MEMBERSHIP AND FELLOWSHIP PROGRAMMES

IN CLINICAL RADIOLOGY

1. AIMS:

The aim of the faculty of radiology is to produce highly trained radiologists to provide quality radiological service to the highest standard throughout the sub-region.

2. LEARNING OBJECTIVES;

- The trainee should at the end of the programme function effectively as a specialist with membership qualification or as consultant with fellowship qualification to provide optimum specialist care to patients.
- Contribute to the development and dissemination of new knowledge and practices to undergraduate and postgraduate medical education and professions allied to medicine.

3. ADMISSION REQUIREMENT

The candidate must possess basic medical degree and registration with Medical Council of the relevant country of training.
The candidate must pass a primary examination.

4. COURSE DURATION

Minimum duration of three years for membership and five years for fellowship qualification.

The minimum duration for the award of membership in General Radiology shall be 36 months (3 years) and additional 24 months (2 years) for the award of Fellowship in a sub-specialty.
Modules 1 and 2 Membership shall be for 18 months (1½ years) respectively. The part I fellowship is for 24 months (2 years) and additional 24 months for Part II Fellowship.

An exemption from parts of the training program may be granted subject to approval by the Council on the recommendation of the Faculty Board

5. COURSE STRUCTURE

Primary Examination as entry requirement into a training programme.
Modules I and II for membership qualification.
Part I or Membership as well as Part II Final for Fellowship qualification.

6. COURSE CONTENT

PRIMARY EXAMINATION

A. GENERAL PHYSICS

A basic knowledge of physics up to Advance level is required. The following items are intended to serve only as a guide to candidates:

- Fundamental Ideas in physics
  - Matter including metals and non-metals; properties of matter; density, inertia
  - Structure of matter, structure of atom, radioactivity, isotopes
  - Force, work, power and energy
  - Different forms of energy: internal potential, chemical, kinetic energies.
  - Other forms of energy: heat, electricity, magnetism, sound, light, x-rays, gamma-rays etc.
  - Relationship between matter and energy; the nature of energy as particles or packets, Planck's idea of energy.
  - Energy of waves; mechanical energy waves; waves caused by radiant energy; characteristics of waves.
  - Law of conservation of matter, energy and momentum. Capacity for holding or retaining energy.
  - Mechanics: Statics, Motion, States of matter and their properties
  - Machines, hydrostatics
  - Speed, velocity, acceleration, momentum
  - Newton's laws of motion; motion in a circle, rotator or spin motor
  - Solids and properties of solids, liquids and surface tension; gases and gas laws
  - Friction in solids and liquids, static, kinetic, viscosity
  - Osmosis, diffusion, dynamics and laws of fluid flow
  - Biological application of the laws of mechanics:
  - Flow or air through the respiratory system
  - Diffusion of gases through tissues
  - Osmotic relationships between body compartments
  - Elastic resistance to ventilation
  - Surface tension of the alveolar liquid-air interface: The Law of Laplace
  - Airway resistance
  - Alimentary tract and the flow of food
  - Renal system and flow of urine in it
  - Haemodynamics of the cardiovascular system
  - Factors which influence viscosity of blood
  - Equilibrium of the blood vessel wall
  - Energetics of the circulation.
  - Heat energy and work
  - Sources of heat energy
  - Heat energy factors
  - Measurement of heat: calorimetry
  - Thermal effects
  - Coefficeints of expansion
  - Latent heat
  - Laws of thermodynamics
  - Conversion of heat into work
  - Transfer of heat conduction, radiation, convection
- Sound Energy

- The speed of sound
- Properties of sound: Intensity, loudness, frequency and pitch
- Doppler effect, resonance, fundamental tones

- LIGHT ENERGY
  - Effects produced when light encounters an form of matter speed of light
  - Interference, reflection, refraction and transmission of light
  - Refractive index, formation of images by reflection
  - Images formed by plane and curved mirrors
  - Lens optics converging and diverging lenses
  - Dispersion of light by a prim: the rainbow
- Electrical Energy
  - Static electricity
  - How electric chages are produced' induced charges
  - Conductors and insulators; capacitors
  - electric potential' power
  - Electricity in motion; electrical circuits; resistances
- Magnetic energy
  - The nature of magnetism
  - Mapping magnetic fields of force
  - Electromagnetism; electric generators

B. BASIC MEDICAL SCIENCES

An integrated content outline that organizes basic science materials of anatomy, physiology, biochemistry, pharmacology and principles of pathology is provided below to facilitate review:

1. System

General principles e.g DNA replication, homeostasis
Individual organ systems.
Cardiovascular
Haematopoietic / Lymphoreticular
Gastrointestinal
Central and Peripheral Nervous Systems
Renal/Urinary
Skin/Connective Tissue
Reproductive
Musculoskeletal
Endocrine
Respiratory

2. Process

* Normal development, structure and changes associated with aging
* Normal processes e.g metabolism, system role in host defense, repair and regeneration, immunologic process.
* Abnormal processes e.g infection, neoplasm, trauma
* Principles of therapeutics, including adverse effects
* Environmental influence and factors on diseases.

C. CLINICAL MEDICAL SCIENCE

All candidates must possess the medical knowledge and understand the four core clinical science subjects of Medicine, Paediatrics, Surgery and Obstetrics and Gynaecology considered essential for

provision of patient care under supervision. Understanding mechanisms of disease, establishing a diagnosis and applying principles of management are important tasks expected of potential trainees.

MODULE I MEMBERSHIP

Radiological Physics

An introductory course on basic radiation physics and radiation safety relevant to clinical radiology should be held during the 18 months of training

It is recommended that approximately 60 hours of formal tuition in basic radiation physics and radiation safety, including the current ionizing radiation regulations and statutory obligations related to ionizing radiation, are delivered before attempting the Module 1 Membership/Part I Fellowship Examination(s). This teaching is given primarily by medical physicists supplemented by clinical radiologists. Candidates for the Module 1/Part I Fellowship Examination(s) will be expected to supplement this tuition by a substantial amount of self-directed learning.

Core knowledge

The syllabus identified for the Module 1/Part I Fellowship Examination(s) includes the following:

- The fundamental physics of matter and radiation.
- Practical radiation protection.
- Statutory regulations and non-statutory recommendations.
- The physics of diagnostic radiology and radionuclide radiology techniques.

Clinical Skills

Radiological and radiographic techniques and procedures

In the eighteen months of training the trainee must be introduced to, obtain a sound understanding of, and begin to acquire some of the practical skills that will eventually be required of a clinical radiologist.

In the case of plain film radiography, trainees should become familiar with the radiographic technique even if they do not take the radiographs themselves.

Communication, interpretation and report writing

In the first year the trainee must begin to acquire some of the interpretation, reporting and communication skills that will eventually be required of a clinical radiologist.

It is recommended that a minimum requirement of two sessions per week to be devoted to reporting. For the core, the trainee will have interpreted and formally reported the following under the supervision of a recognized trainer.

Core

- All core procedures and techniques performed by the trainee.
- A selection of radiographs taken for trauma.
- A selection of in-patient and out-patient radiographs.

Optional

- Reporting of US, radionuclide, CT and MRI investigations.
- Reporting of special procedures not performed by the trainee.
- Reporting of paediatric investigations.

Module 2 Membership

Clinical Skills

Radiological and radiographic techniques and procedures

In the eighteen months of training the trainee must continue with a sound understanding of, and acquisition of the practical skills that will eventually be required of a clinical radiologist.

In the case of plain film radiography, trainees must show better knowledge of the radiographic techniques.

Communication, interpretation and report writing

In the eighteen months, the trainee should acquire more skills of the interpretation, reporting and communication that will be required of a clinical radiologist.

It is recommended that a minimum requirement of three sessions per week to be devoted to reporting. For the core, the trainee will have interpreted and formally reported the following under the supervision of a recognized trainer.

Core

- All core procedures and techniques performed by the trainee.
- A selection of radiographs taken for trauma.
- A selection of in-patient and out-patient radiographs.

