HONG KONG COLLEGE OF RADIOLOGISTS

SPECIALTY TRAINING : RADIOLOGY

OBJECTIVES OF TRAINING

(A) *Basic Specialist Training*

1 To allow a medical graduate to acquire general radiological and radiation protection knowledge, skill and competence, with supervised responsibility for patient care.
2 To develop a disciplined habit of reasoning and a logical approach to specific medical problems with respect to radiology.
3 To appreciate the importance of radiology in the whole system of patient care and health.
4 To be conversant with the updated practice and current literature on relevant subjects.
5 To be able to communicate with clinical colleagues and render appropriate recommendation on imaging investigation and patient management.
6 To be confident to advise on the safest, cheapest and most effective means of arriving at a diagnosis, and to counsel against unnecessary imaging investigation.

(B) *Higher Specialist Training*

1 To develop in-depth skill and knowledge, and practical experience in general radiology to be capable of independent practice in the specialty.
2 To be trained with initiation towards subspecialty development.
3 To be well versed in various imaging modalities to be an effective member of a team in the multidisciplinary approach on patient care.
4 To be capable of promoting efficient utilization of available radiological services at different settings.
5 To be trained to be a radiologist with the appropriate professional attitude.
6 To be motivated towards continuous professional development.

TRAINING REQUIREMENTS

(A) *Entry Requirement & Duration of Training*

1.0 The trainee needs to be fully registrable with the Hong Kong Medical Council.
2.0 The duration of training shall last for a minimum of 6 years.

(B) *Basic Specialist Training: Part I & Part II*

1.0 At least one year of post-registration clinical experience outside radiology are required.
1.1 The post-registration clinical experience should appropriately be in disciplines with wide exposure to various clinical situations, e.g. Internal Medicine, General Surgery, Paediatrics, Emergency Medicine, Obstetrics & Gynaecology, Orthopaedics, etc. For the consideration of clinical experience outside radiology, service at General Outpatient Clinics and Health Services shall not count, whilst service at Anaesthesiology, Pathology, Rehabilitative Medicine and Psychiatry, and Family Medicine training, shall only count up to a maximum of six months.
2.0 Satisfactory attendance of the Part I Training Course organized by the College is advisable prior to the Part I Fellowship Examination.
3.0 The trainee should receive a comprehensive grounding in all subjects related to the production of an organ image or providing the background towards radiological interpretation.
4.0 The topics of basic training includes radiological anatomy, radiographic techniques and equipment, practical radiological procedures, radiation protection, radiation biology, contrast media, relevant aspects of radioisotopes, the physics of radiography, ultrasound, computed tomography, nuclear magnetic resonance, and the principles of digital systems as applied to radiology.
4.1 For *Physics*, emphasis is placed on a clear understanding of the physical basis of radiological practice in a qualitative manner, with sufficient knowledge of the basic principles of radiography,

ultrasound, computed tomography, magnetic resonance imaging and radionuclide imaging. The trainee is expected to have a broad understanding of the function of the components in the main types of imaging equipment. Training should also cover interaction of radiation with matter, its effects on irradiated materials, interaction of radiation with the patient, and radiation protection including relevant legislation. The trainee is expected to learn to explain the radiation risk and radiation protection guidelines to medical and radiographic staff as well as to patients, both for clinical practice and research purposes.

4.2 For *Anatomy*, the basic anatomy and normal variants relevant to the common imaging examinations should be acquired, as well as the radiological techniques required to demonstrate this anatomy.

4.3 For *Radiography*, the trainee is expected to know the positioning, centering or tube angulation for standard radiographic projections. He/she should be able to give practical advice on improving the quality of the resulting image.

4.4 For *Radiological Techniques*, there should be general knowledge of the contrast investigations, including barium studies, and imaging with radionuclides, ultrasound, computed tomography, digital systems and magnetic resonance. For everyday conventional examinations, familiarity and experience are expected; for less common investigations, knowledge in outline is required. Where there are alternative methods of studying a region their comparative merits should be appreciated. The trainee should be familiar with radiographic apparatus and related equipment, relative merits and choice of contrast media, technique-related drugs and radiopharmaceuticals, standard methods of resuscitation and management of contrast reactions.

