Modernising Scientific Careers Programme

GRADUATE DIPLOMA IN HEALTHCARE SCIENCE

Medical Physics Technology
(Radiotherapy Physics and Nuclear Medicine Technology)

(Medical Physics and Clinical Engineering)

Learning Outcomes and Indicative Content
2013/14
CONTENTS

Section 1.0 Background ........................................................................................................... 5
  1.1 High Level Framework ................................................................................................... 5
  1.2 Radiotherapy Physics and Nuclear Medicine Technology Route Map .......................... 6
Section 2.0 Generic Modules .................................................................................................. 7
    Section 2.1 Professional Practice ...................................................................................... 7
    Section 2.2 Scientific Basis of Healthcare Science ......................................................... 11
Section 3.0 Division Specific Modules .................................................................................. 13
    Scientific basis of Medical Physics [20 Credits] .............................................................. 13
Section 4.0 Specialist Modules for Radiotherapy Physics ..................................................... 16
    Section 4.1 Interpretation of the high level framework Medical Physics
        Technology specialising in Radiotherapy Physics .................................................... 16
    Section 4.2 Cancer, Radiobiology and Clinical Radiotherapy Physics ......................... 17
    Section 4.3 Practice of Radiotherapy Physics ................................................................. 20
    Section 4.4 Work Based Training ..................................................................................... 22
Section 5.0 Specialist Modules for Nuclear Medicine ............................................................ 25
    Section 5.1 Interpretation of the high level framework Medical Physics
        Technology specialising in Nuclear Medicine ............................................................ 25
    Section 5.2 Physics and Instrumentation ......................................................................... 26
    Section 5.3 Clinical Indication, Pathology and Patient Care .......................................... 28
    Section 5.4 Work Based Training ..................................................................................... 30
Appendix 1: Contributors to Graduate Diploma curriculum in Medical Physics
Technolog...
Introduction to the Modernising Scientific Careers
Healthcare Science Practitioner Training Programme

Following the publication of Modernising Scientific Careers – The UK Way Forward\(^1\), which set out the four UK countries’ policy and proposals to reform healthcare science training and careers for 21\(^{st}\) century patient care, new curricula have been developed to inform academic programmes and work based training for different stages of the healthcare science career pathway.

Successful completion of the Practitioner Training Programme (PTP) will lead to qualification as a Healthcare Science Practitioner. Normally PTP comprises BSc (Hons) degree programmes in different aspects of healthcare science (Life Sciences, Physiological Sciences, Medical Physics and Clinical Engineering) which will be delivered and quality assured by Higher Education Institutions (HEIs). The degree programmes integrate academic and work based learning. As an interim measure, however, a Graduate Diploma programme is being established in Radiotherapy Physics technology and Nuclear Medicine technology to ensure workforce supply in the short term.

The PTP curricula comprise the knowledge, skills, experiential learning and associated personal qualities and behaviours (professionalism) which a Healthcare Science Practitioner will need to work safely and effectively in the NHS. HEIs will develop degree programmes based on the agreed framework and high level curriculum content specified by the Modernising Scientific Careers programme working with colleagues in the profession. The diploma should deliver the specified learning outcomes and the requisite balance of academic and work based learning. HEIs’ graduate diploma programmes should address equality and diversity issues, as is their responsibility as a public body.

The detailed curricula which will deliver the specified learning outcomes for the work based learning are described in Learning Guides which further define the knowledge, skills and experience needed to work safely and effectively as a Healthcare Science Practitioner in the NHS. It is intended that work base attainment will be assessed to national standards. The assessment system and methods will be detailed in the Learning Guides and used alongside Competency Logs or Portfolios of Learning which will provide a record of the student’s attainment. The Learning Guide for the graduate diploma programmes is the same guide as that for the undergraduate degree programme.

An Implementation Guide has been developed for HEIs offering the new BSc (Hons) degree programmes for Healthcare Science Practitioner Training Programmes. The Guide sets out the requirements which new degree programmes will need to meet, to achieve accreditation by Health Education England as meeting the standards defined in the new MSC curricula. The graduate diploma programme will have to meet the same standards for accreditation

A curriculum feedback and review process will be developed, involving all MSC stakeholders, to ensure that each curriculum addresses the current NHS agenda and takes account of scientific and technological advances.
Section 1.0 Background

This document sets out the proposed structure, high level learning outcomes and indicative content for the Integrated Graduate Diploma in Healthcare Science in Radiotherapy Physics and Nuclear Medicine Technology. The programme combines and integrates both academic and work based learning. The graduate diploma supports a two year work based route for Healthcare Science Practitioner training recruiting existing science graduates. The trainees will be in employment and will attend the graduate diploma on a part-time basis. The rationale for the programme is that it supports a short-term demand for practitioners in Medical Physics until MSC accredited undergraduate degree programmes meet the demand for workforce supply. At the end of the programme the student will be able to fulfil the role of a Healthcare Science Practitioner.

1.1 High Level Framework

The diagram below depicts the high level framework around which graduate diploma programmes must be structured. However, each healthcare science division will interpret and adapt this Modernising Scientific Careers Programme (MSC) framework. The graduate diploma must deliver a minimum of 90 credits at level 6 through the specialism specific curriculum, workplace learning and professional practice modules.

### HIGH LEVEL FRAMEWORK

#### INTEGRATED GRADUATE DIPLOMA IN HEALTHCARE SCIENCE

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scientific Basis of Healthcare Science [10]</strong></td>
<td><strong>Scientific Basis of Healthcare Science – Division/Theme specific curriculum [20]</strong></td>
</tr>
<tr>
<td><strong>Professional Practice [10 level 6]</strong></td>
<td><strong>Scientific Basis of Healthcare Science – Specialism specific curriculum [30 level 6]</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Credits</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generic</strong></td>
<td>10</td>
</tr>
<tr>
<td><strong>Division</strong></td>
<td>20</td>
</tr>
<tr>
<td><strong>Specialism (Level 6)</strong></td>
<td>30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>60</td>
</tr>
</tbody>
</table>

#### Generic Modules: common to all divisions of Healthcare Science

#### Division/Theme Specific Modules: Life Sciences; Medical Physics and Clinical Engineering; Cardiovascular, Respiratory and Sleep Sciences; Neurosensory Sciences

#### Specialist Modules: specific to a specialism
1.2 Radiotherapy Physics and Nuclear Medicine Technology Route Map

The Graduate Diploma will offer two specialisms namely:

i. Radiotherapy Physics  
ii. Nuclear Medicine

The route map below shows how the high level framework has been interpreted for the Graduate Diploma.

