الهيئة السعودية للتخصصات الصحية
Saudi Commission for Health Specialties

MEDICAL PHYSICS FOR DIAGNOSTIC RADIOLOGY

2024


بسم الله الرحمن الرحيم

PREFACE

- The primary objective of this document is to enrich the training experience of postgraduate trainees by outlining the learning objectives to gain independence and competency as future practitioners.
- This curriculum may contain sections outlining some regulations of training; however, such regulations must be sought from the “General Bylaws of Training in Postgraduate Programs” and “Executive Policies” published by the Saudi Commission for Health Specialties (SCFHS), which can be accessed online through the official SCFHS website. The statements listed in the most updated bylaws and executive policies will be the reference to apply in the case of discrepancies between regulation statements.
- This curriculum is subjected to periodic refinements. Please refer to the electronic version posted online for the most updated edition (www.scfhs.org.sa)

I. CONTRIBUTORS

This curriculum was prepared by the Curriculum Development Committee of the Specialty:
• Abdullah Abujamea, PhD. • Fares Mayiah, PhD. • Refaat Al-Mazrou, M.Sc. • Nabil Ozair, MD.
Reviewed and Approved by the Scientific (Council/Committee) Members of the Specialty:
• Ahmed Masawi, M.Sc. • Dr. Ismail AlDahlawi, PhD • Dr. Sultan Alghamdi • Dr. Jafar Faqeeh • Dr. Jameelah Alrashdi
Advisory Committee Members (Curriculum Review Committee members):
• Mazen Alqasmi MBBS, Msc.MedED, SBEM • Nada Saleh Msc.MedEd, MSc, PhD • Ali M Alrehaily M.D., FRCPC., FACR.,MMedEdu
Approved by the Head of the Curricula Review Committee:
• Dr. Ali Alyahya MD, MME, FRCSC

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1. Belal Moftah, PhD, FCCPM
2. Salah Bamajboor, MSc, MIPEM
3. Refaat Almazrou, MSc, FIPEM
4. Abdullah Alrushoud, PhD
5. Wamied Abdel-Rahman, PhD, FCCPM, DABR
6. Waleed Al-Najjar, PhD, DABR, DABMP
7. Salem Sassy, PhD, FIPEM
8. Shada Wadi-Ramahi, PhD, DABR
9. Konstantinos Chantziantoniou, MSc, DABR
10. Dr. Ali Zailai
11. Dr. Khalid Alzimami
12. Dr. Khalid Alyousef

II. COPYRIGHT STATEMENTS

We would also like to acknowledge that the CanMEDS framework has been copyrighted by the Royal College of Physicians and Surgeons of Canada. Many of the descriptions of the competencies have been acquired from their resources. (Please refer to: CanMEDS 2015 physician competency framework; Frank JR, Snell L, Sherbino J, editors. *CanMEDS 2015 Physician Competency Framework*. Ottawa: Royal College of Physicians and Surgeons of Canada; 2015.).

Correspondence: Saudi Commission for Health Specialties P.O. Box: 94656 Postal Code: 11614 Contact Center: 920019393

E-mail: Curricula@scfhs.org.sa

Website: www.scfhs.org.sa

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IV. INTRODUCTION

1. Context of Practice

Medical Physics is the application of the concepts and methods of physics to the diagnosis and treatment of human diseases. Thus, medical physicists play an important part in modern medicine.

Medical physicists who specialize in diagnostic radiology are referred to as “Diagnostic Radiology Medical Physicists.” They are a part of the diagnostic radiology multidisciplinary team dedicated to providing safe and effective diagnosis when using medical imaging modalities.

The Saudi Board of Medical Physics for Diagnostic Radiology aims to produce qualified medical physicists who practice and meet the healthcare requirements of society in a safe manner. This training program aims to pave a path for general medical physicists to gradually improve in their specialties and graduate to a higher grade following completion.

Several countries in the western world have introduced fellowship specialties for health science graduates. Some residency programs typically span 2 years; however, they may extend up to 3 years. An example of such a training program is the well-structured CAMPEP-accredited residency programs.

Residency training in clinical diagnostic radiology medical physics provides educational experiences that prepare residents to be competent Medical Physicists who are capable of providing comprehensive and coordinated care to a broad range of radiation medicine disciplines. Residents must become sufficiently familiar with the fields of radiation to facilitate participation as team members in Saudi healthcare. Residents are provided with the opportunity to work with other members of the healthcare team in inpatient and outpatient settings to become proficient leaders in the organization and facilitate systematic improvement of the various processes constituting patient care. Residents must have a progressive educational experience with increasing patient care responsibility during the 3-year training period. Emphasis will be placed on developing the competence of the residents in assessment, management, communication, and interpersonal skills through all 3 years of training. Training will be conducted under the supervision of general and subspecialty Qualified

Medical Physics faculty to maintain high levels of competencies at regular intervals.

The training program for Medical Physics for Diagnostic Radiology is a unique program that adapts the Canadian Medical Education Directives for Specialists (CanMEDS) framework. The CanMEDS framework has been applied to postgraduate training programs in several countries, as it offers a model of competencies that emphasizes medical expertise and multiple additional non-medical expert roles that aim to serve the needs of society competently. Therefore, the Saudi Commission for Health Specialties (SCFHS) has adopted the CanMEDS framework to establish a core curriculum for all training programs. The residents in the field of diagnostic radiology medical physics will serve within the seven CanMEDS roles, namely medical expert, communicator, collaborator, leader, health advocate, scholar, and professional.

The Medical Physics for Diagnostic Radiology Program comprises 3 years of full-time supervised residency training in medical physics and its specialties. The training institution must be accredited by the SCFHS to offer the Saudi Board Program in Medical Physics. Comprehensive training will be offered. Medical physics residents must be actively involved in patient care, with their responsibility increasing as further experience and competence are gained. Medical physics residents must adhere to the rules and regulations of the training program.

These residents will be awarded the “Medical Physicist for Diagnostic Radiology” qualification upon successful completion of this training program. The graduate must possess a degree of competency and experience considered adequate to practice diagnostic radiology medical physics and will become eligible for a position in the Department of Medical Physics and Radiology as a Medical Physicist Consultant after fulfilling the requisite years of experience by the SCFHS. They will be consulted regarding the selection of appropriate examinations and post-processing, education of residents and staff, research in developing and discovering new methods of optimizing protocols, and leading implementation of quality patient care.

The program encompasses the theoretical and practical parts to strengthen the knowledge and skills of the candidate to manage advanced techniques in each medical imaging specialty.

This curriculum aims to define the process of training and the competencies required for the award of the Saudi Board Certification in Medical Physics for Diagnostic Radiology. A medical physics graduate will possess the

competencies required to work as a Qualified Diagnostic Radiology Medical Physicist (QDRMP) post-training.

2. Goals and Responsibilities of Curriculum Implementation

This curriculum strives to guide trainees to become competent in their respective specialties. This goal requires a significant amount of effort and coordination from all stakeholders involved in postgraduate training. Trainees must be proactive, fully engaged, and exhibit the following characteristics: careful understanding of learning objectives, self-directed learning, problem-solving, eagerness to apply acquired knowledge, and self-awareness and willingness to ask for support when necessary. The Program Director plays a vital role in facilitating the successful implementation of this curriculum. Moreover, the training committee members, particularly the Program Administrator and Chief Resident, play a significant role in program implementation. Trainees must share responsibilities with trainers in curriculum implementation.