5.0 There should be general knowledge of current clinical medicine, surgery and pathology, especially in relation to radiology.

5.1 A sound basic knowledge and application of general and special imaging methodology, including ultrasound, nuclear medicine, computed tomography, magnetic resonance imaging, vascular radiology and interventional radiology.

5.2 Interpretative skill on and judgement of the end products of imaging modalities, including correlative appreciation of the various modalities.

5.3 Planning and decision-making in imaging work-up to solve clinical problems.

5.4 A general awareness of current trends is desirable, including updated radiological literature and relevant statutory radiation protection measures.

6.0 During the whole period of clinical training, emphasis would be put on the cultivation of a high level of professional conduct and ethics. Communication skills would be developed to ensure sound communication among professionals and good patient-doctor relationship.

7.0 A trainee may enter any one of the 6 modules of Part IIA of the Fellowship Examination after 18 months of accredited training in Radiology, provided that he/she has passed the Part I Examination.

8.0 A trainee who passes the Part I Examination before December 2002 can sit the Part IIB of Fellowship Examination after 3 years of accredited training in Radiology, provided that he/she has passed the Part IIA Examination. From 2006, a trainee sitting the Part IIB of the Fellowship Examination must have completed 3.5 years of accredited training in Radiology, provided that he/she has passed all modules of Part IIA of the Fellowship Examination.

(C) *Higher Specialist Training*

1.0 This stage of training comprises two years of training.

1.1 For trainees who are permitted to sit the Part IIB of Fellowship Examination after 3 years of accredited training in Radiology, these two years of Higher Training are undertaken after passing the Part IIB examination.

1.2 For trainees who are permitted to sit the Part IIB of Fellowship Examination after 3.5 years of accredited training in Radiology, 18 months of Higher Training must be undertaken after the trainee has passed the Part IIB examination. 6 months of General Radiology training program are permissible prior to passing the Part IIB examination.

2.0 Emphasis will be made on providing the trainee with opportunities for practical experience, increased responsibility, independent thinking and action in various disciplines of Radiology through a system-based structured programme.

3.0 There should be in-depth knowledge and application of Conventional Radiology. Subspecialty development is also encouraged, with training and interest in more than one subspecialty.

4.0 All training programs (general or subspecialty training) should have prior accreditation by the College.

5.0 There should be knowledge of the ethical standards and legal responsibilities of radiology practice.

6.0 Active participation in intra- and inter-departmental clinico-radiology meetings is required.
7.0 Involvement in academic radiology with teaching commitments, research projects, presentation of papers at local and regional conferences, and contribution to literature are encouraged.
8.0 Training in relevant attributes including management, audit, quality assurance, research techniques, medicolegal responsibility, communication and resource application.

EXAMINATION FORMAT

1.0 The intermediate examination (Fellowship Examination) shall be in two parts.

2.0 *Format of Part I Fellowship Examination* :
2.1 One multiple choice question paper.
2.2 The examination shall test on the current ionising radiation legislation and practical elements of physic knowledge required to support clinical training and patient safety.
2.3 Candidates will be restricted to a maximum of 3 attempts at the examination..

3.0 *Format of Part II Fellowship Examination*.
3.1 Part IIA examination is in modular format, comprising 6 clinical modules, with one multiple choice question paper for each module.
3.1.1 Module 1: Chest and cardiovascular
Module 2: Musculoskeletal, including trauma
Module 3: Gastro-intestinal, including hepatobiliary
Module 4: Genito-urinary, obstetrics & gynaecology and breast
Module 5: Paediatrics
Module 6: Neuroradiology including spine, and head & neck including eyes, ENT and dental structures
3.1.2 Questions will cover general radiology and special imaging or procedures in each clinical module. Questions will also be set on clinical subjects and pathology, within the general framework of Radiology.
3.1.3 15-20% of the question parts in each module will address the basic sciences of physics, anatomy and techniques.
3.1.4 Until 2.5 years of training in Radiology (excluding the year of clinical experience), a candidate will be restricted to a maximum of 3 modules at each sitting
3.1.5 There will be no limit on the number of attempts.