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scientific Basis of Healthcare Science</strong> [10]</td>
<td></td>
</tr>
<tr>
<td><strong>Professional Practice</strong> [10 level 6]</td>
<td></td>
</tr>
<tr>
<td>Introduction to Medical Physics including elements from Professional Practice, Medical Imaging, Radiation Governance and Principles of Scientific Measurement [20]</td>
<td></td>
</tr>
</tbody>
</table>

**EITHER**

**Radiotherapy Physics**

Cancer, Radiobiology and Clinical Radiotherapy Physics including work based training [30 level 6]  
Practice of Radiotherapy Physics including work based training [30 level 6]

| Workbased Training | [20 level 6] |

**OR**

**Nuclear Medicine**

Physics and Instrumentation including work based training [30 level 6]  
Clinical Indications, Pathology and Patient Care including work based training [30 level 6]

| Workbased Training | [20 level 6] |

**Credits**

| Generic | 10 | 10 |
| Division | 20 | |
| Specialism | 30 | 50 |
| Total | 60 | 60 |
Section 2.0 Generic Modules

This section covers the three generic modules that will be studied by all Health care Science students:

- Professional Practice
- Scientific Basis of Healthcare Science

Section 2.1 Professional Practice

Division: Medical Physics and Clinical Engineering
Theme: Medical Physics Technology
Years 1-2: Generic Module Professional Practice [10 credits]

The overall aim of this module is to ensure that the student has the underpinning knowledge and gains the accompanying skills and attitudes to work as a Healthcare Science Practitioner.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the student will:

1. Understand the structure and management of health and social care services and the management of local healthcare systems in the United Kingdom.
2. Know the current quality improvement structure and processes within the NHS.
3. Understand the need to ensure that the needs and wishes of the patient are central to their care.
4. Know the importance of prioritising the patient’s wishes encompassing their beliefs, concerns, expectations and needs.
5. Understand the importance of developing and maintaining the patient-professional partnership.
6. Understand the procedures relevant to the use of chaperones.
8. Understand the patient and carer perspective with respect to the NHS, diversity of the patient experience, healthcare, illness and disability, including an understanding of the impact of life threatening and critical conditions.
9. Know how health inequalities impact on the quality of care provided by the NHS at national and local level.
10. Know the importance of promoting patient centred care.
11. Know the importance of promoting self-care by the patient.
12. Know and understand the principles that underpin effective verbal and written communication including: verbal and non-verbal communication, communication with patients across the age spectrum, communication with users of the NHS who do not have English as a first language and communication with people with disabilities.
13. Know the importance of the concept of shared leadership and the
associated personal qualities and behaviours that promote shared leadership.

14. Know the importance of feedback and frameworks for giving and receiving feedback.
15. Know the underpinning principles of effective team work.
16. Understand the importance of integration across professions, cross division, specialism and boundary working.
17. Know and understand the principles, guidance and laws regarding medical ethics and confidentiality.
18. Know the guidelines and processes for gaining consent.
19. Understand the necessity of obtaining valid consent from the patient.
20. Know the best practice requirements for record keeping within the NHS including accuracy of information recording within patient records.
21. Understand the framework that underpins data security practice in the NHS.
22. Understand the legal framework within which healthcare is provided across the UK including its devolved administrations.
23. Understand the basic principles of infection control and the importance of current infection control measures within the workplace.
24. Know the protocols and practice of basic life support.
25. Understand the need for regulations with respect to patient safety and safe systems within the workplace.
27. Know the processes for the distribution of documentation, e.g. the Department of Health (DH), Central Alerting System (CAS), Medical Device Alerts (MDA).
28. Understand the regulations and current procedures in place with respect to equipment safety.
29. Know the common causes of error and understand the critical incident reporting process.
30. Recognise the cause of error and the importance of a no-blame culture.
31. Know and understand the legal requirements with respect to equality and diversity.
32. Recognise and accept the responsibilities and roles of the Healthcare Science Practitioner in relation to other healthcare professionals.
33. Know the importance of good time management and the techniques underpinning good time management and organisational skills.
34. Understand the importance of maintaining own health and well-being.
35. Understand local guidelines for responding to unacceptable behaviour by patients, carers, relatives, peers and colleagues including harassment, bullying and violent behaviour.
36. Know the core theories of learning particularly those applied to the adult learner and the independent adult learner.
37. Know and understand the theory of reflective practice.
38. Understand the importance of public engagement in science and its role in health and society.
39. Know about history taking, clinical examination framework and process of differential diagnosis and how the information is used to develop clinical management plans.
40. Explain the importance of innovation across healthcare science in particular in the improvement of quality and patient care.