The strategic direction of the SCFHS applies a recognized competency model of training governance to achieve the highest quality of training. The curriculum for postgraduate programs must include research and evidence-based practice, academic affairs in training supervision, and implementation. The Scientific Council updates the content of this curriculum consistently to match the highest standards in postgraduate education for each specialty.

V. ABBREVIATIONS USED IN THIS DOCUMENT

Abbreviation	Description
SCFHS	Saudi Commission for Health Specialties
CT	Computed Tomography
MRI	Magnetic Resonance Imaging
US	Ultrasonography OR Ultrasound
NM	Nuclear Medicine
CAMPEP	Commission on Accreditation of Medical Physics Education Programs
CanMEDS	Canadian Medical Education Directives for Specialists
QC	Quality Control
R(1)	(First) year of residency
R(2)	(Second) year of residency
R(3)	(Third) year of residency
OSCE	Objective Structured Practical Examination
SOE	Structured Oral Exam
Mini-CEX	Mini-Clinical Experience report
DOPS	Direct Observation of Procedural Skills report

Abbreviation	Description
CBD	Case-Based Discussion report
CBE	Competency-Based Education
ITER	In-Training Evaluation Report

VI. PROGRAM ENTRY REQUIREMENTS

The SCFHS stipulates that 3 years of post-graduation experience is required to apply for the Medical Physics for Diagnostic Radiology Medical Physics Residency Program. The objective is to gain experience in a wide field of clinical practice in an approved medical physics department.

A resident in this program must:

- Have a university degree in medical physics or general physics
- Have a minimum of a Masters degree in medical physics
- Pass an admission examination and interview
- Comply with any applicable SCFHS Credentialing Criteria.

Note: Clinical experience during any graduate program is NOT counted towards the 3-year residency

VII. LEARNING AND COMPETENCIES

1. Introduction to learning outcomes and competency-based education

Training must be guided by well-defined "*learning objectives*" driven by targeted "*learning outcomes*" of a particular program to serve the needs of a specific specialty. The learning outcomes must reflect the professional "*competencies*" and tasks to be "*entrusted*" to the trainees upon graduation. This ensures that the graduates will meet the expected demands of the healthcare system and patient care in relation to their particular specialty. *Competency-based education* (CBE) is an approach to "*adult-learning*" based on achieving *pre-defined*, *fine-grained,* and *well-paced* learning objectives that are driven by complex professional competencies.

Professional competencies related to healthcare are usually complex and comprise a mixture of multiple learning domains (knowledge, skills, and attitude). CBE aims to change the traditional approach to postgraduate education. For instance, time of training, although a precious resource, must not be considered a proxy for *competence* (e.g., time of rotation in certain hospital areas is not the primary marker of competence achievement). Furthermore, CBE emphasizes the critical role of the informed judgment of the learner's competency progress, which is based on a staged and formative assessment driven by multiple workplace-based observations. Several CBE models have been developed for postgraduate education in healthcare (e.g., CanMEDS by the Royal College of Physician and Surgeon of Canada [RCPSC], the CBME-Competency model by the Accreditation Council for Graduate Medical Education [ACGME], tomorrow's doctor in UK and multiple others). We strive to incorporate the CanMEDS framework into this curriculum. The following concepts have been incorporated to enhance the implementation of CBE in this curriculum:

- **Competency:** Competency, a cognitive construct assessing the potential to perform efficiently in a given situation, is based on the standard of the profession. Professional roles (e.g., medical expert, health advocate, communicator, leader, scholar, collaborator, and professional) define competency roles to make them mendable for learning and assessment.

- **Milestones**: Milestones are stages along the developmental journey throughout the competency continuum. Trainees will be assisted in their transformation from (novice/supervised) to (master/unsupervised) practitioners throughout their learning journey, from junior and throughout senior levels. This should not undermine the role of supervisory/regulatory bodies toward the malpractice of independent practitioners. Milestones enhance the learning process by pacing the training/assessment to match the developmental level of trainees (junior vs. senior).
- **Learning-Domains:** Efforts should be directed to annotate the learning outcomes with the corresponding domain (K=Knowledge, S=Skills, and A=Attitude), where possible. More than one annotation may be assigned to a given learning outcome.
- **Content-area Categorization:** It is advisable to categorize the learning outcomes in broad content areas related to the practice of the profession. For instance, diagnostic vs. therapeutic, simple vs. complex, and urgent vs. chronic.
- Trainees are expected to progress from novice to mastery level through certain sets of professional competencies. The SCFHS has endorsed the CanMEDS to articulate professional competencies. This curriculum applies the principles of competency-based medical education. The CanMEDS framework has been adopted in this section.

This reference is an example of the general outline of the CanMEDS competency (Frank JR, Snell L, Sherbino J, editors. CanMEDS 2015 Physician Competency Framework. Ottawa: Royal College of Physicians and Surgeons of Canada; 2015)

2. Program Duration

The Diagnostic Radiology Medical Physics Program is a 3-year (R1 through R3) full-time residency in an accredited institution by SCFHS.

3. Program Rotations

Training Year	Mandatory core rotation*	
	Rotation name	Duration
R1	Hospital Orientation and Clinical awareness	8 weeks
	Radiation Protection and Safety	12 Weeks
	General Clinical Radiation Oncology Physics	4 Weeks
	General Clinical Nuclear Medicine Physics	4 weeks
	General Clinical Diagnostic and Imaging Physics	20 weeks
R2	General Radiography	12 Weeks
	Dental Radiography	2 Weeks
	Image Displays	2 Weeks
	Angiography and Fluoroscopy	8 Weeks
	Mammography	8 Weeks
	Computed Tomography	12 Weeks
	Other imaging devices	4 weeks
R3	Nuclear Medicine	8 Weeks
	Ultrasound (US)	10 Weeks
	Magnetic Resonance Imaging	14 Weeks

Training Year	Mandatory core rotation*	
	Rotation name	Duration
	Clinical Physics Practice, Clinical Project and Final Residency Report	16 weeks

- Considering 4 weeks per year for vacation

4. Mapping of learning objectives and competency roles to program rotations:

The overall objective of the program is to produce an independent medical physicist who is a lifelong learner capable of working unsupervised within a multidisciplinary team at a safe and highly professional standard. This can be achieved by enrolling medical physics residents in a well-structured comprehensive residency-training program, such as Clinical Diagnostic Radiology Medical Physics, certified by the SCFHS.