3.2 Part IIB examination consists of a rapid reporting session, a reporting session and an oral examination.
3.2.1 In the reporting session of 45 minutes duration, candidates are required to provide reports on radiological cases. Each case comprises 1-4 films, with brief clinical details.
3.2.2 The cases are chosen so as to include a selection of the main subspecialties of Radiology. Cases are not of equal difficulty, and candidates should ensure that they allow sufficient time to report each case adequately.
3.2.3 Reports must be brief and relevant, and laid out to include the relevant positive and negative findings, an interpretation and a conclusion.
3.2.4 Recommendations for further appropriate investigation may be made, with the reasons for such suggestions clearly stated.
3.2.5 In the rapid reporting session of 30-minute duration, the candidates are required to classify 30 films into normal or abnormal groups, and to diagnose the pathology in the latter group.
3.2.6 The oral examination of one-hour duration consists of two 30-minute vivas each with a different pair of examiners.
3.2.7 During each of the two vivas a wide range of material of varying complexity will be shown. A higher level of performance will be expected in interpreting the common and routine examinations than will be the case with the highly specialized investigations.
3.2.8 Candidates will be given the opportunity to demonstrate their powers of observation and deduction, and a logical and informed approach to film interpretation. There should be a clear ability to debate the merits, relevance, and role of techniques, which might assist in further investigation of diagnostic problems.
3.2.9 There will be no limit on the number of attempts.

4.0 *Review of Performance at Examinations*

5.1 Candidates who fail the examination will be informed of their performance at each paper/session. It is expected that the designated training officer at each training centre will provide counselling.

5.2 After 3 unsuccessful attempts at either Part IIA or Part IIB Examination, a candidate's performance will be reviewed by the Chairman of the Education Committee, one examiner of the examination together with the trainee and the respective supervisor, to advise on the required improvement areas and remedial actions.

5.3 The Review Committee of the College will consider queries and appeals.

EXIT ASSESSMENT FOR COLLEGE FELLOWSHIP

1.0 After completion of the required period of Higher Specialist Training, a trainee can apply for consideration of the Fellowship of the College.

2.0 Exit Assessment exercises are conducted by the College twice a year, normally in January and July.

3.0 A panel of assessors comprising the following members would carry out a formal assessment of the trainee's completion of training:

(i) The Chairman of the Education Committee of the College.

(ii) Two other distinguished members of the trainee's profession, who should NOT be the trainee's supervisors, appointed by the Education Committee and approved by the Council.

4.0 The procedure of assessment would include:

(i) Scrutiny of the training records of the trainee for completeness of training.

(ii) Appreciation of the regular continuous appraisal reports of the respective supervisor.

(iii) Further supportive documents may need to be furnished by the trainee or the respective training centre on request.

(iv) A 30-minute oral assessment of the trainee by the panel of assessors will be held to evaluate the trainee's professional attitude, ability in communication skill, solving clinical or management issues and appreciation of radiology literature.

5.0 A trainee unsuccessful at an Exit Assessment, and the Head of the respective training department, will be informed of the Panel's comments on the weaknesses of the trainee and the advice on appropriate remedial actions.

SYLLABUS

1.0 PART I EXAMINATION

1.1 Fundamental Physics of Matter and Radiation

A. Basic Physics

Fundamental properties of matter and radiation decay
Interactions of ionising radiation with matter

The candidates shall be able to:

- *describe the structure of the atom, the types of radiation and the modes of radioactive decay*
- *understand the concept of half life*
- *give a basic description of the important electron and photon interactions with matter and state how they vary with energy and properties of the material*
- *describe attenuation in terms of absorption, scatter, HVL, and understand the inverse square law*

B. Radiation Hazards and Dosimetry

Biological effects of radiations
Risks of radiation
Principles of radiation protection