<table>
<thead>
<tr>
<th>Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On successful completion of this module the student will:</td>
</tr>
<tr>
<td>1. Demonstrate practice that considers the perspective of the patient and, if appropriate, the carer of the patient.</td>
</tr>
<tr>
<td>2. Establish and maintain the patient-professional partnership.</td>
</tr>
<tr>
<td>4. Contribute to quality improvement in the workplace.</td>
</tr>
<tr>
<td>5. Contribute to productivity initiatives within the workplace including service improvement.</td>
</tr>
<tr>
<td>6. Recognise the need for, and accept change working across different provider landscapes as required.</td>
</tr>
<tr>
<td>8. Act with integrity at all times.</td>
</tr>
<tr>
<td>10. Demonstrate the ability to adhere to current data security regulations.</td>
</tr>
<tr>
<td>11. Work with others, develop and maintain relationships and networks.</td>
</tr>
<tr>
<td>13. Communicate effectively and sensitively with patients, relatives and carers across the age spectrum utilising clear explanations/descriptions.</td>
</tr>
<tr>
<td>14. Listen to others and take other viewpoints into consideration.</td>
</tr>
<tr>
<td>15. Communicate succinctly and effectively with other professionals as appropriate.</td>
</tr>
<tr>
<td>16. Demonstrate the ability to communicate information about the work of the healthcare science workforce to the public.</td>
</tr>
<tr>
<td>17. Demonstrate the ability to give effective feedback.</td>
</tr>
<tr>
<td>18. Apply appropriately the principles, guidance and laws regarding medical ethics and confidentiality.</td>
</tr>
<tr>
<td>19. Demonstrate the ability to gain informed consent.</td>
</tr>
<tr>
<td>20. Ensure that personal practice is always provided in line with the legal framework.</td>
</tr>
<tr>
<td>21. Work within appropriate equality and diversity frameworks at all times.</td>
</tr>
<tr>
<td>22. Apply current regulations with respect to patient safety and safe systems within the workplace including child protection and the use of chaperones.</td>
</tr>
<tr>
<td>23. Demonstrate basic life support skills.</td>
</tr>
<tr>
<td>24. Demonstrate the ability to work in accordance with a range of Standard Operating Procedures, Guidelines and Protocols.</td>
</tr>
<tr>
<td>25. Work within teams, encouraging and valuing contributions from all members of the team.</td>
</tr>
<tr>
<td>26. Work to ensure that the team are aware of risks and work together to minimise risk, and take actions that always promote patient safety.</td>
</tr>
<tr>
<td>27. Work well in a variety of different teams and team settings, and</td>
</tr>
</tbody>
</table>
28. Contribute to discussion on the team’s role in patient safety.
29. Observe the role of the multi-disciplinary team in patient care.
30. Demonstrate adherence to current infection control regulations at all times.
31. Demonstrate adherence to the regulations and current procedures in place with respect to equipment safety.
32. Recognise the causes of error and learn from them, realising the importance of honesty and effective apology.
33. Recognise the desirability of monitoring performance, learning from mistakes and adopting a no-blame culture in order to ensure high standards of care and optimise patient safety.
34. Maintain own health and well-being.
35. Demonstrate the ability to prioritise and organise academic and work based tasks in order to optimise own work and the work of the department.
36. Develop skills of an independent learner and demonstrate a commitment to Continuing Professional Development.
37. Apply skills of reflection to continually improve performance, acknowledging and acting on feedback.
38. Demonstrate application of new healthcare science developments.

**Indicative Content**

- Structure and management of health and social care services in the UK
- Patient-professional partnerships
- Patient and carer perspectives and the diversity of the patient experience
- Use of chaperones
- Current child protection regulations relevant to practice as a Healthcare Science Practitioner
- Health inequalities
- Disability including learning disabilities
- Patient wellbeing and self care
- High Quality Care for All
- Evidence based practice
- Audit
- Service Improvement
- Leadership and management within the NHS
- Verbal and non-verbal effective communication
- Effective written communication
- Communication with colleagues and cooperation
- Communication within patients across the age spectrum
- Time management and decision making
  - Principles of medical ethics and confidentiality
  - Valid consent
  - Equality and diversity
  - Legal framework for practice including fitness to practice
  - Safety - prioritisation of patient safety in practice
  - Safety - team working and patient safety
  - Safety - equipment management
- Safety - safety testing
- Standard Operating Procedures, Guidelines and Protocols
- Basic life support
- Infection control
- Complaints
- Scientific error including critical incident reporting
- Personal health and behaviour
- Local guidelines for responding to unacceptable behaviour by patients, carers, relatives, peers and colleagues including harassment, bullying and violent behaviour
- Principles of quality and safety improvement including quality audit, quality assurance and quality management
- Equipment safety
- Health and well-being
- Continuing Professional Development
- Reflective practice
- Independent adult learning
- Clinical skills, differential diagnosis and clinical management plans

Section 2.2 Scientific Basis of Healthcare Science

<table>
<thead>
<tr>
<th>Division:</th>
<th>Medical Physics and Clinical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme:</td>
<td>Medical Physics Technology</td>
</tr>
<tr>
<td>Year 1:</td>
<td>Generic Module</td>
</tr>
<tr>
<td>Statistical Basis of Healthcare Science [10 credits]</td>
<td></td>
</tr>
</tbody>
</table>

The overall aim of this module is to ensure that the student has the underpinning knowledge of anatomy, physiology, epidemiology, public health medicine, genetics and the psychosocial dimensions of health to provide the foundations for study in healthcare science.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the student will:

1. Describe the normal anatomy, physiology and pathology of the body across the Integumentary, Skeletal, Nervous, Cardiovascular (including blood, blood vessels and lymphatic system), Respiratory, Endocrine, Renal, Gastrointestinal (including nutrition), Urinary and Reproductive systems.
2. Know the structure and function of the cell.
3. Know the process by which embryonic development occurs from conception to birth.
4. Know the principles of inheritance, DNA and genetics including carrier status, genetic crosses/pedigree/punnet squares/cross diagrams.
5. Know the cellular, tissue and systems responses to disease including cell death, inflammation, neoplasia, hypertrophy, hyperplasia, tissue responses to injury and repair.
6. Describe the pathophysiology of disease development in common
diseases across the body systems.
7. Know the factors that affect the health of the population and how these may be addressed.
8. Know how factors affecting health may contribute to inequalities in health between populations.
9. Know the basis of health protection including principles of surveillance, infectious disease control and emergency planning; a basic understanding of how epidemiology is used in planning health services; how epidemiology relates to individual patients and how chronic disease may impact on a patient.
10. Understand how the body changes from birth to old age.
11. Understand the role of genetics in medicine.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the student will:

1. Respect and understand individuals’ beliefs and ways of coping with illness.
2. Demonstrate knowledge of the influence of culture and beliefs on health.
3. Use a range of study skills including time management, organisational skills, using the library, search engines, self-directed learning, critical analysis and avoiding plagiarism.
4. Adhere to the requirements of Good Scientific Practice.

Indicative Content
- Basic principles of
  - The Cell
  - Molecular Biology (Enzymes, Proteins, Metabolism)
  - Genetics
- Introduction to normal Anatomy, Physiology and Pathology across body systems
- Cellular, tissue and systems responses to disease
- Pathophysiology of disease development in common diseases across the body systems
- Response to illness, health beliefs, psychology and sociology of health and illness
- Basic principles of Epidemiology
Section 3.0 Division Specific Modules

This section covers the division specific module on the Scientific Basis of Medical Physics (Year 1) that will be studied by all students undertaking the Medical Physics Technology graduate diploma programme:

Section 3.1 Scientific Basis of Medical Physics

<table>
<thead>
<tr>
<th>Division:</th>
<th>Medical Physics and Clinical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme:</td>
<td>Medical Physics Technology</td>
</tr>
<tr>
<td>Year 1:</td>
<td>Scientific basis of Medical Physics [20 Credits]</td>
</tr>
</tbody>
</table>