Optional

- Reporting of US, radionuclide, CT and MRI investigations.
- Reporting of special procedures not performed by the trainee.
- Reporting of paediatric investigations.

Part 1 Fellowship

Radiological Physics

An introductory course on basic radiation physics and radiation safety relevant to clinical radiology should be held during the 24 months of training. The knowledge required for the Module 1/Part I Fellowship Examination(s) has/have been defined by the faculties.

It is recommended that approximately 60 hours of formal tuition in basic radiation physics and radiation safety, including the current ionizing radiation regulations and statutory obligations related to ionizing radiation, are delivered before attempting the Module 1/Part I Fellowship Examination(s). This teaching is given primarily by

medical physicists supplemented by clinical radiologists. Candidates for the Module 1/Part I Fellowship Examination(s) will be expected to supplement this tuition by a substantial amount of self-directed learning.

Core knowledge

The syllabus identified for the Module 1/Part I Fellowship Examination(s) includes the following:

- The fundamental physics of matter and radiation.
- Practical radiation protection.
- Statutory regulations and non-statutory recommendations.
- The physics of diagnostic radiology and radionuclide radiology techniques.

Clinical Skills

Radiological and radiographic techniques and procedures

Within the 24 months of training the trainee must be introduced to, obtain a sound understanding of, and begin to acquire some of the practical skills that will eventually be required of a clinical radiologist.

In the case of plain film radiography, trainees should become familiar with the radiographic technique even if they do not take the radiographs themselves.

Communication, interpretation and report writing

Within the first year of training the trainee must begin to acquire some of the interpretation, reporting and communication skills that will eventually be required of a clinical radiologist.

It is recommended a minimum requirement of two sessions per week to be devoted to reporting. For the core, the trainee will have interpreted and formally reported the following under the supervision of a recognized trainer.

Core

- All core procedures and techniques performed by the trainee.
- A selection of radiographs taken for trauma.
- A selection of in-patient and out-patient radiographs.

Optional

- Reporting of US, radionuclide, CT and MRI investigations.
- Reporting of special procedures not performed by the trainee.
- Reporting of paediatric investigations.

Part II Final Fellowship

For candidates who possess membership certificate or have passed Part I Fellowship examination, the individual trainee would have had the opportunity to assess their aptitude for, and interest in, the various subspecialties, so that they are in a position to decide the most appropriate areas in which they have the greatest aptitude. This will lead to submission of an approved proposal for dissertation to a desired College.

Overview

The dissertation must fulfil IMRAD guidelines as follows:

- Introduction.
- Materials and Methods.
- Results
- Analysis
- Discussion.

In addition, the methodology must have a clear statement on the hypothesis and sub-hypothesis of the dissertations.(See Appendix)

The framework for core training will consist of rotations which should give appropriate experience in the areas identified below:

System-based subspecialties:

- Breast imaging.
- Cardiac imaging.
- Gastrointestinal (GI) imaging.
- Head and neck imaging including ear, nose and throat, and dental.
- Musculoskeletal and trauma imaging.
- Neuroradiology.
- Obstetric imaging and gynecological imaging
- Thoracic imaging
- Uroradiology
- Vascular imaging including intervention.

Technique - based subspecialty:

- Radionuclide radiology.
- Ultrasonography.
- Computed Tomography.
- Magnetic Resonance Imaging.
- Single Photon Electron Computed Tomography.
- Positron Emission Tomography.

Disease- based subspecialty:

- Oncological imaging.

Age-based subspecialty:

- Paediatric imaging.
- Geriatric imaging.

The core knowledge for each **system based module** includes: physics, detailed radiological anatomy and techniques. The trainee will also be expected to have knowledge of how multisystem disease manifests itself.

Technique-based subspecialties (CT, MRI, US, interventional and radionuclide radiology) are incorporated (for the purpose of defining structured training) within each system-based module and are no longer defined separately in the trainee portfolio, but are defined in this document for reference. Because some training schemes deliver training centered on technique-based rotation, the core competencies are necessary to be acquired.

There is no requirement for training schemes to re-organize training to align with system-based modules, provided that core knowledge, skills and experience are acquired during the period of structured training.

In many training schemes it will be possible for trainees to receive training in more than one subspecialty at the same time, and there may also be opportunities to link certain subspecialties (e.g. CT and oncological imaging). Due to the complexities of such rotations and the inherent differences between training schemes, the individual training schemes will determine the order of rotations and their duration.

Training schemes must ensure that their trainees are able to achieve all the core training objectives for each subspecialty.

Each trainee will participate in an appropriate on-call roster, or other scheme of exposure to acute and emergency radiology, in which he/she will be responsible to a named consultant(s).

Clinical skills

The following sections delineate the core training objectives (knowledge, skills, and experience) that will be acquired during the rotations of assigned years. Where an optional objective is given, practical experience is not essential but a theoretical experience is still required.

Each component of the training programme will have a clearly defined structure for the supervision of the trainee by senior colleagues (trainers). There will be named consultant(s) who will assume responsibility for the training given during that period, including the techniques performed and the reports issued by the trainee.

The trainer will also be responsible for undertaking appraisal of the trainee at the beginning, during and at the end of the rotation and may be involved in the end of rotation assessment.

Core competencies

Core knowledge

- Secure knowledge of the current legislation regarding radiation protection.
- Able to offer advice as to the appropriate examination to perform in different clinical situations.

Core skills

- Participation in reporting plain radiographs which are taken during the general throughput of a normal working day of a department of clinical radiology.
- Performing any routine radiological procedures that might be booked during a normal working day.
- Attendance at and conducting clinico-radiological conferences and multidisciplinary meetings.
- Competence at reviewing studies on a workstation and familiarity with digital image manipulation and post-processing.

Breast

Core knowledge

- Knowledge of breast pathology and clinical practice relevant to clinical radiology
- Understanding of the radiographic techniques employed in diagnostic mammography
- Understanding of the principles of current practice in breast imaging and breast cancer screening
- Awareness of the proper application of other imaging techniques to this specialty (e.g. US, MRI and radionuclide radiology)

Core skills

- Mammographic reporting of common breast disease.

Core experience

- Participation in mammographic reporting sessions (screening and symptomatic).
- Participation in breast assessment clinics.
- Observation of breast biopsy and localization.

Optional experience

- Performing breast biopsy and localization.

Cardiac

Core knowledge

- knowledge of cardiac anatomy and clinical practice relevant to clinical radiology.
- knowledge of the manifestations of cardiac disease demonstrated by conventional radiography.
- familiarity with the application of the following techniques:

- echocardiography (including transoeophageal).
- radionuclide investigations.
- CT.
- MRI.
- Angiography, including coronary angiography.

Core skills

- reporting plain radiographs performed to show cardiac disease and post operative appearances.
- reporting of common and relevant cardiac conditions shown by US, CT and MRI.

Optional experience

- observation of relevant angiographic, echocardiographic and radionuclide studies.
- supervising and reporting radionuclide investigations, CT and/or MRI performed to show cardiac disease.
- experience in echocardiography (including transoephageal)
- observing/performing coronary angiography and other cardiac angiographic and interventional procedures.

Gastrointestinal (including liver, pancreas and spleen)

Core knowledge

- knowledge of GI and biliary anatomy and clinical practice relevant to clinical radiology.
- knowledge of the radiological, contrast studies (including ERCP), US, CT, MRI, radionuclide investigations and angiography.
- Knowledge of the applications, contraindications and complications of relevant interventional procedures.