- Justification
- Optimisation
- Limitation

Absorbed dose, equivalent dose, effective dose and their units

The candidates shall be able to:

- *state the radiation quantities and units: activity, exposure, absorbed dose, equivalent dose, effective dose and the relationships between these quantities*
- *give a description of the biological effects of radiation on tissue*
- *understand and give examples of stochastic and deterministic effects of radiation*
- *demonstrate an awareness of the populations used to evaluate radiation risk, risk values and understand how factors such as age affect these values*
- *communicate the concept of radiation risk from medical exposures to patients.*

1.2 Practical Radiation Protection

General radiation protection
Radiation protection of the patient including pregnancy, infants and children

- Medical and biomedical research
- Health screening

Radiation protection of staff and members of the public
Use of radiation protection devices.

The candidates shall be able to:

- *communicate the concept of radiation risk from medical exposures to patients.*
- *understand the requirements and means for the protection of staff and members of the public arising from their use of radiation and the extent to which they are responsible for safety within the overall radiation protection framework*

1.3 Statutory Requirements and Non-Statutory Recommendations

A. Ionising Radiations Regulations 1999

Responsibility for radiation safety
Local rules and procedures
Role of radiation protection adviser and radiation protection supervisor

Classified workers
Restriction of exposure (through design, systems of work and ppe)
Dose limits
Equipment used for medical exposures
Notification of incidents
Dose constraints for comforters and carers
Routine inspection and testing of equipment
Notification of incidents

The candidates shall be able to:

- *demonstrate a thorough knowledge of the regulations governing the medical exposure of an individual and of their own and other people's responsibilities,*
- *understand their own responsibilities regarding the restriction of the environmental impact of their use of radiation*
- *describe the UK legislation affecting the use of ionising radiations in the medical environment.*

B. Ionising Radiation (Medical Exposure) Regulations 2000

Responsibilities of referrer, operator, practitioner, employer and medical physics expert
Patient identification and consent
Dose recording and diagnostic reference levels
Adequate training and local entitlement
Employers procedures
Quality assurance programmes, clinical evaluation of exposure and clinical audit
Notification of incidents
Research exposures, including ethics committees and dose constraints
Health screening

The candidates shall be able to:

- *To describe the UK legislation affecting the use of ionising radiations in the medical environment*
- *demonstrate a thorough knowledge of the regulations governing the medical exposure of an individual and of their own and other people's responsibilities,*
- *understand their own responsibilities regarding the restriction of the environmental impact of their use of radiation.*

C. Other relevant legislation

- Medicines (Administration of Radioactive Substances) Regulations 1978
- Radioactive Substances Act 1993, Hong Kong legislation.

The candidates shall be able to describe the various UK legislation affecting the use of ionising radiations in the medical environment.

1.4 Diagnostic Radiology and Radionuclide Radiology

A. Diagnostic Radiology

Production of X-rays
- General tubes
- Mammography

Radiological image
Factors affecting radiation dose and image quality
Quality assurance and quality control
Conventional film processing

The candidates shall be able to:

- *understand the basic physics of the production of x-rays*

- *describe basic measures of image quality*
- *have an overview of radiography physics with particular reference to factors affecting image quality and dose.*
- *understand the principles of diagnostic x-ray equipment sufficient to be able to describe factors affecting image quality and patient dose, to recognise artefacts and to be able to use equipment correctly*

B. Fluoroscopy and Fluorography

Image intensification
Operator controlled variables
Measurement of image quality
Factors affecting radiation dose and image quality

The candidates shall be able to:

- *describe basic measures of image quality*
- *have an overview of fluoroscopy physics with particular reference to factors affecting image quality and dose*
- *understand the principles of the equipment sufficient to be able to describe factors affecting image quality and patient dose, to recognise artefacts and to be able to use equipment correctly.*

C. Computed Tomography Scanning (Introduction)

Basic physics of CT
Factors affecting radiation dose and image quality

The candidates shall be able to:

