open to learners who are in possession of a Senior Certificate or equivalent NQF Level 4 Qualification and who meet the entry requirements of the institution offering the Qualification, as well as the specifications of the relevant Statutory Health Council.

QUALIFICATION RULES
Fundamentals and Core Components:

Exit Level Outcomes 1 to 7 constitute the Fundamental and Core Components of the Qualification and together total 440 Credits. They are compulsory for all learners.

The allocation of credits to each Exit Level Outcome can be done by the individual institutions offering the qualification on condition such allocation meets the minimum number of credits for each Exit Level Outcome as stipulated by the relevant Health Council in its curriculum guidelines.

Electives Components:

The Elective Component consists of two parts:

- The research Exit Level Outcome (Outcome 8) in which learners may choose any aspect or topic in the field which is relevant to them and for which they are required to produce the outcomes of their research in a manner, format and to a standard acceptable to the institution offering the qualification. (40 Credits minimum).

- The application of theoretical knowledge and skills in one of the chosen fields as listed below:
  - Needle placement.
  - Contrast media administration.
  - Advances in Computer Tomography Technology.

- Advances in Magnetic Resonance Technology.
- Interventional radiology.
- Advance pattern recognition (this may be in any speciality or system and is at the discretion of the provider).
- Hybrid systems (As applicable in Nuclear Medicine).
- Fusion Imaging.
- Introduction to education Principles.
- Small and medium business enterprises.

This may be assessed in an integrated way with Exit Level Outcomes 1 to 7 or be incorporated into the research project (Exit Level Outcome 8).

• The required clinical competencies will be included with the theoretical competencies in the notional hours of learning and will be determined by the relevant Health Council.

EXIT LEVEL OUTCOMES

1. Performance routine and specialized radiographic procedures to produce images of diagnostic quality.

2. Access, organize and present information applicable to the radiography context in order to record, retrieve and communicate patient data.

3. Evaluate the quality of routine and specialised radiographic images and perform image interpretation to identify normal and abnormal appearances.

4. Plan, develop and apply total quality management appropriate to the diagnostic radiography context.

5. Perform safe and effective patient care in accordance with the patient's needs and departmental protocol to provide a quality service and to maintain the welfare of the patient.

6. Apply the principles of human rights, ethics and relevant medical law which ensure the well-being of the patient.

7. Apply the principles, specific knowledge, skills and values related to one of the the chosen electives as listed.

8. Demonstrate research skills and foster a research climate in Diagnostic Radiography.

Critical Cross-Field Outcomes:

The qualification promotes the Critical Cross-Field Outcomes in the following manner:

• Identify health problems in the context of diagnostic radiography and suggest and implement a solution or plan of action in order to solve the problem professionally will be promoted through effective and safe patient care practices in accordance with the patient's needs by taking into consideration ethical principles as well as human rights and medical law requirements.

• Perform professional duties with confidence in collaboration with other health care professionals and where appropriate assume leadership in tasks or projects in order to promote efficient and effective service delivery and total quality management in the radiography profession as well as the healthcare service in general.

• Keep up with the current trends and changing needs of Diagnostic Radiography service on a regional, national and international level by undertaking research or fostering a research climate within the radiography profession.

• Contribute towards and facilitate continuing professional development of Diagnostic Radiography staff by either engaging in research or fostering the research environment and encouraging teamwork among radiographers and other healthcare professionals.

• Communicate effectively in the learning and health care environment by demonstrating competency and skills necessary for use of technology and associated accessories necessary for transfer or sharing of information among healthcare workers and other stakeholders so as to deliver quality patient care and facilitate management processes.

• Use science and technology in order to improve diagnostic radiography practice through efficient organizational and management skills for both patient's information and any other information necessary to efficient healthcare service delivery.

• Demonstrate an understanding of diagnostic radiography principles in order to solve practical problems within radiography will be promoted by the competent performance of routine and specialised radiographic procedures.