The Diagnostic Radiology Medical Physics Program prepares residents to:

- Plan and provide routine and complex medical physics care to various patients through the application of advanced knowledge and clinical skills
- Keep abreast with modern technologies in medical physics
- Communicate, understand, and function effectively with other healthcare professionals and understand the setting of their organizational system
- Acquire experience in teaching and research to enhance clinical knowledge

Objectives and competency of specific program rotation

1. Rotation Name: Hospital Orientation and Clinical awareness

Training Level: R1

Duration: 8 Weeks

The resident will acquire knowledge regarding the following topics during this rotation:

- Hospital and medical orientation

- Types of medical images
- Radiological anatomy and physiology
- Radiobiology and epidemiology
- Signal acquisition methods
- Ethics and codes of behavior
- Hospital and medical orientation
- Responsibility to society
- Patient care
- Duties and responsibilities
- Interaction with multidisciplinary teams

Knowledge & Skills

The trainee must be capable of the following tasks at the end of this rotation:

- Recognize appropriate clinical dress code
- Compare appropriate hygiene and infection control procedures
- Identify different types of medical images
- Describe radiological anatomy and physiology
- Analyze radiobiology and epidemiology
- Demonstrate an understanding of radiation biology
- Identify the etiology of disease and epidemiology
- Demonstrate an understanding of the interaction between physiology and medical imaging
- Differentiate the underlying physical principles and signal acquisition methods utilized by various medical imaging modalities
- Describe typical physiology on nuclear medicine (NM) and PET images or other dynamic imaging modalities
- Ensure good patient experience
- Illustrate the interactions, duties, and responsibilities of multidisciplinary caregiver teams
- Attend to the needs of the patient by building strong relationships, privacy, and confidentiality
- Demonstrate an understanding of the written procedures of a hospital and departmental quality management system
- Manage the interactions between patients and staff

2. Rotation Name: Radiation Protection and Safety

Training Level: R1

Duration: 12 Weeks

The resident will acquire knowledge regarding the following topics during this rotation:

- Dosimetry regulations
- Dosimetry methods
- Radiation quantities
- Radiation monitoring and hazard
- Radiation protection principles (time, distance, and shielding)
- Personal protective equipment
- Radiation survey equipment
- Regulatory requirements and guidelines
- Engineering radiation controls
- Classification and labeling of radiation-controlled areas
- Handling radiation and radioactive sources and waste

Knowledge & Skills:

The trainee must be capable of the following tasks at the end of this rotation:

- Define dosimetry regulations for workers exposed to radiation with specific considerations for trainees and pregnant women
- Describe the theory, principles of operation, and limitations of film-based dosimeters, electronic personnel dosimeters, thermoluminescent dosimeters, OSL & RPL dosimeters, and calculation methods
- Enumerate the basic operational quantities and their relationship with effective dose, personal dose equivalent, and ambient dose equivalent
- Illustrate the principles of whole body and extremity monitoring
- Recognize the differences between occupational doses according to radiological procedures
- Enumerate the requirements for record keeping and dose watch systems
- Recognize the radiation hazard assessment principles and methodologies for hazard assessment

- Define radiation protection principles (justification, optimization, limitation, time, distance, and shielding)
- Identify dose constraints and reference levels
- List the regulatory requirements and guidelines
- Compare the hazards of ionizing and non-ionizing radiation
- Illustrate and implement appropriate engineering controls (including shielding) to reduce exposure to the staff and public
- Classification and labeling of radiation-controlled areas
- Ensure appropriate installation of signage in all areas with radiation risk
- Select appropriate personal protective equipment
- Assess the radiation dose and its impact
- Handle radiation and radioactive sources safely
- Selection of the radiation survey/contamination equipment
    - Types and their use
    - Calibration certificates
- Select personnel monitoring methods/tools
    - Types of devices
    - Management of records
- Determine the radiation dose limits
- Implement general radiation shielding principles in clinical practice
- Application of statistics to radiation and medical imaging
- Investigate sealed source leak by implementing appropriate testing tools
- Identify internal and external exposure to radiation
- Manage radioactive waste safely
- Follow national and international recommendations and local protocols for quality management
- Demonstrate an understanding of the written procedures of a departmental quality management system
- Evaluate and prevent the risks associated with a given procedure or protocol
- Prevent, investigate, and evaluate incidents in the radiology department and implement corrective actions
- Identify and manage the risks associated with medical imaging

- Manage and formulate plans to respond to emergency situations
- Advise on the use of personal protective equipment, including protective garments and fixed and mobile shielding devices
- Demonstrate knowledge of ethical biomedical research practices, including radiation protection for patients and volunteers

3. Rotation Name: General Clinical Radiation Oncology physics

Training Level: R1

Duration: 4 Weeks

The resident will acquire knowledge regarding the following topics during this rotation:

- Health specialists in radiation oncology
- Role of a radiation oncology physicist
- Radiotherapy systems (linear accelerators, brachytherapy units, and simulators)
- Imaging systems in treatment units
- Simulation systems in radiotherapy
- Quality assurance devices and procedures
- Radiation protection devices

Knowledge & Skills:

The trainee must be capable of the following tasks at the end of this rotation:

- Describe the role of a radiation oncology physicist
- Identify the linear accelerators and other systems for MV X-ray and electron beams
- Identify stereotactic radiation devices
- Compare imaging systems on treatment units: electronic portal imaging devices, kV-MV cone beam computed tomography (CT), opto-electronic systems, stereoscopic X-ray imaging systems, in-room CT, and radiofrequency-based and ultrasound devices.
- Demonstrate quality assurance methods used in radiotherapy

4. Rotation Name: General Clinical Nuclear Medicine physics

Training Level: R1

Duration: 4 Weeks

The resident will acquire knowledge regarding the following topics during this rotation**:**

- Health specialists in nuclear medicine
- Role of a nuclear medical physicist
- Radiation sources (devices and radioisotopes)
- Quality assurance devices
- Radiation protection devices

Knowledge & Skills:

The trainee must be capable of the following tasks at the end of this rotation:

- Recognize the differences between NM and X-ray imaging
- Describe the advantages and disadvantages of NM modalities
- Define the physics of SPECT, SPECT/CT, and PET/CT equipment.
- Recognize the dosimetry and protection differences between NM and radiology (patient and staff).
- Explain the role of medical physicists in NM.
- Demonstrate the QC procedures used in NM

5. Rotation Name: General Clinical Diagnostic Imaging Physics

Training Level: R1

Duration: 20 Weeks

The resident will acquire knowledge regarding the following topics during this rotation**:**

- Health specialists in radiology
- Role of a diagnostic imaging physicist
- Imaging devices (ionizing and non-ionizing radiation-based)
- Performance testing of imaging equipment
- Radiation protection devices
- Quality management of the systems used in radiology
- Acceptance and commissioning of imaging equipment
- QC testing of imaging equipment
- Imaging informatics
- Department design
- Exposure to R2 & R3 Diagnostic Imaging Physics Modules

Knowledge & Skills

The trainee must be capable of the following tasks at the end of this rotation:

- Apply the physics and principles of the entire 'image chain' for all modalities, including acquisition, reconstruction, processing, display, and post processing

- Describe the hardware and software design of the imaging equipment
- Define the fundamentals of planar and projection imaging
- Demonstrate the principles of tomographic imaging
- Discuss technical challenges with engineers (e.g., recalibration or replacement of parts)
- Use imaging equipment safely
- Assess the radiation dose and image quality
- Propose measures to improve image quality
- Support clinical research and multicenter trials

6. Rotation Name: General Radiography

Training Level: R2

Duration: 12 Weeks

The resident will acquire knowledge regarding the following topics during this rotation:

- Production of X-rays: Continuous radiation or Bremsstrahlung characteristic radiation
- Effect of kV, mA, exposure time, filtration, and voltage waveform on the radiation output and image
- X-ray tube theory of operation: principal types and their construction, line focus principle, heel effect, causes of failure, and tube rating
- Generator waveforms: Single-phase generators, three-phase generators, 6- and 12-pulse generators, medium- and high-frequency generators, capacitor discharge generators, and falling load generators, and exposure timers
- Scatter Reduction Techniques: Bucky motion, grids (types, characteristics, and performance), air gaps, and effect on image quality and patient dose
- Tomography (optional): Linear and other tomography, blurring, and concept of section thickness

Knowledge & Tasks

The trainee must be capable of the following tasks at the end of this rotation:

- Describe the x-ray production techniques
- Identify the effects of exposure parameters on radiation output

- Explain the theory of x-ray tube operation
- Illustrate the scatter reduction techniques
- Perform acceptance and annual compliance testing of general radiographic systems
- Perform acceptance and annual testing of digital detector systems, including computed radiography and direct and indirect digital detector systems
- Determine the entrance skin exposure associated with radiographic examinations
- Estimate the patient radiation organ dose and relate the dose to the potential risks associated with radiographic examinations
- Evaluate the radiation dose according to the concepts and relate the dose to the potential risks associated with radiographic examinations
- Describe the complete radiographic imaging chain from the production of x-rays to image formation
- Identify the origin of radiographic contrast and the mechanisms that compromise and enhance contrast
- Define the methods of exposure control in general radiography
- Identify and analyze image artifacts
- Describe the image acquisition protocols, preprocessing of image data, image reconstruction principles, and postprocessing of images
- Operate the X-ray units at a basic level for quality control, image quality assessment, and dosimetry
- Set and compare specifications

7. Rotation Name: Dental Radiography

Training Level: R2

Duration: 2 Weeks

The resident will acquire knowledge regarding the following topics during this rotation:

- Applications of dental radiography
- Types of x-ray machines used in dental radiography
- Components of digital radiography machines
- Acceptance testing procedures for dental radiography

- Advanced techniques in dental radiography
- Radiation and exposure control in dental radiography

Knowledge & Tasks

The trainee must be capable of the following tasks at the end of this rotation:

- Explain the importance and uses of dental radiographs
- List and describe the different types of dental x-ray films and digital imaging used in dentistry and match their indications
- Recognize the advanced imaging modalities used in maxillofacial imaging, as well as their indications, uses, and limitations
- Identify the components of the x-ray machine and explain the production of x-ray beams
- Identify and differentiate between various dental film-holders and devices
- Identify and classify the various types and composition of dental x-ray films
- Demonstrate the differences between two-dimensional x-ray and panoramic x-ray machines
- Describe the complete radiographic imaging chain from the production of x-rays to image formation
- Identify the origin of radiographic contrast and the mechanisms that compromise and enhance contrast
- Define the methods of exposure control in dental radiography
- Perform acceptance and annual testing of dental x-ray systems
- Set and compare specifications

8. Rotation Name: Images Displays and Image Processing

Training Level: R2

Duration: 2 Weeks

The resident will acquire knowledge regarding the following topics during this rotation:

- Image characteristics:
  - Aspect ratio
  - Spatial resolution, matrix size, pixel dimensions, size, and pitch
  - Contrast resolution

- Luminance, pixel intensity, and color

- Viewing conditions:
  - Ambient lighting (peripheral glare)
  - Viewing angle/on-axis viewing (viewing direction)
  - Veil glare
- Types of monitors:
  - Liquid crystal displays (LCD)
  - Light emitting diodes (LED)
  - Active-matrix arrays
- Operator Processing (post-processing):
  - Windowing, display brightness (window level), and display contrast (window width)
  - Spatial domain processing, look-up table (LUT) reprocessing, and equalization
  - Spatial frequency processing: Low-frequency (smoothing) and high-frequency (edge enhancement)
  - Image reformatting: Electronic masking, magnification/zoom/pan, rotation, image flip, region of interest (ROI), and field of view (FOV)
- Measurement:
  - Clinically relevant technical parameters
  - Viewing environment
  - Test patterns
  - Grayscale standard display function (GSDF)
  - Artifacts
  - Uniformity
  - Geometric distortion (for CRT only)

Knowledge & Skills

The trainee must be capable of the following tasks at the end of this rotation**:**

- Describe the human visual system, visual performance in imaging tasks, and the statistical methods used to assess display performance
- Analyze the quality control tests for processors and printers
- Describe the methods for acceptance and quality control testing of image printers

- Describe the methods of identifying and isolating common artifacts from processors, laser printers, and displays
- Evaluate the viewing conditions and ambient illumination in a room
- Assess the display quality of imaging workstations used for primary interpretation and secondary review
- Explain the contrast transfer function for diagnostic display
- Demonstrate the methods of clinical image processing
- Distinguish between different applications of image display systems
- Coordinate the acceptance and constancy testing of image display systems
- Enumerate the clinical applications of image processing
- Perform acceptance and constancy tests of diagnostic image display systems
- Describe the operation of sensitometers, densitometers, daylight film loaders, and darkroom processors

9. Rotation Name: Angiography and Fluoroscopy

Training Level: R2

Duration: 8 Weeks

The resident will acquire knowledge regarding the following topics at the end of this rotation:

- X-ray generation and dose control:
  - Design & operation: Tube design, collimation, grid characteristics, and performance.
- Image receptors:
  - Design & operation: Image intensifier and TV camera (video output), image intensifier and TV camera (digital output), flat panel detectors (digital), and emerging detection systems
  - Performance characteristics: video camera performance characteristics, conversion efficiency (II), veiling glare (II), contrast ratio, distortion, CNR (digital), limiting resolution, MTF, noise power spectra, and NEQ/DQE.
- Controlling the fluoroscopic image:
  - Pulsed vs. continuous fluoroscopy
  - Automatic control modes: control of kV, mA, pulse length, and video voltage
- Viewing the fluoroscopic image:
  - Image display devices
  - Spot film cameras
- Image processing techniques:
  - Digitized image
  - Logarithmic processing
  - Image noise
  - Mask subtraction
  - Pixel shifting
  - Temporal filtering
  - Edge enhancement and image enhancement

- Contrast agents:
  - Basic physical properties & safety aspects
  - Types of contrast studies: Iodine and Barium

Knowledge & Skills

The trainee must be capable of the following tasks at the end of this rotation**:**

- Explain the complete fluoroscopic imaging chain from the production of x-rays to image formation
- Describe X-ray generation and dose control of fluoroscopy systems
- Configure and operate fluoroscopic systems with appropriate regard for radiation safety
- Determine the entrance exposure rate for fluoroscopic examinations conducted using fluoroscopic and x-ray interventional systems
- Estimate the patient ionizing radiation dose and the risk associated with fluoroscopic examinations
- Evaluate the ionizing radiation dose to conceptus and the risks associated with fluoroscopic examinations
- Describe the composition and uses of radiographic contrast agents in fluoroscopy and angiography examinations
- Describe the effects of the choices made by the operator on the patient dose and image quality
- Explain the methods of exposure control in fluoroscopic systems using image intensifiers and flat-panel receptors
- Perform acceptance and compliance testing of fluoroscopic and interventional x-ray systems
- Identify special requirements with regard to radiation protection in fluoroscopy, particularly in X-ray-guided interventions
- Optimize radiation protection in high-dose or high-risk procedures
- Set and compare the specifications required for different sites and applications