- *have an overview of the physics of CT scanners with particular reference to factors affecting image quality and dose*
- *describe basic measures of image quality*
- *understand the principles of CT equipment sufficient to be able to describe factors affecting image quality and patient dose, to recognise artefacts and to be able to use equipment correctly.*

D. Patient Dosimetry

Methods
Diagnostic reference levels (including high dose techniques)
Magnitude and measurements

The candidates shall be able to:

- *describe the methods of output measurement*
- *describe the methods of patient dose measurement*
- *state the reference dose levels in different radiological examinations*
- *state the magnitude of patient doses in different radiographic, fluoroscopic, and CT examinations.*

E. Radionuclide Imaging (Introduction)

Fundamentals of diagnostic use
Properties of radiopharmaceuticals
Factors affecting radiation dose and image quality
Radiation protection requirements for

- Conception, pregnancy and breastfeeding
- Arrangements for radioactive patients
- Keeping of radioactive substances
- Disposal of radioactive waste

The candidates shall be able to:

- *have an overview of nuclear medicine physics with particular reference to factors affecting image quality and dose*
- *state the magnitude of patient doses in different radionuclide imaging studies*
- *understand the principles of radionuclide equipment sufficient to be able to describe factors affecting image quality and patient dose, to recognise artefacts and to be able to use equipment correctly.*

2.0 PART II EXAMINATION

2.1 Radiological Anatomy

MODULE 1: Thorax and Cardiovascular

- Anatomy of the heart, coronary arteries, aorta, vascular structures of the thorax and mediastinum, as demonstrated by radiography, contrast studies and cross sectional imaging
- Anatomy of the lungs, including segmental anatomy, bronchial tree and pleura, as demonstrated by radiography, bronchography and cross-sectional imaging
- Anatomy of arterial, venous and lymphatic systems of the whole body

MODULE 2: Musculoskeletal

- Anatomy of the skull and facial bones
- Anatomy of the axial skeleton, thoracic rib cage and pelvis, including knowledge of the major ossification centres with times of fusion and the common anomalies and variants that may mimic disease
- Anatomy of the muscles and other soft tissues, as demonstrated by ultrasound, CT and MRI

MODULE 3: Gastro-intestinal

- Anatomy of the salivary glands, as demonstrated by sialography and cross-sectional imaging
- Anatomy of the oropharynx, oesophagus, stomach, duodenum, small bowel and colon, as demonstrated by radiography, contrast studies and cross-sectional imaging
- Cross-sectional anatomy of the liver, gall bladder and biliary tree, pancreas and spleen, as demonstrated by ultrasound, CT and MRI
- Anatomy of the peritoneum and retroperitoneum, as demonstrated by cross sectional imaging
- Anatomy of the biliary tree, as demonstrated by direct cholangiography and ERCP, ultrasound and MRCP
- Anatomy of the vascular supply of the upper abdominal viscera, as demonstrated by ultrasound, CT, MRA and angiography

MODULE 4: Genito-urinary, Adrenal, Obstetrics & Gynaecology and Breast

- Anatomy of the kidneys, ureters, bladder, male and female genital tracts, including the pregnant uterus
- Anatomy and dating of the developing normal fetus
- Anatomy of the female breast

MODULE 5: Paediatrics

- The normal appearances of the growing child, including epiphyseal ossification and common variants that may mimic disease. (Detailed knowledge of appearance of ossification centres is not required.)
- The neonatal brain, particularly as demonstrated by cranial ultrasound

MODULE 6: Central Nervous & Head and Neck

- Anatomy of the skull, facial bones and spine

- Anatomy of the brain, spinal cord and meninges, including cerebral and spinal vascular anatomy
- Anatomy of the thyroid and parathyroid glands
- Anatomy of the paranasal sinuses, teeth, pharynx and larynx
- Anatomy of the orbit, including the lacrimal apparatus