ASSOCIATED ASSESSMENT CRITERIA

Associated Assessment Criteria for Exit Level Outcome 1:

1.1 Request form is interpreted for validity and knowledge of relevant radiographic terminology, anatomy, physiology and pathology to help in selecting appropriate techniques for the production of images necessary for providing diagnostic information to assist in patient management.
1.2 Accessory equipment and imaging systems are selected and appropriately utilized to specific positioning techniques to ensure optimal exposure factors are selected and adapted to produce images of diagnostic quality.
1.3 Radiation protection and safety measures are effectively applied to each radiographic technique and procedure.
1.4 Routine and specialized radiographic techniques and procedures with and without contrast media are prepared for, and performed competently.
1.5 Sterile techniques are demonstrated for the correct needle placement in a vein.

Associated Assessment Criteria for Exit Level Outcome 2:

2.1 Information technology skills are demonstrated to record, retrieve and communicate patient data.
2.2 Data is compiled and information is scientifically presented.
2.3 Information technology is effectively communicated within the radiographic context.
2.4 Relevant information is selected and critically evaluated.

Associated Assessment Criteria for Exit Level Outcome: 3

3.1 Radiographic images are evaluated for diagnostic quality according to relevant evaluation criteria and also to ensure that the images conform to the medico-legal requirements.
3.2 Images are evaluated for normal and abnormal radiographic appearances by applying integrated knowledge of anatomy, physiology and pathology.
3.3 Corrective measures to the radiographic techniques are applied where necessary.
3.4 Radiographic appearances are communicated to the referring health care professional to enable further patient management.
3.5 Independent judgement and discretion in the performance of additional radiographic views is exercised where justified.

Associated Assessment Criteria for Exit Level Outcome 4:

4.1 Principles of quality assurance and quality control are demonstrated in the development of departmental protocols.
4.2 Equipment and accessories are selected, purchased and maintained within an available budget to provide an efficient and cost-effective service.
4.3 Communication and co-operation between all role players is effectively developed and maintained in order to provide an optimal service.
4.4 Performance management strategies are developed in a manner which shows an understanding of management principles and current legislation.
4.5 Departmental records and statistics are accurately maintained in accordance with the departmental and professional council requirements.
4.6 Integrated knowledge of management, technology and legislation is demonstrated in the ability to design and equip a new, or alter an existing, ultrasound facility.

Associated Assessment Criteria for Exit Level Outcome 5:

5.1 Patient is assessed relevant to presenting clinical condition and appropriate action taken.
5.2 The cultural and psychological diversity of patients are respected to ensure a quality service is provided.
5.3 A simple but professional explanation of the radiographic procedures is given to the patient before, during and after the procedure to ensure the co-operation of the patient.
5.4 Optimal patient care is applied before, during and after the procedure.
5.5 Effective written, verbal and non-verbal communication skills during interaction with patients and health care team members are demonstrated.
5.6 Skills and knowledge of first aid are demonstrated as and when applicable.
5.7 Signs and symptoms of contrast media reaction are recognised, appropriate action taken and assistance in emergency medicine following such reactions is demonstrated.

Associated Assessment Criteria for Exit Level Outcome 6:

6.1 Psychological, cultural and ethical considerations of the patient and their families are recognised and acted upon in a professional manner.
6.2 Rights of the patient, as entrenched in the Human Rights Bill, the Patients Charter and medical law are protected and confidentiality maintained.
- Needle placement.
- Contrast media administration.
- Advances in Computer Tomography Technology.
- Advances in Magnetic Resonance Technology.
- Interventional Radiology.
- Advance Pattern Recognition (this may be in any speciality or system and is at the discretion of the provider).
- Hybrid Systems (As applicable in Nuclear Medicine).
- Fusion Imaging.
- Introduction to Education Principles.
- Small and Medium Business Enterprises.

Assessment criteria for Exit Level Outcome 7:

7.1 Apply and integrate the principles and/or philosophy of the subject into related activities.
7.2 Apply the specialised techniques required to achieve the contextual objective.
7.3 Apply quality assurance principles to ensure optimal results within the context of the subject.

Associated Assessment criteria for Exit Level Outcome 8:

8.1 Professional and self development with respect to educational, career and entrepreneurial opportunities.

8.2 Participation in the social, political and academic debate about what research is and how it should be done in the health sector.
8.3 The research of others are analysed and understood in order that it may be replicated or inform own research.
8.4 Pertinent literature is reviewed in order to design a research project.
8.5 Research principles and methodology in the field of radiographic research are demonstrated in the form of a research project.
8.6 Results of the research project are reported according to the requirements of the institution offering the qualification.