The overall aim of this module is to ensure that the student understands the breadth of the application of science within medical physics, understands the underpinning radiation physics and imaging science and is able to work safely within the medical physics environment within a hospital.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the student will:

1. Describe the role of Medical Physics in the patient pathway.
2. Describe and explain the principles of Radiation Protection.
3. Describe and explain appropriate national and international legislation and policies.
4. Demonstrate an understanding of the factors affecting the design of radiation facilities.
5. Describe and explain the principles of image formation, acquisition and manipulation including image registration, image storage and sharing.
6. For each modality, (Radiology, Fluoroscopy, Computerised Tomography, Nuclear Medicine, Magnetic Resonance Imaging [MRI], Positron Emission Tomography [PET]), describe and explain the principles of operation.
7. Describe and explain the role of each modality in the patient pathway including the main clinical applications.
8. Describe and explain the quality assurance framework for each modality.
9. Critically evaluate the risks and benefits of each modality.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the student will:

1. Work using safe and precise technical skills.
2. Actively seek accurate and validated information from all available sources.
3. Select and apply appropriate analysis or assessment techniques and tools.
4. Evaluate a wide range of data to assist with judgements and decisionmaking.
Indicative Content

Medical Physics and Patient Pathway
- The role of Medical Physics in
  - Diagnostics
  - Therapeutics
  - The equipment lifecycle
  - Innovation and service development

Clinical Sources of Radiation
- Ionising and non-ionising radiation sources and hazards

Radiation Protection
- As Low as Reasonable Achievable (ALARA)
- Principles of dose limitation
- Net positive benefit, dose limits
- National and International legislation and recommendations
- Controlled and supervised areas, classified persons
- Roles and responsibilities of staff, including Radiation Protection Advisor, Radiation Protection Supervisor
- Hospital organisation of radiological protection; radiation safety policy, local rules
- Personnel and environmental dose monitoring
- Instrument calibrations
- Registration, safe custody, transport, use and disposal of radioactive sources
- Contingency plans, including radiation emergencies
- Notification of radiation accidents and incidents
- Biological and effective half life
- Record keeping

Controls
- Equipment circuit breakers, interlocks; warning signs
- Use of distance, shielding, time
- Calculation of shielding requirements
- Environmental radiation surveys

Image formation, acquisition, manipulation, storage and sharing
- Theory of Image Formation including reconstruction from projections
- Display and manipulation of images
- Image registration
- Storage and sharing of images, Digital Imaging and Communications in Medicine (DICOM), Health Level 7 (HL7)

Principles of operation
- Formation of the X-ray image, Fluoroscopy, Computed Radiography,
Digital Radiography (CR/DR), Computerised Tomography scanners

- Nuclear Medicine
  - Construction of the gamma camera, Single Photon Emission Computed Tomography (SPECT)
  - Positron Emission Tomography
  - Factors affecting the formation of the image

- Magnetic Resonance Imaging
  - Basic physics
  - Formation of the image
  - Image sequences and their appearances

Application

- Common clinical applications of each modality
- The possible risks and health effects of each modality
- Quality assurance and testing
- Choice of modality for different common clinical problems
  - Future directions in imaging
  - Gating techniques in imaging
Section 4.0 Specialist Modules for Radiotherapy Physics

Section 4.1 Interpretation of the high level framework Medical Physics Technology specialising in Radiotherapy Physics

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Basis of Healthcare Science [10]</td>
<td></td>
</tr>
<tr>
<td>Professional Practice [10 level 6]</td>
<td></td>
</tr>
<tr>
<td>Introduction to Medical Physics including elements from Professional Practice, Medical Imaging, Radiation Governance and Principles of Scientific Measurement [20]</td>
<td></td>
</tr>
<tr>
<td><strong>Radiotherapy Physics</strong></td>
<td></td>
</tr>
<tr>
<td>Cancer, Radiobiology and Clinical Radiotherapy Physics including work based training [30 level 6]</td>
<td>Practice of Radiotherapy Physics including work based training [30 level 6]</td>
</tr>
<tr>
<td>Workbased Training [20 level 6]</td>
<td></td>
</tr>
</tbody>
</table>

**Credits**

<table>
<thead>
<tr>
<th>Generic</th>
<th>Division</th>
<th>Specialism</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>20</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>50</td>
<td>60</td>
</tr>
</tbody>
</table>

**Generic Modules:** Common to all divisions of Healthcare Science

**Division/Theme Specific Modules:** Life Science; Medical Physics and Clinical Engineering; Cardiovascular, Respiratory and Sleep Sciences, Neurosensory Sciences

**Specialist Modules:** Specific to a specialism
Section 4.2 Cancer, Radiobiology and Clinical Radiotherapy Physics

| Division: | Medical Physics and Clinical Engineering |
| Theme:    | Medical Physics Technology              |
| Specialism: | Radiotherapy Physics                   |
| Year 1:  | Cancer, Radiobiology and Clinical Radiotherapy Physics [30 Credits] |

The overall aim of this module is to ensure that the student can plan a range of Radiotherapy treatments and immobilisation devices.

### Learning Outcomes: Knowledge and Understanding

On successful completion of this module the student will:

1. Describe and explain the role of Radiotherapy in the cancer pathway and critically review tumour pathology of some common tumour sites.
2. Describe and critically evaluate the principles of radiobiology applied to external beam Radiotherapy.
3. Discuss the requirements relating the application of medical imaging to radiotherapy and appraise the choice of imaging technique.
4. Discuss the requirements relating to patient care in the mould room and specify and appraise factors, principles and constraints which affect treatment regimes and treatment planning.
5. Describe target volumes as defined in current national and international standards.
6. Define dose prescriptions and reporting as per current national and international standards.

### Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the student will:

1. Respect and uphold the rights, dignity and privacy of patients.
2. Establish patient-centred rapport when developing and fitting immobilisation devices.
3. Appreciate the empathy and sensitivity needed when dealing with the patient experience of long term conditions and terminal illness.
4. Actively seek accurate and validated information from all available sources in developing treatment plans, including appropriate imaging.
5. Select and apply appropriate analysis or assessment techniques and tools for developing and validating treatment plans.