Core skills

- reporting plain radiographs performed to show GI disease
- performing and reporting the following contrast medium examinations

- swallow and meal examinations
- small bowel studies
- enema examinations

- performing and reporting transabdominal US of the GI system and abdominal viscera
- supervising and reporting CT of the abdomen
- performing:

- US-guided biopsy and drainage
- CT-guided biopsy and drainage

Core experience

- experience of the following contrast medium studies

- sinogram
- stomagram (loopogram)
- GI video studies

- experience of the manifestations of abdominal disease on MRI
- experience of the current application of radionuclide investigations to the GI tract in the following areas

- liver
- biliary system
- GI bleeding (including Meckel's diverticulum)
- Abscess localization
- Assessment of inflammatory bowel disease

- experience of the application of angiography and vascular interventional techniques to this subspecialty
- experience of the relevant application of the following interventional procedures:

- percutaneous biliary stenting

Optional experience

- observation of ERCP and other diagnostic and therapeutic endoscopic techniques
- endoluminal US

- performing T-tube cholangiography
- observation of percutaneous cholangiography
- observation of percutaneous gastrotomy
- familiarity with performance and interpretation of the following contrast studies:

- proctogram
- pouchogram
- herniogram

- experience of the relevant application of the following interventional procedures:

- balloon dilatation of the oesophagus/stent insertion
- porto-systemic decompression procedures

Head and neck imaging including ORL/Dental

Core knowledge

- knowledge of head and neck anatomy and clinical practice relevant to clinical radiology
- knowledge of the manifestations of ORL/dental disease as demonstrated by conventional radiography relevant contrast examinations, US, CT and MRI
- awareness of the application of US with particular reference to the thyroid and salivary glands and other neck structures
- awareness of the application of radionuclide investigations with particular reference to the thyroid and parathyroid glands

Core skills

- reporting plain radiographs performed to show ORL/dental disease
- performing and reporting relevant contrast examinations (e.g., barium studies including video swallows)
- performing and reporting US of the neck (including the thyroid, parathyroid and salivary glands)
- supervising and reporting CT of the head and neck for ORL problems
- supervising and reporting CT for orbital problems
- supervising and reporting MRI of the head and neck for ORL problems
- reporting radionuclide thyroid investigations

Optional experience

- Performing biopsies of neck masses (thyroid, lymph nodes etc.)
- Observation or experience in performing US of the eye
- Supervising and reporting CT and MRI of congenital anomalies of the ear
- Reporting radionuclide parathyroid investigations
- Performing and reporting of sialography
- Performing and reporting of dacrocystography

Musculoskeletal including trauma

Core knowledge

- knowledge of musculoskeletal anatomy and clinical practice relevant to clinical radiology
- knowledge of normal variants of normal anatomy, which may mimic trauma
- knowledge of the manifestations of musculoskeletal disease and trauma as demonstrated by conventional radiography, CT, MRI, contrast examinations, radionuclide investigation and US

Core skills

- reporting plain radiographs relevant to the diagnosis of the disorders of the musculoskeletal system including trauma
- reporting radionuclide investigations of the musculoskeletal system, particularly skeletal scintigrams
- supervising and reporting CT of the musculoskeletal system
- supervising and reporting MRI of the musculoskeletal system
- performing and reporting USS of the musculoskeletal system
- supervising CT and MRI of trauma patients

Core experience

- experience of the relevant contrast examinations (e.g. arthrography)

Optional experience

- familiarity with the application of angiography
- awareness of the role and where practicable, the observation of discography and facet injections
- observation of image-guided bone biopsy

Neuroradiology

Core knowledge

- knowledge of neuroanatomy and clinical practice relevant to neuroradiology
- knowledge of the manifestation of central nervous system as demonstrated in conventional radiography, CT, MRI, conventional angiography, CTA and MRA
- awareness of the applications, contraindications and complications of invasive neuroradiological procedures
- familiarity with the application of radionuclide investigations in neuroradiology
- familiarity with the application of CT and magnetic resonance angiography in neuroradiology

Core skills

- reporting plain radiographs in the investigation of neuroradiological disorders
- supervising and reporting cranial and spinal CT
- supervising and reporting cranial and spinal MRI

Core experience

- observation of cerebral angiograms and their reporting
- observation of carotid US including Doppler
- experience in MR an CT angiography and venography to image the cerebral vascular system

Optional experience

- performing and reporting cerebral angiograms
- performing and reporting myelograms
- performing and reporting carotid US including Doppler
- performing and reporting Cranial US
- observation of interventional neuroradiological procedures

- observation of magnetic resonance spectroscopy
- experience of functional brain imaging techniques (radionuclide and MRI)

Obstetrics and gynaecology

Core knowledge

- knowledge of obstetrics and gynecological anatomy and clinical practice relevant to clinical radiology
- knowledge of the physiological changes affecting imaging of the female reproductive organs
- knowledge of the changes in maternal and foetal anatomy during gestation
- awareness of the applications of angiography and vascular interventional techniques
- awareness of the applications of MRI in gynecological disorders and obstetrics

Core skills

- reporting plain radiographs performed to show gynecological disorders
- performing and reporting transabdominal and endovaginal US in gynecological disorders, including early complications of early pregnancy(e.g., ectopic)
- supervising and reporting CT in gynecological disorders
- supervising and reporting MRI in gynecological disorders

Core experience

- performing and reporting hysterosalpingography

Optional experience

- supervising and reporting MRI in obstetric applications (e.g. assessing pelvic dimensions)
- observation of foetal MRI
- observation of angiography and vascular interventional techniques in gynecological disease
- performing and reporting transabdominal and endovaginal US in obstetrics

Oncology

Core knowledge

- knowledge of oncological pathology and clinical practice relevant to clinical radiology
- familiarity with tumour staging nomenclature
- familiarity with the application of US, radionuclide investigations, CT and MRI, angiography and interventional techniques in oncological staging, and monitoring the response of tumors to therapy
- familiarity with the radiological manifestations of complications which may occur in tumor management

Core skills

- reporting plain radiographs performed to assess tumours
- performing and reporting US, CT, MRI and radionuclide investigations in oncological staging and monitoring the response of tumours of tumours to therapy
- performing image-guided biopsy of masses under US and CT guidance

Paediatric

Core knowledge

- knowledge of paediatric anatomy and clinical practice relevant to clinical radiology
- knowledge of disease entities specific to the paediatric age group and their clinical manifestations relevant to clinical radiology
- knowledge of disease entities specific to the paediatric group and their manifestations as demonstrated on conventional radiography, US, Contrast studies, CT, MRI and radionuclide investigations
- the management of suspected non-accidental injury

Core skills

- reporting plain radiographs performed in the investigation of paediatric disorders including trauma
- performing and reporting US in the paediatric age group
- performing and reporting routine fluoroscopic procedures in the paediatric age group particularly:

- contrast studies of the urinary tract
- contrast studies of the GI system

Core experience

- experience of supervising and reporting CT, MRI and radionuclide investigations in the paediatric age group

Optional experience

- the practical management of the following paediatric emergencies:

- neonatal GI obstruction
- intussusceptions

Thoracic

Core knowledge

- knowledge of thoracic anatomy and clinical practice relevant to clinical radiology
- knowledge of the manifestations of thoracic disease as demonstrated by conventional radiology and CT
- knowledge of the application of radionuclide investigations to thoracic pathology with particular reference to radionuclide lung scintigrams
- knowledge of the applications, risks and contraindications of the technique of image-guided biopsy of thoracic lesions

Core skills

- reporting of plain radiographs performed to show thoracic disease
- supervising and reporting radionuclide lung scintigrams
- supervising and reporting CT of the thorax, including high resolution examinations and CT pulmonary angiography
- drainage of pleural space collection under image guidance

Core experience

- observation of image guided biopsies of lesions within the thorax
- familiarity with the applications of the following techniques:

- MRI
- Angiography

Optional experience

- supervising and reporting MRI
- angiography

- bronchial stenting

Uroradiology

Core knowledge

- knowledge of urinary tract anatomy and clinical practice relevant to clinical radiology
- knowledge of the manifestations of urological disease as demonstrated on conventional radiography, US, CT and MRI
- familiarity with the current application of radionuclide investigations for imaging the following:

- renal structure
- renal function
- vescio-ureteric reflux

- awareness of the application of angiography and vascular interventional techniques

Core skills

- reporting plain radiographs performed to show urinary tract disease
- performing and reporting the following contrast studies:

- intravenous urogram
- retrograde pyelo-ureterography
- loopogram
- nephrostogram
- ascending urethrogram
- micturating cysto-urethrogram

- performing and reporting transabdominal US to image the urinary tract
- supervising and reporting CT of the urinary tract
- reporting radionuclide investigations of the urinary tract in the following areas:

- kidney
- renal function
- vesico-ureteric reflux

- performing nephrostomies

Core experience

- observation of percutaneous ureteric stent placement
- observation of endorectal US
- performing image-guided renal biopsy under US and CT guidance
- MRI applied to the urinary tract
- experience of angiography and vascular interventional techniques
- experience of antegrade pyelo-ureterography

Optional experience

- Urodynamics
- Percutaneous nephrolithotomy
- Lithotripsy

3.2.2.16 Vascular and vascular intervention

Core knowledge

- knowledge of vascular anatomy and clinical practice relevant to clinical radiology
- familiarity with the indications, contraindications, pre-procedure preparation (including informed consent), sedation and anesthetic regimens, patient monitoring during procedures, procedural techniques and post procedure patient care
- familiarity with procedure and post procedure complications and their management
- familiarity with the appropriate applications of the following techniques:

- US (including Doppler)
- Digital subtraction techniques
- Intra-arterial angiography
- CT and CT angiography
- MRI and MRI angiography

Core skills- imaging

- reporting plain radiographs relevant to cardiovascular disease
- femoral artery puncture techniques and the introduction of guide wires and catheters into the arterial system
- venous puncture techniques both central and peripheral and the introduction of guide wires and catheters into the venous system
- performing and reporting the following procedures:

- lower limb angiography
- arch aortography
- abdominal aortography
- lower limb venography (contrast or US)

- performing the following techniques:

- US (including Doppler), venous and arterial
- Digital subtraction angiography

- supervising and reporting CT examinations of the vascular system including image manipulation
- supervising and reporting MRI examinations of the vascular system including image manipulation

Optional experience- imaging

- selective angiography (e.g., hepatic, renal, visceral)
- pulmonary angiography
- alternative arterial access (e.g., brachial, axillary puncture)
- upper limb venography
- portal venography
- pelvic venography via femoral approach
- superior vena cavography
- inferior vena cavography

Optional experience- interventional

- angioplasty and stenting techniques
- embolisation
- thrombolysis
- caval filter insertion
- central venous access

The core training objectives for the technique-based subspecialties CT, MRI, radionuclide radiology, and USS are listed below for reference, although they have been incorporated into the system based modules for the

purpose of this document and the trainee portfolio. Core training objectives for interventional radiology are listed below but are also incorporated into the system based modules.

Computed tomography

Core

- knowledge of the technical aspects of performing CT, including the use of contrast media
- knowledge of cross-sectional anatomy as demonstrated by CT
- practical experience in supervision including vetting requests, determining protocols, the examination, and post-processing and reporting of the examination in the following anatomical sites:

- brain
- head and neck
- chest
- abdomen and pelvis
- musculoskeletal
- vascular

- experience in performing CT-guided procedures, e.g., biopsy and drainage
- familiarity with the application of CT venography and angiography
- familiarity with post-image acquisition processing

n.b.: these examinations may be performed during a system-based attachment (e.g., neuroradiology) or during a CT attachment

Magnetic resonance imaging

Core

- understanding of current advice regarding the safety aspects of MRI
- knowledge of the basic physical principles of MRI, including the use of contrast media
- knowledge of the cross-sectional anatomy on orthogonal planes, and the appearance of normal structures on different pulse sequences
- experience in supervision including vetting requests, determining protocols, the examination, and post-processing and reporting of the examination in the following anatomical sites:

- brain
- head and neck
- chest
- abdomen and pelvis
- musculoskeletal (e.g., hips, knees, shoulders and extremities)

- experience of the application of magnetic resonance angiography and venography
- familiarity with post-image acquisition processing

n.b., this experience may have been gained during a system based attachment (e.g., musculoskeletal) or during a MRI attachment.

Radionuclide radiology

Core

- secure knowledge of the relevant aspects of current legislation regarding the administration of radiopharmaceuticals
- knowledge of the technical aspects of radionuclide radiology relevant to optimizing image quality
- knowledge of the radiopharmaceuticals currently available for the purposes of imaging organs and locating inflammatory collections, tumours and sites of haemorrhage
- knowledge of the relevant patient preparation, precautions (including drug effects), and complications of the more commonly performed radionuclide investigations
- knowledge and understanding of the principles and indications of the more commonly performed radionuclide investigations and how these relate to other imaging techniques, in particular knowledge of the radionuclide investigations in the following topic areas:

- cardiology
- endocrinology
- gastroenternology and hepato-billiary disease
- haematology
- infection
- lung disease
- nephro-urology
- nervous system
- oncology
- paediatrics
- skeletal disorders

- understanding the significance of normal and abnormal results
- knowledge of the strengths and weaknesses of radionuclide investigations compared to other imaging modalities
- experience in supervision and reporting of radionuclide investigations

Optional

- familiarity with the practical application of positron emission tomography:

ideally the training in radionuclide radiology should take place during a radionuclide imaging attachment, but it may occur in part or wholly during one or more system-based attachments.

Ultrasound

Core

- knowledge of the technical aspects of USS relevant to optimizing image quality
- knowledge of the cross-sectional anatomy as visualized on USS
- experience in performing and reporting transabdominal US examination of structures in the following anatomical areas:

- general abdomen (including vessels)
- pelvis (non-obstetric)
- small parts (scrotum, thyroid, neck structures)
- upper abdomen (including lower chest)

- experience of performing Doppler USS imaging (e.g., leg veins, portal vein, carotid artery)
- performing USS of the breast

- experience in USS of the musculoskeletal system
- performing USS-guided interventional procedures (e.g., biopsy and drainage)

Optional

- obstetric USS
- performing transcranial paediatric USS

Interventional radiology

Core

- familiarity with the equipment and techniques used in vascular, biliary and renal interventional techniques
- familiarity with the indications, contraindications, pre-procedure preparation (including informed consent), patient monitoring during the procedure, and post procedure patient care
- familiarity with procedure and post procedure complications and their management
- performing nephrostomies
- US-guided interventional procedures (e.g., biopsy and drainage)
- CT-guided interventional procedures (e.g., biopsy and drainage)
-

Optional

Angioplasty and stenting techniques

- Observation of the spectrum of interventional procedures currently performed in the following systems:
- vascular system (including neurovascular)

- urinary system
- biliary system
- GI system
- Musculoskeletal system
- experience of MRI-guided interventional procedures

The trainee will also attain an appropriate level of knowledge in:

Clinical conditions in which radiology has a role in diagnosis and/or treatment

- applied pathology and physiology where it contributes to a better understanding of radiological signs and methods of investigation
- those aspects of clinical medicine and pathology which are essential to the safe and effective conduct of interventional procedures
- current trends and recent advances in clinical radiology
- medical ethics
- statistics and research methods
- Communication (breaking bad news, consent, communication with colleagues etc.)
- the legal and ethical framework within which radiology and general healthcare provision operates
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The trainee will develop skills, as part of his/her general professional development, in:

- teaching
- clinical audit

- clinical effectiveness
- clinical risk management including discrepancy review
- quality standards
-

- Research
- management
- health informatics
- Some of these aspects of training will require attendance at in-house and/or external meetings and courses at appropriate periods during the training.