Integrated Assessment:

Integrated assessment takes the form of an appropriate variety of assessments methods for example; Written and oral examinations, problem-solving assignments, projects, presentations, case studies, portfolios, log books, clinical reports, assessment of clinical competence through simulated and clinical assessment in situ, Objective Structure Clinical Examinations (OSCE) and the successful completion of a mini-dissertation.

The qualification will be awarded to a learner who has provided evidence to the satisfaction of the assessors that the stated competence of the Qualification, as detailed in the stated outcomes, has been achieved, either through Education and Training in a single provider's learning programme or though experience that complies with the stated specific outcomes i.e. Recognition Prior Learning (RPL) is recognised.

However, the integrated assessment needs to have the following characteristics:

- It should assess the extent to which learners can practice competently, effectively and safely in any clinical context nationally and internationally.
- It should measure the extent to which learners have integrated the professional roles, knowledge and skills delivered through the different outcomes reflected in the relevant programme.
- It should provide opportunities for reflection-in-action and reflection-on-action to develop reflexive competence.

INTERNATIONAL COMPARABILITY

The primary reason for designing this Qualification was to meet the needs of the South African community as identified by the National Department of Health. To ensure that this Qualification compatible with the international standards. To evaluate the degree to which this Qualification is in line with international best practice it was compared to similar qualifications offered around the world. For this report, qualifications from Nigeria and Australia were selected.

Nigeria as an African Country is on par with South Africa economically. Determining the comparability of this Qualification against one from Nigeria provided some indication of the possible employability of the qualifying students within the African continent. Nigeria offers Diagnostic Radiography qualifications which range from Certificates to Professional Degrees as well as Post Graduate courses such as Computed Tomography.

University of Nigeria, Enugu campus offers a five year Bachelor of Science degree in Medical Radiography. This is a full-time course and no part-time registration is allowed. The period of training is divided into three stages. The first year of study is the preliminary stage and focuses on Biological and Physical Sciences. The second year of study is the pre-clinical stage and focuses on Patient Care and General Hospital Practice. Learners are exposed to clinical training from the third to the fifth year of study. This last stage incorporates the clinical and professional training.

All courses offered for this degree are compulsory except the Principles of Management and Histology/Histopathology (practical) courses. To be awarded the degree, the learner must pass all subjects.

Entrance requirements:

Appropriate level pass of the Joint Admission and Matriculation Board examinations with English, Mathematics, Physics, Biology and Chemistry. These requirements compare favourably with the South African Qualification except that, English does not form part of the requirements due to the language policies of some institutions. Chemistry is not a prerequisite to study Radiography but may be an advantage.

Scope:

The curriculum at undergraduate level covers mainly Diagnostic Radiography, with an introduction to Medical Ultrasound, Radiotherapy, Nuclear Medicine and Computed Tomography. This scope is also similar to the way Diagnostic Radiography is offered in South Africa, except that Computed Tomography is not taught as an additional course, but forms part of the course. Advances in Computed Tomography have also been identified as an elective for the South African qualification.

Stress areas or major subjects:

- Medical Radiographic Physics.
- Medical Radiographic Equipment Engineering.
- Medical Radiographic Photography.
- Imaging Processing and Optics.
- Clinical Radiographic Procedures.
- Hospital Practice and Healthcare System.
- Medical Radiographic Anatomy and Physiology.
- Other Medical Imaging Modalities.
- Radiation Therapy Techniques.
- Medical Radiographic Pathology.
- Research Methodology.

Even though this qualification does not specify which subjects or modules form part of the fundamental, core or electives, the distribution compares well with what has been proposed for the Bachelor of Diagnostic Radiography in South Africa, since they are both full time courses, students need to pass all subjects to be awarded a degree and that clinical training is compulsory.

The major difference is the duration of study, learner exposure to the clinical environment and the subjects offered in the first year of study. The fact that completion of the research project is compulsory makes both qualifications comparable, professional degrees, after which the successful student may proceed to the Masters degree.