2.2 Radiological Techniques

Knowledge is required of the techniques listed below

MODULE 1: Thorax and Cardiovascular

- Plain film techniques for imaging the thorax, with knowledge of how variation in exposure factors influences the final image
- Basic knowledge of bronchography, coronary angiography and magnetic resonance angiography
- Cross-sectional imaging techniques in the thorax with specific reference to high resolution CT (HRCT)
- Angiographic techniques for imaging the aorta, great vessels and peripheral vascular system, with a knowledge of common interventional procedures
- Contrast venography of arms, legs and central veins
- Ultrasound imaging of arterial and venous systems, including uses and applications of Doppler, colour Doppler and power Doppler imaging
- Imaging of the lymphatic system, especially with radionuclide techniques

MODULE 2: Musculoskeletal

- Plain film techniques for imaging the skeletal system, including specific projectional techniques
- Ultrasound, CT and MRI techniques for the examination of the skeletal system and soft tissues
- Arthrographic techniques, including CT
- The use of radionuclide imaging in the skeletal system

MODULE 3: Gastro-intestinal

- Plain film radiography of the abdomen
- Contrast studies of the intestinal tract and salivary glands, including video studies of the upper gastro-intestinal tract and sialography
- Techniques for imaging the biliary tract, including ERCP and MRCP
- Common techniques for cross-sectional imaging of the gastro-intestinal tract and upper abdominal organs
- Optimisation of cross-sectional imaging for specific applications by manipulation of physical variables, eg ultrasound frequency, CT pitch
- Use of contrast agents in cross-sectional imaging of the abdomen
- Common diagnostic and therapeutic interventional procedures.
- Common radionuclide imaging techniques

MODULE 4: Genito-urinary, Adrenal, Obstetrics & Gynaecology and Breast

- Common contrast techniques for the examination of the renal tract, including intravenous urography, antegrade and retrograde pyelography, cystography, urethrography and nephrostogram
- CT urography and renal ultrasound, including Doppler
- Radionuclide techniques for revaluating renal function, excretion and micturition
- Ultrasound techniques for examining the male and female genital tracts, including endocavity examination of prostate and female pelvis

- Ultrasound of the pregnant uterus and developing fetus
- Ultrasound and contrast hysterosalpingography
- Mammography, ultrasound and MRI of the breast
- Nephrostomy insertion, ureteric stenting and renal biopsy procedures
- Breast biopsy techniques

MODULE 5: Paediatrics

- Plain radiographic techniques of chest, abdomen and skeleton
- Contrast studies of the gastro-intestinal and urinary tracts
- Common paediatric ultrasound techniques, including cranial, musculoskeletal, abdominal and pelvic studies
- CT and MRI examinations of the child
- Radionuclide imaging techniques
- Common paediatric interventional procedures

MODULE 6: Central Nervous & Head and Neck

- Plain radiography of the skull, facial bones and teeth
- Cross-sectional imaging with CT and MRI
- Imaging of the intracranial circulation, including intra-arterial angiography and CT and MR angiography
- Dacrocystography
- Myelography

2.3 Contrast Media, Radiopharmaceuticals and Drugs

2.3.1 Contrast media: The contrast media to be studied are those which relate to the practical procedures mentioned in 2.2. For each contrast agent the following are expected:

Official name
Doses, including doses for children.
Constitution (not the detailed formula).
Modes of administration and the clinical uses
Routes of elimination.
Relative advantages of the different types of media
Side effects and treatment of reactions
Contra-indications to use.

2.3.2 Radiopharmaceuticals: The choice of radiopharmaceuticals

2.3.3 Drugs: Some knowledge, including the dosage, is expected of those drugs commonly used in radiological practice:

Preparation of the gastro-intestinal tract, including drugs modifying bowel behaviour
Sedation before radiological procedures
Prophylaxis and treatment of adverse reactions to contrast media
Prophylaxis and treatment of reactions to radiological procedures other than to contrast, e.g. in phaeochromocytoma

2.3.4 Materials:

Instruments used in common special radiological studies, e.g. hysterosalpingogram, urethrogram, lymphogram, etc.
Catheters, guide-wires, sheaths, needles, etc. used in vascular and interventional studies.