The following management skills should be acquired:

* Contextual awareness, understanding the bigger picture and developing an ability to operate effectively at all appropriate levels in the NHIS

* strategic thinking

* functional and operational skills, and knowledge of the day-to-day operation of radiology departments and other healthcare units

* clinical governance including clinical effectiveness, quality assurance and clinical risk management

human resources/people management, team building, complaints procedures, professional development

Health informatics

The trainee should:

- develop core skills in information technology, especially the ability to perform basic word processing, and to access computerized medical databases, electronic mail systems and the internet
- keep abreast of developments in information management relevant to radiology departments
- strive for best practice in patient record keeping and the transfer of clinical data and images
- comply with the Acts and Directives concerning data protection in clinical practice, and when using patient data for research, audit or teaching
- understand the principles and practice of evidence based medicine
- understand how clinical information is used in clinical governance

The trainee should develop the following personal attributes as part of his/her general professional development:

- self-awareness
- time management
- team work
- handling uncertainty
- skill in communicating with patients
- skill in communicating with colleagues

At the end of the fourth year the trainee should:

- have substantial experience of interpreting and reporting plain radiographs in all subspecialties
- have acquired experience of performing and reporting all core
- be able to advise clinicians on appropriate imaging strategies for the investigation of routinely encountered clinical situations (e.g. jaundice)
- be able to perform and give a provisional interpretation of standard emergency imaging procedures
- have attempted the Final Part II FWACS examination

- There will be annual reviews of all trainees as outlined in Section 2.9. These will aim to:
- verify experience and competence gained during the preceding year by reviewing the in-training assessments
- ensure that set targets have been met
- review clinical, technical and general professional development (listed in Sections 3.2.2-3.2.5)

7. COURSE ASSESSMENT

Primary

- Multiple Choice questions in General Physics and Basic Medical Sciences
- Multiple Choice questions in Clinical Medical Sciences in the core areas of internal medicine, surgery, paediatrics, obstetrics and gynaecology
- Each question will consist of 5-stem True or False options.

Pass Mark

The candidate must score at least 50% on the average

Module 1 Membership

- Radiological Anatomy
- Techniques of Radiological Procedures)
- Radiological Physics
- Clinical radiology
    - Written papers shall consist of either MCQ or essay type questions
- Slide viewing
- Viva Voce

Pass at Module 1

The candidate must:
- Score a minimum of 50% in at least two of the radiology theory written papers
- Score not less than 45% in the third written paper
- Score at least 50% in the overall theory papers
- Score at least 50% in slide viewing
- Score at least 50% in the overall examination

- Assessment of log-book
- Progressive annual assessment by training department in conjunction with the institution and the appropriate College.

Module 2 Membership

- Written Clinical Radiology
- Slide viewing
- Orals

Pass at Module 2

The candidate must:
- Score at least 50% in the clinical radiology theory written paper
- Score at least 50% in the combined clinical (slide viewing and Orals)
- Score at least 50% in the overall examination

- Assessment of log-book
- Progressive annual assessment by training department in conjunction with the institution and the appropriate College.

Part I Fellowship

The Part I Fellowship in Radiology Examination comprises written and oral papers in

(1) radiation physics and radiation safety
(2) Radiologic Anatomy and Techniques of Imaging
(3) Clinical Radiology
(4) Image viewing examination session in Clinical Radiology
(5) Oral Examinations in Radiation Physics and Clinical Radiology.

Pass at Part I Fellowship

The candidate must:

- Score a minimum of 50% in at least two of the radiology theory written papers (Techniques of Radiological Procedures or Clinical Radiology)
- Score not less than 45% in the third written paper
- Score at least 50% in the overall theory papers
- Score at least 50% in slide viewing
- Score at least 50% in the overall examination

- Assessment of log-book
- Progressive annual assessment by training department in conjunction with the institution and the appropriate College.

Part II Fellowship

The Part II Fellowship in Radiology, which is a final exit examination covering all the subspecialties within clinical radiology, is in the following sections namely:

- Single written paper consisting of multiple choice questions
- Image viewing examination session in Clinical Radiology
- Viva Voce examinations and reporting sessions
- Defence of Dissertation

Pass at Fellowship

The candidate must:

- Pass the defence of the Dissertation
- Score at least 50% in the clinical radiology theory written paper
- Score at least 50% in the Oral examination
- Score at least 50% in the overall examination

- Assessment of log-book
- Progressive annual assessment by training department in conjunction with the institution and the appropriate College.

Any candidate who has passed the written and the clinical aspects of the examination but fails the dissertation shall have this component of the examination banked and be examined only on the dissertation in subsequent examinations.

On the other hand any candidate who has passed the dissertation aspect of the examination but fails the written shall also have this component of the examination banked and be examined only on the written and clinical in subsequent examinations

8. LEARNING METHODS

- Clinical apprentiship
- Didactic lectures
- Group discussion and tutorials/seminars
- Update and revision courses
- Clinico-radiological/Clinico-pathological meetings

9. CERTIFICATION

Award of Membership and "rural posting" in general Radiology
Candidates that are successful at Module 2 examination shall be awarded the provisional certification, for "rural posting" for 1 year. After the completion of the "rural posting", he/she becomes fully certified.

After the completion of the membership programme and "rural posting", and he/she becomes fully certified, he/she may proceed to Fellowship programme if so desired.

Definition of Rural Posting in Radiology
For the purposes of radiology as a speciality, rural posting will take place in the departments of radiology of the state General hospitals and other secondary healthcare centers where the minimum basic imaging facilities are available.

Award of Fellowship in Radiology
Candidates that are successful at the exit final examination shall be awarded the Fellowship qualification.

10. ACCREDITATION CRITERIA

The accredited department in the Teaching Hospital or Medical centers should have:

- Personnel
    - Two consultants, at least one with 5-years post Fellowship experience
    - At least a Medical Physicist
    - Resident Doctors (3 Residents to 1 Consultant)
    - Radiographers
    - Nursing Staff.
    - Darkroom Staff
- Equipments

    Basic
    - At least 2 Static radiographic machines
    - At least 3 mobile radiographic machines
    - At least 1 fluoroscopy machine

    - At least 2 ultrasound machines with colour Doppler facilities
    - 1 Computed Tomography Machine
    - Mammography unit
    - Automatic X-Ray Film Processor / Manual Film Processor

      Optional
    - 1 C-Arm fluoroscopy machine
    - 1 Magnetic Resonance Imaging Machine
    - 1 Radionuclear Scanning Machine
    - PACS system

- Radiation Protection
    - Personnel Monitoring
    - Radiation Warning Lights and Signs
    - Survey Meter
    - Radiation Safety Officer/Radiation Safety Committee
- Infrastructure
    - Reporting Room
    - Seminar Room
    - Departmental Library
    - Internet Services
    - Audio-visual equipment

MEMBERSHIP AND FELLOWSHIP IN RADIATION AND CLINICAL ONCOLOGY.

AIM The aim of the Faculty of Radiology is to train high caliber oncologist to provide accessible quality oncological service throughout the sub region

LEARNING Objectives

- The Trainee by the end of the programme will Function effectively as specialist and consultants, provide optimal, ethical and patient-centered medical care
- Demonstrate Commitment to their patients, profession, and society through ethical practice**.**
- Establish and maintain clinical knowledge, skills and attitudes appropriate to Radiation and Oncology treatments .
- Demonstrate effective clinical problem solving and judgment to address patient problems, including interpreting available data and integrating information to generate differential diagnoses and management plans including use of chemotherapy.
- Demonstrate competent planning and execution of radiation therapy. This will include knowledge of relevant clinical examination and imaging techniques to acquire information on the extent of the volumes to be treated; use of treatment simulation equipment; interaction with physics and radiation therapy planning personnel; ability to prepare and interpret radiation treatment plans, knowledge of all common types of external beam radiation equipment, intracavitary and interstitial radiation techniques, and unsealed radioisotopes.
- Contribute to the development, dissemination, and translation of new knowledge and practices to undergraduate and graduate medical and allied health support services.

ENTRY REQUIREMENTS

The candidate must possess MB ChB/MBBS certificate or its equivalent from a recognized university.
The candidate must be fully registered with the Medical and Dental Council
The candidate must have done four post qualification rotations in the four major disciplines: namely Medicine, Surgery, Obstetrics and Gynaecology and Paediatrics.
The candidate must pass an entrance examination or primary examination and interview.

COURSE DURATION

Council may exempt a candidate from part of the training programme and examination following an application and approval, on the recommendation of the Credentials Committee through the Faculty Board.

The examination towards the Fellowship is in 3 parts:

Module 1/Part I Membership examination in the Basic Sciences : Applied Physics , Radiobiology ,Anatomy and Cancer Biology.

- This examination can be taken only after completion of pre-registration internship and full registration by the Medical and Dental Council.
- .A continous physical presence of at least 12 months in an accredited radiotherapy department as a clinician.