10. Rotation Name: Mammography

Training Level: R2

Duration: 8 Weeks

The resident will acquire knowledge regarding the following topics at the end of this rotation:

- Mammography: Introduction to breast pathology
- Differentiate between symptomatic and screening breast imaging
- Basic principles of soft-tissue imaging:
  - Contrast improvement at low kVp
  - Image contrast as a function of radiation absorbed dose
  - Geometric blurring as a limiting factor
- Basic principles of the mammographic system:
  - Target/filter combinations including emission spectra
  - Compression
  - Magnification technique
  - AEC design
  - Scatter rejection
  - Image receptor design
  - Screen-film system and processing
  - Digital image receptors
- Image display
- Image performance criteria
- Alternative Imaging Modalities

Knowledge & Skills

The trainee must be capable of the following tasks at the end of this rotation**:**

- Identify the breast pathology
- Differentiate between symptomatic and screening breast imaging
- Explain the basic principles of soft-tissue imaging
- Define the complete mammographic imaging chain from the production of x-rays to image formation
- Identify the origins of radiographic contrast and mechanisms that compromise and enhance contrast
- Determine the mean glandular dose for mammography examinations

- Review the quality control procedures and records for mammography systems
- Evaluate the viewing conditions for evaluating or interpreting mammography images
- Describe the exposure control methods in mammography and the purpose of breast compression
- Describe the relationships between radiation dose and image quality and the effect of x-ray technique factors and image receptors on these relationships
- Perform acceptance and annual compliance testing of mammography systems (including digital and, if available, film/screen mammography systems)
- Perform acceptance and annual compliance testing of stereotactic biopsy mammography systems
- Identify the effect of compression in mammography
- Familiarize themselves with computer aided diagnosis in mammography
- Demonstrate familiarity with image guided biopsies
- Describe tomosynthesis in mammography
- Set and compare specifications and advice on the purchase and use of a mammography unit

11. Rotation Name: Computed Tomography

Training Level: R2

Duration: 12 Weeks

The resident will acquire knowledge regarding the following topics during this rotation:

- Basic principles of cross-sectional imaging
- Other applications of CT such as treatment planning, PET/CT, SPECT/CT, Cone Beam CT (dental and ENT).
- Components of data acquisition:
  - X-ray tube
  - Collimation
  - Detectors
  - Automatic exposure control

- Scanner Design:
  - First and Second generation
  - Third generation
  - Fourth generation
  - Single slice scanning
  - Helical (spiral) scanning
  - MDCT scanning
  - Cone beam
  - Electron beam and other CT

- Image matrix, reconstruction, and display:
  - Voxels and pixels
  - CT-numbers
  - Basic principles of image reconstruction
  - Reconstruction techniques such as helical and multi-slice (z-interpolation)
  - Reconstruction filters (soft, bone, and standard)
  - Window width and level
- Image quality descriptors:
  - Spatial [high-contrast] resolution
  - Low-contrast resolution
  - Spatial uniformity
  - Z-axis resolution
  - Noise
  - MTF
  - Relationship between the image quality descriptors and exposure, as well as the reconstruction and display parameters (e.g. noise, mAs, and reconstruction filter)
  - Influence of phantom design on the image quality descriptors
- Scanner dose parameters:
  - C(air) (CTDI(air)) Cw (CTDIw), Cvol (CTDIvol)
  - DLP

- Artifacts:
  - Partial volume
  - Metal artifacts
  - Motion
  - Beam hardening (cupping)
  - Ring artefact (detector malfunction)
  - Spiral scanning artifacts
  - Photon starvation
  - Cone beam artifacts
- CT Fluoroscopy:
  - Basic technical considerations
  - CT angiography
  - CT perfusion
  - Cardiac CT

Knowledge & Skills

The trainee must be capable of the following tasks at the end of this rotation**:**

- Demonstrate the basic principles of cross-sectional imaging
- Explain the complete CT imaging chain from the production of x-rays to image reconstruction
- Describe the physical meaning of CT values, such as the Hounsfield units)
- Enumerate image quality descriptors
- Determine the effects of specifics of CT imaging protocol on the image quality, patient dose, and diagnostic benefits of an examination
- Determine computed tomography dose index (CTDI) for CT examinations
- Estimate patient ionizing radiation dose and the risks associated with CT examinations
- Evaluate the ionizing radiation dose to conceptus and risks associated with CT examinations
- Identify image artifacts
- Describe different CT techniques and methods
- Demonstrate awareness of different modes of operating CT scanners

- Perform acceptance and compliance/accreditation testing of CT systems
- Review daily quality control tests of CT systems
- Describe requirements with regard to radiation protection in CT, especially pediatric CT and CT guided interventions
- Set and compare specifications

12. Rotation Name: Other imaging methods

Training Level: R2

Duration: 4 Weeks

The resident will acquire knowledge regarding the following topics at the end of this rotation:

- Physics of optical imaging
- Advantages of optical imaging
- Types of optical imaging
- Application of optical imaging
- Advanced imaging techniques
- QC technique for optical imaging

Knowledge & Skills

The trainee must be capable of the following tasks at the end of this rotation**:**

- Identify the basic physics of optical imaging
- Define the advantages of optical imaging
- Differentiate between different types of optical imaging
- Explore the applications of optical imaging
- Review advance imaging techniques
- Perform acceptance and annual compliance testing of optical imaging systems

13. Rotation Name: Nuclear Medicine

Training Level: R3

Duration: 8 Weeks

The resident will acquire knowledge regarding the following topics during this rotation:

- Radioactive decay and resulting emissions
- Radionuclides production
- Components of Gamma cameras, SPECT, SPECT/CT, and PET/CT systems
- Principles of radionuclide therapy and treatment procedures
- Standards for gamma camera/SPECT acceptance testing
- Manufacturer specifications of system performance
- Interpretation of the acceptance test results
- Criteria for acceptable performance
- Appropriate action if equipment fails acceptance testing
- Radiation protection practices implemented in NM laboratories
- Radiation protection practices implemented in diagnostic imaging
- Procedures and therapeutic applications of radiopharmaceuticals

Knowledge & Skills

The trainee must be capable of the following tasks at the end of this rotation**:**