2.4 Physics

2.4.1 General Remarks

(A) A basic knowledge of physics is assumed.

(B) The whole of the syllabus should be covered in approximately 20 hours of formal teaching. The hours indicated in brackets for each section are a guide as to how these 20 hours might be divided, with reference to the approximate depth of knowledge expected in the topic.

(C) A mathematical approach to the syllabus is inappropriate. The emphasis should be placed on a clear understanding of the physical basis of radiological practice in a qualitative sense. However, the knowledge of the approximate magnitude of quantities encountered in daily practice will be expected, e.g. percentage transmission of X-radiation through a patient; the activity of a radionuclide used for bone scanning.

(D) Equipment design and construction details will not be examined, but an understanding of the function of equipment components relevant to image formation may be tested. The trainee should possess sufficient knowledge to be able to discuss sensibly with radiographers and clinicians, to recognize artefacts and to use equipment correctly.

(E) Basic electricity, magnetism and mathematics are not included in the syllabus and questions on those subjects will not be included in the examination.

(F) During formal teaching, all physics demonstrations/practicals should have a direct relevance to everyday radiology.

2.4.2 Scope of the Syllabus

(A) THE X-RAY IMAGE (6 hours)
- (i) Geometric factors and magnification, effect of focal size, geometric movement and unsharpness.
- (ii) Conventional film/screen systems: basic structure; characteristic curve; latitude; density; speed; contrast and how to influence or manipulate it.
- (iii) Basic principles of image intensification. Operator-controlled variables.
- (iv) Principles of tomography, particularly CT, with emphasis on operator-controlled variables, e.g. slice thickness, partial volume effect, field size and effect on resolution, data storage and display, pixel/voxel, window width and level, grey scale, artefacts.
- (v) Basic principles of digital imaging, digital and computed radiography, and picture archiving and communications systems (PACS).
- (vi) Quality assurance.

(B) PRINCIPLES OF DIAGNOSTIC ULTRASOUND (5 hours)
- (i) The basic components and functions of an ultrasound system.
- (ii) Types of transducer and the production of ultrasound with emphasis on operator-controlled variables.
- (iii) The operational frequencies of medical ultrasound.
- (iv) The interaction of ultrasound with tissue, including biological effects.
- (v) The basic principles of A, B, M, real-time and duplex scanning.
- (vi) The basic principles of pulsed, continuous wave and colour Doppler ultrasound.
- (vii) Recognition and explanation of common artefacts.
- (viii) Quality assurance.

(C) MAGNETIC RESONANCE IMAGING (5 hours)
- (i) Basic principles and origin of the signal.
- (ii) Principles of basic sequences in clinical use and imaging modes.
- (iii) Physical principles of contrast media.
- (iv) Operator-controlled variables.
- (v) Common artefacts.
- (vi) Concept of T1, T2, proton density and effect of motion on signal.
- (vii) Hazards to patients, staff and passers by.
- (viii) Quality assurance.

(D) RADIONUCLIDE IMAGING (4 hours)
- (i) The function of a gamma camera.

(ii) Properties of radiopharmaceuticals.
(iii) Static and dynamic imaging.
(iv) Handling of radionuclides.
(v) Introduction to single photon emission computed tomography (SPECT) and positron emission tomography (PET).
(vi) Quality assurance.

2.5 Clinical Radiology

2.5.1 All aspects of Radiology, with emphasis on imaging management of patients.

2.5.2 General Radiology: A sound knowledge of the common aspects of Radiology that comprise the routine general work in most hospitals.

2.5.3 An appreciation of the role and scope of all available techniques, including highly specialized radiology in relation to the management of clinical problems.

2.5.4 Trainees will also be expected to demonstrate knowledge of:

(A) Clinical conditions in which radiology has a role in diagnosis or management.

(B) Applied pathology, where it contributes to a better understanding of radiological signs and methods of investigation.

(C) Aspects of the radiological sciences (e.g. physics and equipment), anatomy and techniques, sometimes to a level well beyond that which is required for the basic training, but only where relevant to the management of clinical cases or to the solving of diagnostic problems.