Module 2/Part 2 Membership examination

This examination is on principles of surgical, medical and radiation oncology and applied pathology -in-general. This examination can only be taken after all the following conditions are met by a candidate:

- Success at or exemption from the Part I examination .
- Successful completion of at least 36 months (including the first year) of instruction and training in fulltime posts in a recognized department of Radiotherapy and Oncology.
- Present a logbook of procedures participated in during the 36-month period three months prior to examination date to the faculty through the head of department.
- A book of 10 cases will also be required and submitted with the log book.

Fellowship Examination

The candidate will continue to train by upgrading of skills toward independent practice of oncology for a minimum of 1 yr to be qualified to be admitted for the fellowship examination. This examination will dwell on research development and ability to demonstrate independent oncology practice.

Candidates will need a minimum of 24months to complete this phase.

For admission to Final (Exit) Fellowship / Part III examination a candidate must

- have passed the Module 2/Part 2 examination
- have done at least five years of training.

COURSE STRUCTURE

The first year

For most trainees, the first year of training represents their first opportunity to learn and acquire knowledge of basic sciences and principles of radiotherapy practice.

Overview

At the end of the first year, the trainee should:

- Feel confident in his/her choice of radiotherapy and clinical oncology as a career.
- Have mastered the basic radiation physics and radiation safety required in clinical radiology to the level of the Examination(s).
- Be familiar with the concept and terminology of radiotherapy and clinical oncology.
- Understand the various treatment modalities and options and their applications.
- Understand the responsibilities of a radiation oncologist to the patient including the legal framework and the necessity for informed consent.
- Be familiar with the various treatment procedures and techniques used in Radiotherapy.
- Be Familiar with chemotherapeutic procedures, dose calculations and side effects and their management.
- Understand the principles of radiation protection and be familiar with the legal framework for protection against ionizing radiation.
- The trainee should also demonstrate that he/she is capable of safe radiological practice.
- Be familiar with safety requirements for radionuclide radiology.
- Have a sound understanding of core radiobiological principles.
- Understand and practice clinical audit and risk management.

Basic Radiation Sciences

An introductory course on basic radiation physics, radiation biology , anatomy , pathology and radiation safety relevant to clinical radiology should be held during the first 6 months of training

- **Radiation Blology**
- **Physics**
- **Cancer Blology**
- **Applied Anatomy.**

The WACS recommends that approximately 60 hours of formal tuition in basic radiation physics and radiation safety, including the current ionizing radiation regulations and statutory obligations related to ionizing radiation, are delivered before attempting the First Examination(s).
This teaching is given primarily by medical physicists supplemented by Radiotherapists.
Candidates for the First Examination(s) will be expected to supplement this tuition by a substantial amount of self-directed learning.

Core knowledge

The syllabus identified for the First Examination(s) includes the following:

- The fundamental physics of matter and radiation
- Practical radiation protection
- Statutory regulations and non-statutory recommendations
- The physics of radiotherapy
- Radiobiology/ cancer biology.
- Anatomy

Clinical Skills

Radiotherapeutic Procedures

In the first year of training the trainee must obtain a sound understanding of, and begin to acquire some of the practical skills that will eventually be required of a specialistt radiotherapist.

The trainee should be familiar with the broad spectrum of malignancies and non-malignant diseases managed by the Radiotherapist.
He should be familiar with various treatment modalities and begin to plan simple treatments.

The trainee should acquire competence in the administration of chemotherapeutic agents and learn to manage its complications.

. **Core**

- Treatment planning of simple cases like external beam treatment for cervical cancer.
- Sessions with Simulator.
- Administration of chemotherapy to patients.
- Observe and assist at brachytherapy sessions
- Patient Clerking and investigation.

The second to fourth year.

- Clinical Radiation oncology
- Medical oncology
- Pathology of cancer
- Palliative care
- Simulation technique
- Treatment planning techniques
- Basic research skills.

Rotations for Part II Membership Programme

The Trainee will rotate through the following Specialties:

-General Surgery(oncology cases) 2 weeks

-Urology(oncology) . 2 weeks

-Hematology 2 weeks

-Paediatric Oncology 2 weeks

-Pathology . 2 weeks

-Radiology (CT/MRI) . 2 weeks

Routine for Residents

- Daily scheduled outpatient clinic and simulation for treatment .
- Once a week teaching with the Consultant
- Weekly chart rounds /tutorials with the Consultant
- Weekly film rounds /tutorials with the Consultant
- At least once a week planning sessions
- Monthly journal club meeting with the Consultant
- Biweekly seminars in specific topics with Consultants
- Trainees will conduct clinical research and publish a paper per year with the Consultant

DISSERTATION REQUIREMENT for FELLOWSHIP

- Period of research is mandatory for this final exit examination.

- Twelve months of full-time research in any aspect of radiotherapy and clinical oncology is allowed as part of the 5 years of specialist training.
- At the discretion of the Supervisor, up to 24 months of the 5 years of accredited training may be spent in clinically based research.
- Upon completion the candidate will be required to defend dissertation in addition to a written examination and voice viva examination.

COURSE CONTENT

1 CURRICULUM FOR PART I/ module I EXAMINATION FOR THE MEMBERSHIP IN RADIATION /ONC

Physics curriculum

Atomic and nuclear structure

2.1 Structure of the atom
- 2.1.1 Nucleus, orbital shells, energy levels, binding energy
- 2.1.2 Particles - proton, electron, neutron, positron
- 2.1.3 Describe atomic number, atomic mass, isotopes

2.2 Wave and quantum models of radiation
- 2.2.1 Energy and wavelength, energy spectrum

2.3 Radioactivity
- 2.3.1 Decay processes
- 2.3.2 Activity, half life
- 2.3.3 Parent – daughter relationships and equilibrium
- 2.3.4 Nuclear reactions, bombardment and reactors

2.4 Production of photons and electrons

2.4.1 Physical concepts of beam production
- Bremsstrahling
- X-ray tube design
- Energy spectrum
- Characteristic radiation

2.4.2 Generation of beams
- Filters
- Gamma sources
- Linear accelerator
- Beam geometry

2.4.3 Attenuation of beams

- Half value layer
- Attenuation, energy transfer, and absorption
- Attenuation co-efficient

2.5 Interaction of x-rays and gamma rays with matter
- 2.5.1 Absorption and scatter of x-rays in matter
- 2.5.2 Photoelectric effect
- 2.5.3 Compton effect
- 2.5.4 Pair production

2.6 Interactions of particulate radiation

- 2.6.1 Direct and indirect ionisation
- 2.6.2 Elastic and inelastic collisions
- 2.6.3 Linear energy transfer
- 2.6.4 Heavy particles interactions
- 2.6.5 Interactions of Neutrons
- 2.6.6 Interactions of Electrons

2.7 Radiotherapy equipment

2.7.1 Linear accelerator
- Construction of radiotherapy machines
- Principles of beam production
- Beam collimation and modifiers

2.7.2 Cobalt units

2.7.3 Simulators

- Operation
- Fluoroscopy and Intensifiers
- CT simulation

2.7.4 Other imagers

- Principles of ultrasound, CT, MRI, PET
- Applications and limitations of above imaging to radiotherapy

2.7.5 Brachytherapy

- Sources used
- Calibration of sources
- Radioprotection

2.7.6 Equipment selection and specifications

2.8 Radiation beam quality and dose
- 2.8.1 Mono energetic and heteroenergetic beams
- 2.8.2 Dose quantities and units

- Kerma
- Exposure
- Absorbed dose
- Dose equivalent
- RBE dose
- Calculation of absorbed dose from exposure
- Relationship between kerma, exposure and absorbed dose

2.9 Radiation measurement and calibration

2.9.1 Ionisation chambers
2.9.2 Principles of beam calibration
2.9.3 Other methods of measuring absorbed dose

- Calorimetry
- Chemical dosimetry
- Solid state detectors
- Film dosimetry

2.10 Photon beam treatment

2.10.1 External beam planning principles
- Inverse square law
- Backscatter factor
- Electron build-up
- Percentage depth dose
- Equivalent squares
- Tissue-air ratio