Registration requirements: Qualified Radiographers register with the Radiographers Registration Board of Nigeria. The board participates in the development of Radiography curricula as offered by the various Education Institutions in Nigeria. This a similar to the South African situation where qualifications are developed through the participation of the Education Institutions and the members of the Professional Board for Radiography under the Health Professions Council. Other institutions in Nigeria offer courses which may be at a level lower than that of the professional degrees.

Federal School of Radiography, in Lagos Nigeria offers a three year Certificate. The course covers Natural Sciences, Anatomy and Physiology as well as Radiographic Equipment,

Techniques, Principles of Radiotherapy and Radiographic Photography. This Qualification does not compare well with the three year National Diploma or Bachelors degree as currently offered in South Africa. It compares well with the one year supplementary Diagnostic Radiography, which has since been discontinued by the Health Professions Council of South Africa (HPCSA).

Post Graduate Certificate courses such as Computer Tomography are offered by the Institute of Radiography of Nigeria. The examinations for this Certificate course are conducted by the Institute of Radiography in conjunction with the Association of Radiographers of Nigeria. This course is registered with the Radiography Board of Nigeria.

These courses compare well with additional courses offered by the various Education Institutions in South Africa and registered with the HPCSA. The Education Institutions are required to apply for accreditation by the HPCSA before they can offer these additional courses. These Certificate courses registered with HPCSA are listed as electives for the Bachelor of Radiography degree.

Australia offers a four year Bachelor of Science (Medical Imaging) Degree at the Curtin University of Technology. This degree is similar to the Bachelor's degree designed for South Africa in that both are full time and the learner must pass all courses in order to graduate. The difference lies in the course content. The programme offered at the Curtin University of Technology has a major Mathematical content, offered in first and fourth years of study. From the program, there is no evidence of learners being introduced to research principles.

The Curtin University of Technology has an Honours programme which offers successful learners the chance to do Research Methodology in one of the three speciality areas, namely; Ultrasound, Nuclear Medicine or Diagnostic Radiography. This means that for learners to do research in Radiography, they will have to extend their study programme from four to five years. Extensive clinical training is done in the third and fourth year of study. This is not necessarily the situation with South African programmes; clinical training is scheduled to commence as early as the first year. The learners who successfully complete the study program for the Bachelor of Science (Medical Imaging) in Australia are awarded a professional status through the registration with the Australian Institute of Radiography.

Conclusion:

Most of the other African countries offer two to three year qualifications. These countries do not have their own examining or accreditation bodies. Most of the courses offered are either accredited by the United Kingdom or American organisations. Since Nigeria is a country that is well established with its own regulatory authorities it has proven to be a good example for comparison with the proposed Bachelors Degree in Diagnostic Radiography for South Africa. It is therefore shown that the South African Qualification complies with international standards.

ARTICULATION OPTIONS

Vertical articulation:

- Master of Radiography, NQF level 8 and above.
- Master of Radiography: Diagnostics, NQF level 8 and above.
- Master of Radiography: Radiation Therapy, NQF level 8 and above.
- Master of Technology: Radiography, NQF level 8 and above.
- Master of Technology: Radiography, NQF level 8 and above.

Horizontal articulation:

- Bachelor of Radiography Honours, NQF Level 7.
- Bachelor of Radiography Honours: Radiation Therapy, NQF Level 7.
- Bachelor of Radiography Honours: Radiographic Therapy, NQF Level 7.

• Bachelor of Radiography: Diagnostics, NQF Level 7.

MODERATION OPTIONS
Internal and external moderation of learner achievement should be undertaken by those who have qualifications at or above the level of qualification.

NOTES
All learners for this Qualification are required to be registered as learners by the relevant Professional Council for the duration of the period of study in an accredited clinical training centre with accredited mentorship.

Registration of Assessors:

Assessment is conducted by one or more internal assessors/examiners employed by the relevant provider as well as an external moderator appointed from industry/other academic institution.

A practicing Practitioner, registered with the relevant Statutory Health Council, with a Bachelor of Diagnostic Radiography, or equivalent, or higher, or appropriate research/teaching/academic/clinical experience in the category is appointed.

UNIT STANDARDS
This qualification is not based on Unit Standards.

LEARNING PROGRAMMES RECORDED AGAINST THIS QUALIFICATION
None