### Indicative Content

**Clinical Evaluation including Application of Medical Imaging to Radiotherapy**
- Referral pathways including national pathway guidelines

Page | 17
Graduate Diploma MP Technology 2013-14 Final 1.0 040313
• Clinical evaluation - pathology, staging, investigations
• Therapy options including new technologies
• Aim of radiotherapy - radical, adjuvant, palliation
• Follow-up
• Imaging
  o Multiplanar sectional anatomy from Computed Tomography (CT) and Magnetic Resonance Imaging (MRI)
  o Functional imaging - Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT)

Radiobiology Related to Radiotherapy
Linear energy transfer and radiobiological effect
• Cell survival curves - shape, cell kill, chromosomes and cell division
• Dose response relationship
• Radiosensitivity
• Tumour systems
• Dose – time relationship
• Radiation pathology - acute and late effects
• Radiation carcinogenesis
• Radiobiological models – linear quadratic

Tumour Pathology
• Anatomy, pathology, lymphatic drainage and associated critical structures
  o Head and neck
  o Central nervous system
  o Pituitary
  o Thorax
  o Breast
  o Abdomen
  o Pelvis
• Hodgkin’s Disease
• Leukaemia
• Extremities
• Metastases

Treatment Planning Considerations
• Prescribed Dose
• Target delineation
• Treatment techniques (site specific)
• Typical tissue heterogeneities

Positioning and Immobilisation
• Isocentric mounting
• Front and back pointers
• Patient positioning
• Patient care in the Mould Room
• Immobilisation (site specific)
Localisation
- Surface contouring
- Use of orthogonal radiographs and shift radiographs
- Computed Tomography localisation
  - Inhomogeneities
  - Surface contours and organs at risk
- Use of imaging and image fusion
- Data Transfer
- Planning target volume – margins
- Organs at risk (critical organs and dose constraints)

Dose Planning and Display
- Treatment Planning algorithms including pencil beam, collapsed cone and Monte Carlo
- Dose distribution computation
- Computer Planning
  - 2-Dimensional, 3-Dimensional and 4-Dimensional plans
  - Comparison of Computed Tomography and non-Computed Tomography plans
  - Beam’s eye view
- Plan Evaluation
  - Isodose distributions
  - Dose volume histograms
- Conformal planning
- Optimisation including inverse planning techniques and Intensity Modulated Radiotherapy (IMRT)
- Forward planned segmented field techniques

Beam Modification
- Collimation - asymmetric jaws
- Beam shaping and shielding
- Bolus and compensators
- Wedges: mechanical, dynamic, virtual

Dose Calculations
- Dose prescription
- Phantom Scatter Factors
  - Back Scatter Factor
  - Peak Scatter Factor
- Head scatter
- Radiation Output
- Computation of treatment time/set dose
- Effect of inhomogeneities

Verification
- Positional accuracy and tolerances
- Dosimetric accuracy - patient dose monitoring
- Record and verify systems
Advanced imaging techniques

**Brachytherapy Preparation and Planning**
- Sources - nuclide, structure, identification
- Afterloading equipment
- Units of measurement
- Source calibration
- Calculation of dose distributions

**Intensity Modulated Radiotherapy (IMRT)**
- Image Guided Radiotherapy (IGRT)
- Gating Proton
- Ion therapy

**Section 4.3 Practice of Radiotherapy Physics**

**Division:** Medical Physics and Clinical Engineering  
**Theme:** Medical Physics Technology  
**Specialism:** Radiotherapy Physics  
**Year 2:** Practice of Radiotherapy Physics [30 Credits]

The overall aim of this module is to ensure that the student understands the basis of Radiotherapy equipment, dose measurement, calibration and quality assurance and how they affect patient treatment.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the student will:

1. Demonstrate understanding, analysis skills and judgement in treatment planning, radiation dose measurement and calculation, in radiotherapy.
2. Demonstrate understanding, comprehension and judgement in the operation of radiotherapy equipment and associated quality control procedures and systems.
3. Demonstrate an understanding of the relevant principles relating to the calculation of dose distributions within patients.
4. Demonstrate an understanding of and critically evaluate, radiotherapy equipment, the beams produced, their characteristics and how they are analysed.
5. Critically discuss the principles of radiation protection in radiotherapy.

**Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)**

On successful completion of this module the student will:

1. Actively seek accurate and validated information from all available sources.
2. Select and apply appropriate analysis or assessment techniques and tools for the calibration and quality assurance of radiotherapy equipment.

3. Evaluate a wide range of data to assist with judgements and decision making.

Indicative Content

External Beam Radiation Treatment Equipment
- Construction and principles of operation of very low energy, low energy, medium energy X-ray equipment
- Linear Accelerator
- Photon beam generation
- Electron beam generation
- Cobalt teletherapy
- Cyclotron
- Operation and controls of treatment equipment

Dose Distribution
- Photon interactions with respect to Radiotherapy
- Central axis depth dose
- Irregular fields - equivalent square – sector integration
- Off-axis dose - dose in shielded regions – scatter, primary beam hardening
- Isodose curves
- Beam quality, source size, source surface distance, source collimator distance, beam flatness, flattening filters, field size, penumbra, oblique incidence, tissue heterogeneity
- Summation of isodose curves
- Beam weighting
- Guidelines for field arrangements
- Large field treatment techniques
- Field matching asymmetric collimators
- Effect of change in radiation beam energy

Dose Measurement
- Kerma and absorbed dose
- Selection of appropriate dosemeter
- Absolute dose measurement
- Relative dose measurement
- Beam data acquisition
- Patient dosimetry – diodes, Thermoluminescent Dosimeters (TLD), Electronic Portal Imaging Devices (EPID)
- Electron dosimetry
- Phantoms

Electron Beams
- Depth dose characteristics
- Isodose curve characteristics
- Oblique incidence
- Beam shaping

**SXT Dosimetry**
- Back scatter factors
- Lead cut-outs
- Applicators
- Eyeshields (internal and external)

**Radiation Protection**
- Structural shielding
- Measures for reducing radiation dose to staff during brachytherapy
- Source handling and storage
- Procedures for radioactive patients leaving hospital
- Death of radioactive patients - removal of implants

**Quality Control and Quality Assurance**
- Quality systems
- Treatment Machine Quality Control (QC) Program - logic, method and frequency
- Quality Control of external beam radiotherapy equipment
- Quality Control of radiotherapy simulator
- Quality Control of Computed Tomography and Magnetic Resonance Imaging
- Quality Control for brachytherapy equipment and systems
- Quality Control for treatment planning systems
- Treatment plan and radiotherapy prescription calculation checks
- Quality Control of dosimetry systems

**Section 4.4 Work Based Training**

<table>
<thead>
<tr>
<th>Division:</th>
<th>Medical Physics and Clinical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme:</td>
<td>Medical Physics Technology</td>
</tr>
<tr>
<td>Specialism:</td>
<td>Radiotherapy Physics</td>
</tr>
<tr>
<td>Year 1 and 2:</td>
<td>Work based Training [20 Credits]</td>
</tr>
</tbody>
</table>

The overall aim of this module is to give the student experience of Radiotherapy Physics that ensures that the student can undertake the full breadth of practice expected of a newly qualified healthcare science practitioner in Radiotherapy Physics. This is delivered through work placements in Years 1 and 2 of the diploma course.