- Describe the beta decay, electron capture, positron decay, positron annihilation, isomeric transitions, and their application
- Demonstrate the principles of radionuclide production with cyclotrons, reactors, radionuclide generators, and others
- Enumerate the detectors used in NM
- Describe the characteristics of a counting system, the effect of background counts, and minimum detectable counts
- Demonstrate the characteristics of electronics related to NM devices
- Explain the concepts of basic detector properties such as energy resolution, sensitivity, spatial resolution, and temporal resolution and their effects on the performance of NM devices
- Demonstrate the statistical techniques are used for radiation measurement in NM
- Describe the physical and technical principles of the imaging devices used in NM including gamma camera systems, single photon and PET systems, combined modality systems, and dedicated scanner design
- Describe the basic concepts of image reconstruction in NM including analytical and iterative reconstruction technique
- Describe the basic procedures for correction and quantitation and limits in NM
- Define the basic calibration procedures of NM systems
- Perform acceptance and periodical testing of NM systems
- Recognize the principles of radionuclide therapy, treatment procedures, selection of radiopharmaceuticals for therapy, and radiation safety for therapy procedures
- Describe the radiation protection practices for implementing laboratory tests, diagnostic imaging procedures, and therapeutic applications of radiopharmaceuticals
- Set and compare the specifications for different systems

14. Rotation Name: Ultrasound

Training Level: R3

Duration: 10 Weeks

The resident will acquire knowledge on the following topics during this rotation:

- Plane waves:
  - One-dimensional wave equation and harmonic solution
  - Wave variables: pressure, particle velocity, and displacement
  - Intensity and relation to pressure amplitude
  - Decibel notation
  - Acoustic impedance
  - Reflection and transmission at interfaces
- Propagation of sound waves through tissue:
  - Speed of sound
  - Attenuation and absorption
  - Scattering
  - Nonlinear propagation and definition of B/A
- Single element transducers:
  - General design considerations
  - Factors that affect frequency and bandwidth
  - Continuous wave beam patterns
  - Beam patterns for pulsed operation
  - Focusing
- Transducer arrays:
  - Principle of one-dimension array types
  - Design, element layout, matching, and backing material
  - Multi-frequency operation
  - Formation of transmit beam and transmit focusing
  - Beam formation during the reception; receive focusing
  - Apodization and dynamic aperture
  - Estimates of axial and lateral resolution
  - Slice thickness

- Pulse echo equipment signal processing:
  - Pulsing characteristics and duty factors
  - Transmit power
  - Receiver gain, overall gain, and temporal gain correction (TGC)
  - Compression and demodulation
  - Harmonic imaging
  - Mode, B-mode, and M-mode
- B-Mode Imaging:
  - Principal imaging methods
  - Image frame rate
  - Continuous wave and pulsed Doppler
  - Doppler equation
  - Nature of Doppler signals
  - Spectral analysis
  - Pulsed Doppler
  - Aliasing
- Flow imaging with ultrasound (US):
  - Velocity imaging
  - Energy imaging
  - Information content on color flow images
  - Blood pool contrast agents
- Equipment performance testing:
  - Axial, lateral, and elevational resolution
  - Methods for measuring resolution
  - System sensitivity and visualization depth
- Information and artifacts in gray scale imaging and Doppler
- Bioeffects and Safety:
  - Acoustic output measurements
  - Real-time output labels: MI and TI
  - Biological effects of US
  - Safe operating levels

Knowledge & Skills

The resident must be capable of the following tasks at the end of this rotation**:**

- Identify the characteristics of plan waves
- Describe the propagation of sound waves through tissue
- Describe the complete US imaging chain from the production of vibrations to image reconstruction
- Explain the sources of contrast in US imaging
- Explain the effects of the specifics of US imaging protocol on the diagnostic benefits of the examination
- Differentiate between different US imaging modes and techniques
- Select appropriate transducers for gray-scale or Doppler imaging and understand the effect of ultrasound imaging parameters such as frequency, overall gain, time gain compensation, and focusing on image quality
- Identify image artifacts and remedies
- Optimize image quality in clinical images
- Review the requirements for acceptance and annual compliance testing of US systems
- Perform periodic quality control tests to evaluate US systems and transducers
- Set and compare specifications for different applications

15. Rotation Name: Magnetic Resonance Imaging

Training Level: R3

Duration: 14 Weeks

The resident will acquire knowledge regarding the following topics during this rotation:

- Magnetic resonance imaging (MRI) scanner hardware:
  - Whole-body magnet
  - Gradients
  - Radio frequency (RF) system
  - RF coils
  - RF shielding of the magnet room

- Magnetic shielding, types, effectiveness, and impact on image quality
- Measurement of RF noise

- Operation of the MRI System
- Image production:
  - NMR signal and free induction decay
  - T1-T2 contrast
  - Frequency and phase encoding gradients
  - RF pulses and slice selection gradients
  - Basic MRI sequences (spin and gradient echo)
- Effect of the following parameters on the signal-to-ratio (SNR) and image:
  - Coil selection
  - Imaging parameters such as TR-TE bandwidth, field of view, and matrix size.
  - Signal encoding in phase, frequency, and slice orientations
- Types of MRI sequences and their effect on images
- MRI safety, hazards, and site planning.
- Quality control in MRI:
  - Different types of artifacts and their effect on the image and measures to avoid them.
  - Effects of SNR, signal and gradient uniformity, ghosting, slice thickness, and resolution on the images
  - Important QC parameters
  - Frequency of testing for various parameters

Knowledge & Skills

The resident must be capable of the following tasks at the end of this rotation:

- Describe the NMR imaging theory
- Identify the different components of MRI system
- Identify the fundamentals of RF signal acquisition and image production
- Explain the role of k-space formalism in MRI
- Explain the complete MRI chain from signal production to image reconstruction

- Describe the effect of specific pulse sequences affect contrast in MRI, and explain their relationships to the diagnostic benefits of examinations
- Outline the requirements for MRI safety and practicing MRI safety procedures
- Identify the requirements for MRI site planning and safety zones
- Perform acceptance and annual compliance/accreditation testing of an MRI system
- Review daily quality control tests performed by technologists on an MRI system
- Perform quality control tests on a variety of RF coils
- Set and compare specifications for system components.

16. RESEARCH PROJECT

Training Level: All levels

Duration: Throughout the entire program

Medical physicists make significant contributions to the advancement of radiology and research within the medical physics community.

Medical physicists should complete one or more short, focused research projects during their training program to prepare for this responsibility. These projects may be small projects or more dedicated research projects that are a part of the program requirement that help trainees develop advanced competencies across the program.

The well-structured, and scope-limited research project must be supervised by a professional medical physicist. The study topic should be relevant to radiology physics and practice, ideally within the scope of the clinical and applied areas of radiology research.

The research project should result in a written report, such as an article for a medical physics or radiology publication. Please refer to **Appendix-D** for further details regarding the research timeline and milestones.

The primary objectives of the research project are as follows:

Medical Expert

- To demonstrate an understanding of the basic principles of research design, methodology, data analysis, clinical epidemiology, and the advantages and disadvantages from the perspective of radiology.

- To familiarize themselves with the ethical requirements of research and responsible use of informed consent.
- To implement appropriate methods for drafting research proposals, manuscripts, data collection, and discussion of the analysis results.
- To demonstrate awareness regarding the current research topics in radiology using available medical informatics systems.
- To skillfully present scientific presentations and participate in public discussions.