2.10.2 Dose calculations

- Monitor unit calculations
  - Output factor
  - Field size correction factors
  - Collimator and phantom scatter factor
  - Beam modifier factors
  - Patient attenuation factors

- Calculations in practice
  - SSD technique
  - SAD technique

2.10.3 Translation of planning to calculations
- Beam parameters

- Beam weighting
- Arc rotation therapy
- Irregular fields

2.10.4 Computerised treatment planning
- Isodose curves (beam characteristics)
- Surface dose
- Parallel opposed beams
- Wedge techniques, isodose curves, angles
- Beam combinations

2.10.5 Surface corrections and heterogeneities
- Surface obliquity
- Inhomogeneity correction

2.10.6 Adjoining fields and special dosimetry problems
- Two-fields
- Three-fields
- Craniospinal gapping
- Pacemaker
- Gonadal dose
- Pregnant patient

2.11 Electron beam treatment

2.11.1 Basic characteristics
- Depth-dose curves
- Interactions
- Obliquity

2.11.2 Treatment planning principles
- Selection of energy, field size
- Skin dose
- Bolus
- Field shaping
- Field-matching
- Inhomogeneities

2.12 External beam quality assurance

2.12.1 Goals

2.12.2 Roles and duties

2.12.3 Staffing

2.12.4 Linac QA
- Commissioning linear accelerators (principles)

2.12.5 Routine Quality assurance requirements
- Daily, monthly, annually

2.13 Radiation protection and shielding

2.13.1 Definitions and standard

2.13.2 Dose equivalent and effective dose equivalent

2.13.3 Types of radiation exposure
- Background
- Man-made
- National recommendations on exposure limits

2.13.4 Protection regulations

2.13.5 Administrative requirements
- Safety programme
- Staff monitoring

2.13.6 Radiation shielding principles

- Treatment room design
- Types of barriers
- Neutron shielding for high energy beams
- Sealed source storage
- Protection equipment and surveys
- Monitoring equipment

2.14 Imaging in radiation oncology
2.14.1 Routine diagnostic imaging principles
2.14.2 Port films
2.14.3 Processors
2.14.4 Other imaging

- Electronic portal imaging devices

2.15 3D conformal therapy
2.15.1 Concepts and goals vs traditional RT
- Technology and methods for planning
- Multiple volume images
- Image processing
- Virtual simulation
- DRR’s
- Multiple beams and non-coplanar beams

2.15.2 Optimisation methods
- Uniform vs non-uniform delivery
- Margins
- DVH’s

2.15.3 Implications of treatment variabilities
- Set-up
- Patient factors

- ICRU 50 and 62 prescribing recording and reporting

2.16 Assessment of patient setup and verification
2.16.1 Immobilisation devices and methods
2.16.2 Positioning devices and methods
2.16.3 In-room treatment imaging

- Cone-beam CT
- Ultrasound
- Fiducials
- On-line correction of set-up errors
- Adaptive planning concepts

2.17 Brachytherapy planning
1.17.1 Calculation of dose distribution
- Calculation of dose from a point source/line source

2.17.2 Systems of implant dosimetry

2.17.3 Implantation techniques
- Surface
- Interstitial
- Intracavitary

2.17.4 Gynaecological implants
- Manchester system
- Bladder and rectal dose
- ICRU

2.18 IMRT
2.18.1 Delivery systems
2.18.2 Principles of dose prescription and inverse planning
2.18.3 QA

2.19 Special procedures
2.19.1 Stereotactic radiosurgery
- Delivery systems
- Principles of planning and delivery
- QA

2.19.2 Total body irradiation
- Principles of planning and delivery

2.20 Particle therapy
2.20.1 Protons
- Energy deposition
- Equipment
- Beam dosimetry

- Principles of production and delivery

2.20.2 Neutrons
- Basic interactions
- Principles of production and delivery

3 Radiobiology and Cancer Biology

3.1 **Basic Principles of radiobiology**

3.1.1 Interaction of radiation with matter
3.1.2 DNA damage by radiation
3.1.3 Cell survival curves
3.1.4 Cell radiosensitivity and radiocurability
3.1.5 Cell cycle
3.1.6 Lethal, potentially lethal, sublethal damage and repair
3.1.7 Dose rate effects
3.1.8 The basis of fractionation: 4 R's of radiobiology
3.1.9 Factors that modify clinical radiation response and methods to overcome limitations. The oxygen effect, radiosensitisers, radioprotectors, hypoxic cell sensitisers, hyperthermia, linear energy transfer.

3.1.10 Biological equivalent dose and linear quadratic equation (including practical clinical calculations)

3.1.11. Other radiation modalities (neutrons, protons), relative biological effectiveness
3.1.12 Tumour growth kinetics (Tpot, growth fraction, cell loss).

3.2 **Effect of radiation on normal tissue**

3.2.1 Normal tissue tolerance – organ and volume specific
3.2.2 Acute and late effects of radiation on normal tissues, including the eye and gonads (also hereditary effects, carcinogenesis)

3.2.3 Total body radiation
3.2.4 Effect of irradiation on the embryo and fetus

3.3 **Cancer biology**

3.3.1 Terminology of molecular biology of cancer
3.3.2 Carcinogenesis
3.3.3 Oncogenes
3.3.3 Tumour suppressor genes
3.3.4 Growth factors and signal transduction pathways
3.3.5 Apoptosis
3.3.6 Angiogenesis
3.3.7 Invasion and metastasis.

4.0 Applied Anatomy

4.1 Keeping the goal of treating the oncology patient in mind:

4.1.1 The structure, boundaries, vascular and lymphatic pathways, and neurological supply of: head and neck, the central nervous system, thoracic and abdominal organs and upper limbs proximal to mid humerus and lower limbs proximal to and including the femoral triangle

4.1.2 Landmark localisation:
- On surface anatomy
- Imaging

4.1.3 The relation of organs to one another and their movement

4.1.4 Radiological anatomy on relevant imaging techniques

4.1.5 Routes of potential cancer spread.

Syllabus for Part 2/Module 2 examination:

5.0 Tumour pathology and General oncology

5.1 Tumour Pathology.
For each tumour site and type, the following aspects should be studied:

5.1.1 Epidemiology and aetiology
- Natural history
- Clinical presentation
- Characteristic imaging findings
- Laboratory diagnosis of disease:
  - Macroscopic and microscopic appearance of tumour compared withnormal tissue of origin and differential diagnosis.
  - Grading and staging systems in use
  - Immunohistochemistry AND special stains
  - Tumour markers
  - Molecular techniques available (brief overview)

The candidate should be able to interpret a pathological report including pathologic prognostic and predictive factors

5.2 General Oncology

The candidate should be familiar with all aspects of oncological disease:

1.2.1 Physiology of oncologic symptoms and syndromes
- Pain
- Nausea and vomiting
- Tumour lysis syndrome
- Hypercalcemia

5.2.2 Symptoms, signs, differential diagnoses, work up and staging of patients with tumours seen in oncological practice should be known. The candidate should be able to adequately interpret X-rays, scans, pathology and other laboratory results.

5.2.3 Physiology which is relevant to therapy

- Endocrine systems – particularly the thyroid and Pituitary Adrenal gonadal axis
- The immune system as (applied to Oncology – especially HIV infection)
- Haematoposiesis

5.2.4 The candidate should know and be able to plan and describe oncological treatment options for all patients including those routinely treated by other specialities e.g. Medicine, Surgery and Gynaecology. Principles as well as complications of curative and palliative cancer surgery should be known.

5.2.5 The expected benefits, complications and limitations of all treatment options should be known.

5.2.6 Knowledge of diseases that are non-malignant, but are treated in the practice of radiotherapy and/or chemotherapy is required. (Eg. Pituitary adenoma, acoustic neuroma, arterio-venous malformation, keloid, heterotopic ossification, thyroid eye disease, etc)

5.2.7 Candidate should have knowledge of cancer prevention techniques, screening, early detection and education of the public.

5.2.8 Some knowledge of effective communication techniques used to adequately and accurately inform cancer patients and family about disease and treatment is required.