**Important Note:** Work based training does not have to be confined only to the work base but elements may be taught in other environments, e.g. a clinical skills laboratory, simulation centre or science laboratory.

**Learning Outcomes:** Knowledge and Understanding
On successful completion of this module the student will:

1. Demonstrate increased knowledge, understanding and confidence in application, of the core skills in clinical, patient identification, communication skills and management, and quality assurance.
2. Demonstrate competence for routine tasks and/or situations in Radiotherapy Physics including treatment planning, dose measurement, quality assurance, calibration and operation of equipment, and patient interventions.
3. Critically review and evaluate departmental protocols in relation to the core skills in Health and Safety, human rights, patient identification, communication skills and management, quality assurance.
4. Critically review and evaluate routine tasks in relation to treatment planning, dose measurement, quality assurance, calibration and operation of equipment, and patient interventions.
5. Produce a professional portfolio which cumulatively records and provides evidence of the skills, knowledge and attitudes gained.

**Learning Outcomes: Practical Skills**

On successful completion of this module the student will:

1. Produce a range of Radiotherapy dose treatment plans using imaging data, defined treatment parameters, dose calculations and simulation.
2. Undertake processes to assist in the safest and most effective treatment being delivered to the patient.
3. Make safe and appropriate immobilisation devices in accordance with local protocols.
4. Participate in the preparation and delivery of Brachytherapy treatment procedures.
5. Undertake quality control procedures for Radiotherapy Systems.
6. Demonstrate the ability to use a wide range of dosimeters for a variety of dose measurements types in accordance with established procedures.
7. Apply a professional approach to all activities undertaken within the radiotherapy department.

**Learning Outcomes: Clinical Experience**

On successful completion of this module the student will:

- Work safely in all radiation areas.
- Perform treatment dose calculations for external beam radiotherapy.
- Input data to record and verify systems.
- Outline anatomical structures to agreed protocols.
- Outline clinical Target volumes.
- Produce treatment plans for standard individual patient external beam radiotherapy using a planning computer.
- Produce treatment plans for individual brachytherapy patient treatment.
- Prepare sealed sources for use in brachytherapy.
- Administer sealed sources using afterloading techniques.
- Select and customise patient related devices to assist with radiotherapy.
- Take impression of patient for the production of radiotherapy positioning devices.
- Produce patient specific radiotherapy positioning devices.
- Specify and design treatment machine accessories and modifications to assist with radiotherapy.
- Perform dose measurements to support radiation treatment.
- Conduct definitive calibrations of radiation delivery and measurement devices.
- Quality control radiotherapy systems.
- Maintain radiotherapy equipment.
- Prepare for radionuclide therapy procedures.
- Review patient status, suitability and consent for radionuclide therapy.
- Participate in the provision of a radionuclide therapeutic service.
- Manage radioactive patients.
- Monitor and decontaminate areas used for radionuclide therapy.

**Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)**

On successful completion of this module the student will:

1. Present complex ideas in simple terms in both oral and written formats.
2. Challenge discriminatory behaviour and language.
3. Adapt communication style and language to meet needs of listeners.
4. Respect and uphold the rights, dignity and privacy of patients.
5. Establish patient-centred rapport.
6. Consistently focus on professional duty of care.
7. Reflect and review own practice to continuously improve personal performance.
8. Consistently operate within sphere of personal competence and level of authority.
9. Manage personal workload and objectives to achieve quality of care.
10. Actively seek accurate and validated information from all available sources.
11. Select and apply appropriate analysis or assessment techniques and tools.
12. Evaluate a wide range of data to assist with judgements and decision making.
13. Contribute to and co-operate with work of multi-disciplinary teams.
## Section 5.0  Specialist Modules for Nuclear Medicine

### Section 5.1  Interpretation of the high level framework Medical Physics Technology specialising in Nuclear Medicine

<table>
<thead>
<tr>
<th></th>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Basis of Healthcare Science [10]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional Practice [10 level 6]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Medical Physics including elements from Professional Practice, Medical Imaging, Radiation Governance and Principles of Scientific Measurement [20]</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nuclear Medicine</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics and Instrumentation including work based training [30 level 6]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical Indications, Pathology and Patient Care including work based training [30 level 6]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workbased Training [20 level 6]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Credits | |
|---------|--------|--------|
| **Generic** | 10 | 10 |
| **Division** | 20 | |
| **Specialism** | 30 | 50 |
| **Total** | 60 | 60 |

Generic Modules: Common to all divisions of Healthcare Science

Division/Theme Specific Modules: Common to a Division (Life Sciences; Medical Physics and Clinical Engineering; Cardiovascular, Respiratory and Sleep Sciences, Neurosensory Sciences)

Specialist Modules: Specific to a specialism
Section 5.2 Physics and Instrumentation

<table>
<thead>
<tr>
<th>Division:</th>
<th>Medical Physics and Clinical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme:</td>
<td>Medical Physics Technology</td>
</tr>
<tr>
<td>Specialism:</td>
<td>Nuclear Medicine</td>
</tr>
<tr>
<td>Year 1:</td>
<td>Physics and Instrumentation [30 Credits]</td>
</tr>
</tbody>
</table>

The overall aim of this module is to ensure that the student has an understanding of the instrumentation used in the Nuclear Medicine department and understands the physical processes behind image formation, manipulation and display.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the student will:

1. Describe and explain radiation dosimetry and protection in nuclear medicine.
2. Demonstrate a detailed understanding of imaging systems used in Nuclear Medicine, (gamma camera, Single Photon Emission Computed Tomography, Positron Emission Tomography, Computed Tomography), their performance, uses and applications and quality control procedures.
3. Compare and critically contrast the structure, function and use of different types of imaging system.
4. Understand the principles of radionuclide production.
5. Critically discuss the problems associated with the assay of radioactive material and demonstrate an understanding of the principles of such measurements.
6. Demonstrate an understanding of image analysis, reconstruction, registration, display, storage and transfer.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the student will:

1. Respect and uphold the rights, dignity and privacy of patients.
2. Establish patient-centred rapport.
3. Actively seek accurate and validated information from all available sources when analysing nuclear medicine investigations.
4. Select and apply appropriate analysis or assessment techniques and tools.