Training Methods

- Specify a period dedicated to research or full-time rotation in research to be conducted, as appropriate.
- Dedicated courses or workshops that enhance research skills required by the program.
- The project is expected to span more than a month. Therefore, completion of the work should be parallel with the other subsequent rotations.
- The trainee must select a supervisor to aid in accessing essential resources that facilitate the appropriate utilization of research skills and periodically discuss the progress.
- The trainee must finish the research proposal by the end of the first 6 months. The proposal must be accepted by the Institutional Review Board.
- An oral abstract of the study results must be presented at the specified time point (e.g., end of final year before appearing for the final examination), on the Specialty Research Day.
- The research paper must be submitted at least 2 weeks before the Specialty's Research Day.
- Trainees must strive to work on presenting the research results at national and/or international meetings and aim to publish their work in indexed journals.

Evaluation

- Participation in designated courses/lectures/workshops will be monitored and incorporated into the annual evaluation score.

- Panel scoring of the research abstract presentation will be conducted at the end of the pre-specified point year, on the Specialty's Research Day. This score will serve as the rotation score for the specific month.

COMMUNICATOR

- Demonstrate skills in conveying and discussing scientific research to scientific communities through the use of posters, abstracts, teaching slides, manuscripts, and other scientific communication modalities.
- Communicate and collaborate effectively with the research supervisor to conduct the research.

COLLABORATOR

- Identify, consult, and collaborate with appropriate experts, research institutions, and/or organizational bodies to conduct research.

LEADER

- Identify an area of research interest and a research supervisor to engage in the pursuit of scientific inquiry and dissemination.
- Utilize available resources and regularly meet with an identified research mentor.
- Set realistic priorities and use resources in a time-effective manner to optimize professional performance.
- Utilize healthcare resources in a cost-effective manner.

HEALTH ADVOCATE

- Recognize the contributions of scientific research in improving the health of patients and communities.

SCHOLAR

- Pose appropriate research questions, recognize and identify gaps in knowledge and expertise around the research question, and formulate an appropriate study design to address this gap.
- Conduct the research as outlined in the proposal.
- Collect and analyze the data utilizing appropriate methods.
- Prepare abstracts and manuscripts suitable for publication in peer-reviewed journals and/or international scientific meetings.
- Identify the limitations of the research and areas for further research.

PROFESSIONAL

- Uphold ethical and professional expectations of research in accordance with the guidelines set forth by the Institutional Review Board, including maintenance of meticulous data and conduct of ethical research.
- Demonstrate personal responsibility for setting research goals and working with the supervisor to set and achieve research timeline objectives.
- Attribute authorship and contributions appropriately during the publication of the research
- Disclose potential financial conflicts of interest (including speaker fees and consultative relationships) as appropriate when engaging in and disseminating research results.

VIII. CONTINUUM OF LEARNING

Continuum of learning includes learning that should take place in each key stage of progression within the specialty. Trainees are trained in life-long Continuous Professional Development (CPD). Trainees should keep in mind the necessity of CPD for every healthcare provider in order to meet the demands of their vital profession. The following table states how the role is progressively expected to develop throughout junior, senior, and consultant levels of practice.

Undergraduate	R 1 (Junior Level)	R 2-3 (Senior Level)	Consultant
Non-practicing	Dependent/supervised practice	Dependent/supervised practice	Independent practice/provide supervision
Obtain basic medical physics science and foundational level to core discipline knowledge	Obtain fundamental knowledge related to diagnostic imaging medical and radiation physics	Apply knowledge to develop appropriate tools related to diagnostic radiology medical physics techniques	Acquire advanced and up-to-date knowledge related to diagnostic radiology medical physics techniques and implement into practice
Internship to the practice of discipline	Apply medical physics skills such as radiation safety and quality control to different diagnostic radiology systems	Inspect and review radiation dose and quality control for diagnostic imaging systems and develop techniques to optimize the quality and control radiation dose	Evaluate challenges and develop appropriate methods and management plan

IX. TEACHING METHODS:

Various learning methods have been designed to ensure that the Medical Physics residents achieve the competencies described in the curriculum. The program comprises training to acquire cognitive and technical skills and understand how they relate to the physics, applied anatomy, pathology, and physiology of radiation in medicine. The program strives to implement learning through innovative teaching methods and technology. Moreover, the training program comprises practical procedures and interpretation methods taught in a sequential and integrated manner through lectures, tutorials, seminars, and apprenticeships that provide hands-on experience. The trainees are expected to gain an understanding of the importance of learning and play active roles in determining the content and process of their own learning. The training program will implement the adult learning concept in each feature of the activities where the residents are responsible for their own learning requirements. Formal training time would include the following four teaching activities:

1. Program-Specific Learning Activities
2. Universal topics
3. General Learning Opportunities

1- Program-Specific Activities:

Program-specific activities are educational activities specifically designed and intended for teaching trainees during the training period. The trainees must participate in these activities; non-compliance can subject trainees to disciplinary actions. Program administrators should strive to support these activities by allocating protected time for trainees to participate in these activities.

A-One half academic day every week

One weekly academic half-day activity must be assigned to all residents. This half-day activity must correspond to at least 2–4 hours of formal teaching time per week. Residents must be released from their rotation-related commitments during this time. Structured learning sessions must be pre-planned with dedicated instructors, specific timing, and designated locations. The academic half-day covers the core diagnostic imaging medical physics topics determined and approved by the program council that align with pre-defined competencies and teaching methods. The learning objectives of each topic must be clearly

defined. Appendix C presents an example of the half-day academic activities program.

This academic activity should cover the following:

1. Provide the knowledge, technical skills, and experience necessary for residents to evaluate image and diagnostic imaging system performance.
2. Promote effective communication and sharing of expertise among peers and colleagues.
3. Promote the development of investigative skills to better understand technical skill processes that apply to individual patients and the general patient population.
4. Advise colleagues from their specialties and other specialties with regard to the problems related to medical physics.
5. Enable residents to identify the humanistic and ethical aspects of a medical physics career.
6. Enable the residents to examine and affirm their personal and professional moral commitments.
7. Enable residents to use their knowledge in clinical reasoning and equip them with the interaction skills required to apply this insight, knowledge, and reasoning to patient care.
8. Explore methods used for radiation protection and dose monitoring methods.
9. Describe the safety regulations and roles and remain abreast with any updates.

B- Practice-Based Learning

Training exposures during daily activities, including courses and workshops (e.g., simulations, systems quality and calibration tests, and radiation exposure measurements), represent excellent learning opportunities. Trainees must build their capacity based on self-directed learning.

Practice-based learning enables the educator to supervise trainees to become competent in the diagnostic medical physics practical skills that ensure fulfilling knowledge, psychomotor, and/or attitude learning domains. Each trainee must maintain a logbook documenting the procedures observed, performed under supervision, and performed independently. The program training committee suggests the minimum number of procedures to be performed during each rotation before training completion to maintain competency after certification.

The skills learned during rotations include but are not limited to:

1. Investigate and analyze patient care procedures

2. Learn and apply epidemiology and radiation biology in medical scenarios
3. Use scientific data to improve diagnostic imaging procedures
4. Participate in research and development activities in collaboration with physicians practicing radiation oncology, nuclear medicine, radiology, and other related fields
5. Evaluate testing data and identifying unexpected artifacts and errors
6. Assess the functionality of the equipment and issues that arise during QC; identify and fix errors made by the user.