(D) Aspects of clinical medicine and pathology which are essential to the safest and effective conduct of interventional procedures performed for diagnosis or for treatment.

(E) The definition and meaning of the basic statistical terms which are necessary for understanding and evaluating statistical claims in published papers. Attendance of the medical statistics sessions in the Clinical Oncology Part I Training Course, or equivalent courses, is advisable.

(F) Current trends and recent advances in all fields of Radiology.

2.5.5 A trainee on completion of training is expected to be able to undertake and report most ultrasound examinations without direct supervision.

(A) A broad experience of ultrasound examinations of various regions of the body should be gained, including abdominal, gynaecological, obstetric, urogenital, vascular, joint and neonatal cranial ultrasound examinations.

(B) The trainee should spend at least 75 hours undergoing practical training in obstetric ultrasound, including the technique for examination of first trimester pregnancies.

2.5.6 The trainee should receive basic instruction in the frequently performed angiograms such as aortogram, lower limb angiogram and selective visceral angiogram; and interventional procedures such as percutaneous nephrostomy and abscess drainage.

3.0 HIGHER TRAINING PRIOR TO EXIT ASSESSMENT

3.1 The two years of Higher Training should consist of General Radiology, Subspecialty Training (this refers to training for knowledge and skill in a subspecialty, and not total training for accreditation in that subspecialty), and training in relevant attributes.

3.2 For a broad knowledge-based exposure, the two years of training should consist of :

(A) Minimum of 6 months full time General Radiology.

(B) Minimum of two Category A subspecialty subjects (well-recognized radiology subspecialties including Breast Radiology, Gastrointestinal Radiology, Genitourinary Radiology, Head & Neck Radiology, Interventional & Vascular Radiology, Musculoskeletal Radiology, Neuroradiology and Paediatric Radiology), of which one subject should be of 6-month duration.

(C) Remaining period of training in General Radiology, Category A subspecialty subjects, Category B subspecialty subjects (technique-based subspecialties including Ultrasonography, CT, MRI and Nuclear Medicine) or Category C subspecialty subjects (subjects related to clinical subspecialties particularly strong at a hospital, for instance Transplantation Radiology, Intensive Care Imaging, Oncologic Radiology).

3.3 Higher General Radiology Training:

(A) The program should differ from Basic General Radiology Training, with emphasis on independent performance and supervising responsibility.

(B) The program should be arranged with designated assignments and rotations.

(C) Teaching activities (to clinicians, younger trainee radiologists, radiographers, nurses and medical students) to attain in-depth knowledge of a subject and to improve on presentation skills.

(D) Management of and contribution to film museum and teaching files.

(E) Audit and quality assurance activities.

(F) Academic radiology: research techniques, presentation skills, literature review.

(G) Nurture of professional attitude (ethical standards, legal responsibility, professional image, contribution towards professional organizations and activities, co-ordination with clinical colleagues for better healthcare).

(H) Administrative skills and practice.

3.4 Subspecialty Training:

(A) Structured program conforming to the College guidelines for the specific subspecialty, including the defined minimum workload.

(B) Five or more service sessions weekly specific for the subspecialty is advisable.

(C) For Category A subspecialty subjects, related application with multiple imaging modalities should be built into the program. If certain modalities are not available at the specific hospital, sessional attachment to another hospital is advisable.

(D) Two or more trainers are desirable for each subspecialty.

(E) A trainer of a subspecialty program should have previous training in the subspecialty, reasonable years of experience in the subspecialty, major portion of clinical practice being in the subspecialty, related publications and presentations, and regular attendance of related subspecialty conferences in recent years.

(F) Subspecialty clinico-radiological conference related to Category A subjects should be available on a regular basis, at least once every fortnight, with presentation by the trainee of at least 2 cases per conference.

3.5 At least one research project is to be presented by the trainee at College Annual Scientific Meeting (or regional / international radiology conferences) and published / accepted for publication (in the Journal of the College or other professional journals).