Indicative Content

- Radiation Hazards
- Dosimetry of Unsealed Radionuclide Sources
- Principles of Radionuclide Production
  - Carrier free radionuclides
- Radionuclide generator systems: growth and decay curves, elution profiles
  - Available generator systems and their construction
  - Cyclotron and reactor production, general principles
- Nuclear Properties of Radionuclides Used in Nuclear Medicine
  - Atomic weight, number, half life, mode of decay, principal emissions
- Mathematical Methods
  - Counting statistics, precision of net sample counts
  - Isotope dilution methods
  - Flow studies, Fick principle, initial slope, transit time
  - Convolution and deconvolution methods
  - Clearance techniques, exponential analysis
- The Assay of Radioactivity
  - The problems associated with assay
  - Background and shielding
  - Counting loss associated with dead time and its correction
  - Efficiency and the optimisation of counting conditions, dual isotope counting
  - The geometry of the detecting system
  - The assay of radioactive samples
  - Detection systems
  - Radionuclide identification
  - Quantification of uptake, relative and absolute
  - Use of standards, background and phantoms
  - Whole body monitors
- Imaging systems in Nuclear Medicine
  - The Gamma Camera
  - The Computed Tomography (CT) scanner
  - Positron detectors
  - Positron Emission Tomography/Computed Tomography (PET/CT), Positron Emission Tomography/Magnetic Resonance Imaging (PET/MRI)
  - Single Photon Emission Computed Tomography/Computed Tomography (SPECT/CT)
  - Commissioning and quality control
  - Future detector systems – flat panel and solid state detectors
- Image analysis and display
- Image reconstruction
- Image registration
- Image display systems
- Image storage and transfer
  - Digital Imaging and Communications in Medicine (DICOM), Picture Archiving and Communications Systems (PACS), Radiology Information Systems (RIS) and Health Level 7 (HL7)
Section 5.3 Clinical Indication, Pathology and Patient Care

The overall aim of this module is to ensure that the student has the underpinning knowledge to allow them to carry out a range of Nuclear Medicine investigations.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the student will:

1. Describe and demonstrate an understanding of anatomy and physiology issues relating to the practice of Nuclear Medicine and development of novel radiopharmaceuticals and techniques.
2. Critically discuss the problems associated with the care of patients undergoing nuclear medicine investigations or treatments.
3. Demonstrate an understanding of the procedures, radiation protection and legislative issues surrounding the administration of radioactive materials with adult and paediatric patients.
4. Demonstrate an understanding of Radiopharmacy techniques including generators, isotope properties and blood labelling techniques.
5. Describe and critically analyse the role of Nuclear Medicine in the diagnosis of disease with particular reference to the skeletal, respiratory and renal systems.
6. Critically review and evaluate applications of nuclear medicine in terms of diagnosis and therapy for a range of body systems with due reference to patient care needs.
7. Discuss and evaluate radiopharmaceuticals in terms of radionuclide chemistry, biological behaviour and factors affecting product quality.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the student will:

1. Respect and uphold the rights, dignity and privacy of patients.
2. Establish patient-centred rapport.
3. Actively seek accurate and validated information from all available sources when analysing nuclear medicine investigations.
4. Select and apply appropriate analysis or assessment techniques and tools.
Indicative Content

- Anatomy and Physiology which needs to be considered in the planning and interpretation of radionuclide tests
- Immunology
- Infection
  - acute, chronic, pus, abscess, differential diagnosis between abscess, cyst and tumour
- Neoplastic disease
  - tumours, primary and secondary, (metastases), benign and malignant tumours, assessing the extent of malignant involvement
- Nursing and Emergency Procedures
- Administration of Radioactivity
- Adverse Incident Reporting Procedures
- Radiation Protection for Nuclear Medicine
- Radiopharmaceuticals used in Nuclear Medicine
  - The design of the radiopharmacy
  - Good Manufacturing Practice
  - The types of preparation
  - Sterilisation techniques
  - The operation of the radiopharmacy
  - Maintaining and monitoring the pharmaceutical environment
  - Waste disposal
- Radiochemistry and Quality Control
  - The chemistry of technetium
  - Radiochemical techniques
  - Production of radiopharmaceuticals
  - Labelling of blood products
  - Selection of appropriate radiopharmaceutical
- Perception of the Image
- In Vivo Non-imaging Techniques
- Techniques requiring the Assay of Radioactive Samples
- The Application of Nuclear Medicine in Diagnosis including PET/CT and SPECT/CT.
  - For radionuclide tests in common use this should include knowledge of
    - The radiopharmaceutical used, activity administered and route of administration, half life, beta energy
    - The preparation of the patient
    - The views and samples which must be obtained, dynamic protocols
    - The use of any special data handling techniques or display mode
    - Any special features of the study
    - Possible artefacts
    - Setting up the equipment – energy windows, collimation etc.
• The clinical context in which radionuclide tests may be of value and the influence of the test results on patient management.
• The radiation dose to the patient and the risks and benefits of the particular radionuclide test to a particular patient.
• New developments in Nuclear Medicine, and the changing role of Nuclear Medicine in the diagnosis and treatment of disease and the relevant imaging modalities used in reaching a diagnosis.

Applied to:
• Skeletal Imaging
• Central Nervous System
• The Endocrine System
• The Cardiovascular System
• The Respiratory System
• The Renal Tract
• The Gastrointestinal System

• Therapeutic Applications of Radionuclides in Nuclear Medicine

Section 5.4 Work Based Training

Division: Medical Physics and Clinical Engineering
Theme: Medical Physics Technology
Specialism: Nuclear Medicine
Year 1 and Year 2: Work Based Training [20 Credits]

The overall aim of this module is to give the student experience of Nuclear Medicine that ensures that the student can undertake the full breadth of practice expected of a newly qualified Healthcare Science Practitioner in Nuclear Medicine. This is delivered through work placements in years 1 and 2 of the degree course.