5.2.9 Management of common psychological reactions in oncology patients.

5.2.10 The candidate should be able to discuss supportive care/symptomatic treatment in oncology and terminal care.

5.2.11 Knowledge of the practice of medicine in accordance with medical ethics is expected.

5.2.12 Knowledge of quality of life assessment is required.

6.0 Radiation and Medical Oncology

6.1 **Radiotherapy:**

An in depth knowledge of the use and applications of radiotherapy and chemotherapy as well as biological and hormonal therapy applicable to tumours isessential. The candidate must be able to contrast this with other forms of treatment available and justify its use.

The candidate should be able to:

6.1.1 Justify the intent of radiation treatment and explain the rationale of sequencing in relation to other treatment modalities.

6.1.2 Describe the treatment planning process with respect to:

- Positioning and immobilization
- Simulation/scanning
- Delineation of tumour/treatment volumes and critical structures

6.1.3 Describe and justify the likely beam arrangement for a given tumour

6.1.4 Prescribe a course of treatment and describe:

- Dose, fractionation schedules, and treatment length.
- Normal tissue tolerances and limitations

6.1.5 Discuss plan assessment/appraisal

6.1.6 Discuss treatment supervision including:

- Verification
- Diagnosis, grading and treatment of acute toxicities of treatment and assessment of the impact of treatment on quality of life.

6.1.7 Discuss clinical applications, rationale and techniques of:

- brachytherapy
- Radio-isotope therapy
- Other specialised radiation techniques

6.2 **Systemic therapy (Chemotherapy, hormonal therapy, biological therapy)**

The candidate should have an in depth knowledge of the principles and indications for systemic therapies used in the curative and palliative setting and be able to describe:-

6.2.1 Classification and mechanism of action of cytotoxics.
6.2.2 Side effects and toxicities, as well as management of these
6.2.3 Commonly used therapeutic regimens and schedules
6.2.4 Rationale of sequencing in relation to other treatment modalities
6.2.5 Interactions with radiotherapy
6.2.6 Biological therapies
6.2.7 Indications for radiosensitisers
6.2.8 Knowledge of recent literature pertaining to oncologic diseases is expected

7.0 Learning Portfolio

The Learning Portfolio documents the trainees experience.
It includes a guideline to a list of procedures and templates for the completion of case reports in Radiation Oncology and Medical Oncology.

In addition, trainees will be encouraged to use the Learning Portfolio to learn Applied basic sciences and the associated roles of an Oncologist in Health Care Practice ie Collaborator, Communicator, Health Advocate, Manager, an ethically based Professional and Scholar.

The Learning Portfolio is to be signed off by the Head of Department prior to the trainee sitting the Part II examinations and needs to be presented to the examiners PRIOR to the time of the Part II oral examination.

SYLLABUS FOR FINAL (EXIT) FELLOWSHIP / PART III EXAMINATION

8.1 Dissertation

AIM

- To establish an understanding of research methodology .
- Ensure participation in research as intergral components of radiation oncology training and subsequent specialist practice.
- To encourage trainees to contribute to the oncology literature.

A Topic which illustrates aspects of the

- Basic Science of Oncology
- Analysis and modelling of treatment techniques
- A critical /substantial literature review as relevant to practice in Ghana

Reviewed by **supervisor** before submission to college.

STRUCTURE MUST CONFORM TO RECOMMENDATION OF ADMINSTERING COLLEGE

- Completed at least 6 months prior to the Part III examination and submitted to college for examiners
- Should be presented in publishable.

8.2 Additional content may be required to complete this aphase depending on the faculty.

Appraisal and Assessment

The first year in Radiotherapy can be a difficult year of transition for trainees. Heads of training schemes and College tutors are encouraged to offer advice, a mentor system and a counseling service during the year. The following milestones should be acknowledged.

The trainee must meet with the College tutor and/or the head of the training scheme at the beginning of and after 3 months in post, to identify any difficulties and suggest solutions. Candidates failing the First Examination(s) should be counseled by the head of the training scheme and/or the College tutor on each occasion.
All trainees should be assessed at the end of the first year by the local training scheme before the annual assessment (RITA) process.

The possible outcomes of this assessment process are listed below:

*** Progress** into the second year of training

* **Conditional progress** into the second year of training. A specific action plan will be formulated with the trainee to redress deficiencies in performance. Progress will be re-assessed as appropriate within the second year of training.

* **Directed training without progression**. If the trainee is so far short of the objectives from their first year of training such as to prevent them continuing into the second year of training, directed training is recommended to achieve those objectives. The Committee recommends that repetition of the entire first year should only be recommended for exceptional purposes.

The second to fourth years
After the initial 6-month period of training when the First Examination(s) syllabi are covered, there will be approximately 54 months of core training during which trainees should receive structured training in all the constituent subspecialties of Radiation Oncology.
A log book and learning portfolio to be provided and assessed once a year throughtout.
At the end of four year the trainnee should produced a book of cases(number determined by faculty).

By the end of the fourth year a trainee will usually have had the opportunity to pass the final Examinations. The core of knowledge required to pass the Final Examination(s) has been defined by the College.

Part II Final Fellowship (Exit)

Dissertation on oncology topic to be directed by supervisor and appraised for final document the format should strictly conform to college specific.

Additional requirements may be required depending on faculty.

Examinations

The Part I Membership examination shall consist of the following in Essay and MCQ form.

Paper 1 – Physics (3 hours)

Paper 2 – Radiobiology and Cancer Biology (3 hours)

Paper 3 – Applied anatomy/ physiology (2 hours) .

Clinical - An oral examination comprising of above subjects with some practicum in physics. (1hr)

The Part II Membership/ Fellowship examinations will consist of Essay and MCQ .

Three written papers as follows:

Paper 1 – Tumour pathology and Treatment planning (3 hours)

Paper 2– Radiation Oncology (3 hours)

Paper 3 - Clinical Oncology (3 Hours)

A viva voce examination consisting of:

A clinical examination which will be concerned with proficiency in clinical examination as well as investigation and treatment of patients, (1 hour practical)

A practical examination in the technical/practical aspects of radiation therapy.

The Part III / Final fellowship examination will consist of

- VIVA (2 HOURS)
- Questions about submitted dissertation (45 MIN)
- Questions ABOUT Statistics as Applied to Oncology (30 MIN)
- Statistical critique of a published article (15min)
- Case presentation and discussion in detail (30min)
- Final mark will include marks awarded from assessment of dissertation and critique of an article.

General considerations for success at the exams are as follows:

- A minimum of total of 50 % is required to pass written papers.
- A mInimum of 45% for one paper is however required.
- Failure to achieve 50% in clinical examination constitutes a failure of whole exam.

LEARNING METHODS

- Didactic lectures
- Apprenticeship
- Tutorials
- Journal discussions
- Contious professional development through update and review courses. At least twice a year.

CERTIFICATION

- Completion of Module I/Part I examination. - No certification
- Completion of Module 2 / Part II examination - Provisional Membership Certification Award as per college
    - Candidates that are successful at Module 2 examination shall be awarded the provisional certification, for rural posting for 1 year.
- After the completion of the rural posting - Full Membership certification.
    - After the completion of the membership programme and rural posting, and he/she becomes fully certified, he/she may proceed to Fellowship programme if so desired.
- Completion of Final (Exit) Fellowship /Part III examination

  and submission of accepted dissertation - Fellowship Certification Award as per college.

ACCREDITATION CRITERIA

Minimum requirement

- At least two consultants with at least 5 yrs post fellowship experience
- At least one Phd in Medical Physics
- Therapy radiographers at least two
- Fully equipped radiology center in hospital
- Fully equipped pathology services
- Teaching hospital based
- Minimum of 500 new patients per year
- Multidisciplinary team for cancer management

- One teletherapy unit
- Simulator
- Treatment planning system
- Fully equipped physics department.
- Brachytherapy unit for cervix
- Ability to create custom blocking
- Availability of full range basic chemotherapy drugs
- Oncology nurses.
- Radiation safety officer