Important Note: Work based training does not have to be confined only to the work base but elements may be taught in other environments, e.g. a clinical skills laboratory, simulation centre or science laboratory.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the student will:

1. Demonstrate increased knowledge, understanding and confidence in application, of the core skills in clinical, patient identification, communication skills and management, and quality assurance.
2. Demonstrate competence for routine tasks/situations in Nuclear Medicine including imaging, non-imaging and therapeutic patient interventions, preparation of radiopharmaceuticals, quality assurance, and the operation of equipment.
3. Critically review and evaluate departmental protocols in relation to the core skills in Health and Safety, human rights, patient identification,
5. Produce a professional portfolio which cumulatively records/provides evidence of the skills, knowledge and attitudes gained.

### Learning Outcomes: Practical Skills

On successful completion of this module the student will:

1. Demonstrate competence for routine tasks and situations in Nuclear Medicine including imaging, non-imaging and therapeutic patient interventions, preparation of radiopharmaceuticals, Quality Assurance, and the operation of equipment.
2. Demonstrate the ability to work safely within the legislative and policy framework around the safe use of ionising radiation within a hospital environment.
3. Be able to use a dose calibrator in the preparation and measurement of radioactivity.
4. Perform a full range of equipment life cycle procedures as an equipment user.
5. Be able to set up, optimise and operate imaging equipment safely so as to be able to produce the highest quality results for interpretation across a range of nuclear medicine investigations.
6. Be able to perform all aspects of the preparation required including providing relevant information and instructions to the patient/carer to ensure the Nuclear Medicine Investigations and Treatment is successful.
7. Be able to administer Radiopharmaceuticals whilst observing all safety, control of infection and radiation protection governance requirements.
8. Be able to perform full range of common Acquisition and Recording techniques used when carrying out Diagnostic Imaging procedures.
9. Be able to perform a range of Nuclear Medicine Therapy procedures used in the clinical treatment pathway of patients.
10. Be able to work in a Radio-pharmacy safely and within the legislative and statutory framework to prepare and dispense radiopharmaceuticals for use in the diagnosis or treatment of patients.
11. Be able to apply quality control procedures within the Radiopharmacy to establish and maintain a safe environment which meets all legislative and medicine inspectorate requirements.
12. Demonstrate the ability to perform In-Vitro procedures in Nuclear Medicine.
13. Demonstrate the ability to perform Tracer Methodology procedures in Nuclear Medicine investigations.

### Learning Outcomes: Clinical Experience

On successful completion of this module the student will:

1. Work safely in all radiation areas.
2. Authorise referrals and schedule nuclear medicine procedures.
3. Prepare for imaging procedures including Positron Emission Tomography/Computed Tomography (PET/CT) and Single Photon Emission Computed Tomography/Computed Tomography (SPECT/CT).
4. Prepare for non-imaging procedures.
5. Prepare for radionuclide therapy procedures.
6. Review patient status and suitability for diagnostic procedures.
7. Review patient status, suitability and consent for radionuclide therapy.
8. Obtain biological samples for use in diagnostic or therapeutic nuclear medicine procedures.
10. Acquire and record data during diagnostic imaging procedures including Positron Emission Tomography/Computed Tomography (PET/CT) and Single Photon Emission Computed Tomography/Computed Tomography (SPECT/CT).
11. Perform non-imaging diagnostic procedures.
13. Manage radioactive patients.
14. Analyse results of nuclear medicine procedures including Positron Emission Tomography/Computed Tomography (PET/CT) and Single Photon Emission Computed Tomography/Computed Tomography (SPECT/CT).
15. Monitor and decontaminate areas where radioactive materials are used.
16. Verify prescription and/or order for radioactive and non-radioactive medicinal products working to standard operating procedures.
17. Plan production of radioactive and non-radioactive medicinal products.
18. Prepare working environment for manufacture and supply of radioactive and non-radioactive medicinal products.
19. Prepare radioactive and non-radioactive medicinal products for diagnostic and routine therapeutic use under standard operating procedures.
20. Dispense aliquots of radioactive and non-radioactive medicinal products for immediate diagnostic and routine therapeutic use under standard operating procedures.
21. Observe the production of radiopharmaceuticals containing positron emitting radionuclides.
22. Release of routine diagnostic radioactive and non-radioactive medicinal products suitable for clinical use.
23. Dispatch radiopharmaceuticals to intended user.
25. Receive and store radioactive and non-radioactive materials and products for use in manufacture and supply.
26. Radiolabel blood components for diagnostic purposes.
27. Confirm that routine, finished radiopharmaceutical products meet specification.
28. Quality assure Nuclear Medicine equipment including Positron Emission Tomography/Computed Tomography (PET/CT) and Single Photon Emission Computed Tomography/Computed Tomography (SPECT/CT).
29. Collect, monitor and record radioactive waste.
## Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the student will:

1. Present complex ideas in simple terms in both oral and written formats.
2. Challenge discriminatory behaviour and language.
3. Adapt communication style and language to meet needs of listeners.
4. Respect and uphold the rights, dignity and privacy of patients.
5. Establish patient-centred rapport.
6. Consistently focus on professional duty of care.
7. Reflect and review own practice to continuously improve personal performance.
8. Consistently operate within sphere of personal competence and level of authority.
9. Manage personal workload and objectives to achieve quality of care.
10. Actively seek accurate and validated information from all available sources.
11. Select and apply appropriate analysis or assessment techniques and tools.
12. Evaluate a wide range of data to assist with judgements and decision making.
13. Contribute to and co-operate with work of multi-disciplinary teams.
Appendix 1: Contributors to Graduate Diploma curriculum in Medical Physics Technology

The Graduate Diploma curriculum is based entirely on the BSc curriculum for Medical Physics Technology which was coordinated by the Modernising Scientific Careers (MSC) professional advisors with valued contributions throughout the development process from the following professionals in each specialism:

Medical Physics Technology curriculum working group
Allyson Butcher
Barbara Dawson
Carl Rowbottom
Christine Taylor
Claire Greaves
Colin Martin
Diane Allen
Michaela Moore
Stuart Macd Wilson

The BSc curriculum for Medical Physics Technology was also circulated to the following professional bodies and societies for their comments and contributions:

IPEM: Institute of Physics and Engineering in Medicine
VRCT: Voluntary Register of Clinical Technologists
BNMS: British Nuclear Medicine Society
NRIG: National Radiotherapy Implementation Group
SCoR: The Society and College of Radiographers