In general, practice-based learning involves the application of scientific principles and techniques to solve problems or obstacles encountered in the clinical setting. The following are some of the general methods that are commonly employed:

1. Clinical Rotations: Medical physics residents must participate in clinical rotations in radiation oncology departments, diagnostic imaging centers, or other relevant clinical settings. The residents must work under the supervision of experienced medical physicists during these rotations, engaging in hands-on activities related to radiation protection, quality assurance, dosimetry, image analysis, and other aspects of medical physics practice.
2. Case-Based Learning: Case-based learning is commonly used in medical physics education. Trainees are presented with clinical cases or scenarios that necessitate the application of their knowledge and problem-solving skills to analyze and develop appropriate solutions. This method helps bridge the gap between theoretical knowledge and real-world scenarios.
3. Supervised Practical Training: Trainees receive supervised practical training wherein they actively participate in tasks related to medical physics practice, such as equipment calibration, quality assurance measurements, radiation protection survey, image analysis, patient-specific quality control, and other essential activities under the guidance of experienced medical physicists.

2- Universal topics

Universal topics are educational activities developed by the SCFHS that are intended for all specialties. Priority is given to topics that possess the following qualities:

- High value
- Interdisciplinary and integrated

- Require expertise that may extend beyond the availability of the local clinical training sites

Universal topics have been developed by the SCFHS. Trainees can access these topics available under e-learning. Each trainee has personalized access (to access the online modules). Each universal topic is followed by a self-assessment at the end of the module. As indicated in the “executive policies of formative assessment and annual promotion”, universal topics are a mandatory component of the criteria for the annual promotion of trainees from their current level of training to the subsequent level, particularly at the residency level. Universal topics are distributed over the whole period of training.

The topic content will be delivered in a modular fashion. A formative online assessment will be conducted at the end of each learning unit. A combined summative assessment in the form of a context-rich MCQ will be conducted after the completion of all topics. All trainees must attain a specified minimum level in the summative assessment. Alternatively, the topics can be completed in a summative manner along with the specialty examination.

Module 1: Medical Fundamentals (Introduction)

Topic 2. Hospital-Acquired Infections:

The residents must be capable of the following tasks at the end of the learning unit:

a) Discuss the epidemiology of HAIs with special reference to Hospital-Acquired Infections (HAIs) in Saudi Arabia

b) Identify HAIs as a major emerging threat in healthcare

c) Identify the common sources of HAIs;

d) Describe the risk factors for common HAIs, such as ventilator-associated pneumonia, methicillin-resistant Staphylococcus aureus, central line-associated bloodstream infections, and vancomycin-resistant enterococcus

e) Identify the role of healthcare workers in the prevention of HAIs

f) Select appropriate pharmacological (e.g., selected antibiotics) and non-pharmacological (e.g., removal of indwelling catheter) measures for the treatment of HAIs

g) Propose a plan to prevent the outbreak of HAIs in workplaces.

Module 6: Frail & Elderly

Topic 30: Care of the Elderly:

A. The residents must be capable of the following tasks at the end of the learning unit:

a) Describe the factors to be considered while planning patient care for the elderly

b) Recognize and include the needs and well-being of caregivers

c) Identify the local and community resources available for the care of the elderly

d) Develop an individualized care plan for elderly patients by including ideas from other healthcare professionals

Module 7: Ethics and Healthcare

Topic 31: Occupational Hazards of Healthcare Workers (HCWs):

The residents must be capable of the following tasks at the end of the learning unit:

a) Recognize common sources and risk factors for occupational hazards among HCWs

b) Identify common occupational hazards in workplaces

c) Familiarize themselves with legal and regulatory frameworks governing occupational hazards with respect to HCWs

d) Harbor a proactive attitude to promote workplace safety

e) Protect themselves and colleagues against potential occupational hazards in workplaces.

Topic 33: Patient Advocacy:

The resident must be able to perform the following tasks at the end of the learning unit:

f) Define patient advocacy

g) Recognize the role of patient advocacy as a core value governing medical practice

h) Describe the role of patient advocates in patient care

i) Develop a positive attitude toward patient advocacy

j) Be a patient advocate in conflicting situations

k) Familiarize themselves with local and national patient advocacy groups

Topic 35: Ethical Issues: Treatment Refusal and Patient Autonomy:

The resident must be able to perform the following tasks at the end of the learning unit:

a) Predict situations wherein the patient or family is likely to decline a prescribed treatment;

b) Describe the concept of a rational adult in the context of patient autonomy and treatment refusal

c) Analyze key ethical, moral, and regulatory dilemmas affecting treatment refusal

d) Identify the importance of patient autonomy in the decision-making process

e) Counsel patients and families declining medical treatment in the best interests of patients.

Module 2 Cancer:

Topic 7: Side Effects of Chemotherapy and Radiation Therapy:

The resident must be able to perform the following tasks at the end of the learning unit:

a) Describe important (e.g., frequent/life/organ threatening) of common chemotherapy drugs

b) Explain the principles of monitoring side-effects in a patient undergoing chemotherapy

c) Describe the pharmacological and non-pharmacological measures available to ameliorate the side-effects of commonly prescribed chemotherapy drugs

d) Describe important (e.g., common and life-threatening) side effects of radiation therapy

e) Describe the pharmacological and non-pharmacological measures available to ameliorate the side-effects of radiotherapy

Topic 9: Cancer Prevention:

The resident must be able to perform the following tasks at the end of the learning unit:

a) Conclude that many major cancers are preventable

b) Identify smoking prevention and life-style modifications as major preventable measures

c) Identify preventable cancers

d) Discuss the major cancer prevention strategies at the individual and national levels

e) Counsel patients and families regarding cancer prevention, including screening, in a proactive manner

3- General Learning Opportunities.

1. Journal club:

Journal articles are preselected, and the activity is prepared and discussed by residents under supervision to:

- Promote continued professional development
- Stay up-to-date with the literature
- Learn and practice critical appraisal skills

2. Guest speakers on core medical physics topics:
   - Increase medical physicist staff and resident knowledge and skills to improve patient care
   - Demonstrate and apply current practice guidelines in the field of medical physics
   - Describe the latest advances in the field of medical physics and research
3. Tutorials:
   - Provide a good quality foundation of knowledge regarding the skill required by medical physicist
   - Discuss and review quality testing of imaging systems
   - Explore different methods used in radiation protection
   - Demonstrate methods used to controls and limit radiation dose
   - Develop a sense of confidence in handling artifacts and image optimization in diagnostic imaging
4. Courses and Workshops

Trainees are encouraged to attend professional conferences, workshops, and seminars to stay updated on the latest advancements, research, and best practices in medical physics. These events provide opportunities for the trainees

to learn from experts, network, and engage in discussions on current topics and challenges in the field.

5. Self-directed Learning
    - Maintain a personal portfolio (self-assessment, reflective learning, and personal development plan)
    - Achieve personal learning goals beyond the essential and core curriculum
    - Reading, including web-based material
    - Audit and conduct research projects
    - Attend national and international conferences
6. Professional Development and Certification Programs

Trainees are encouraged to pursue professional development opportunities and certification programs offered by medical physics societies and organizations. These programs provide additional training, educational resources, and certification exams that validate the competence and expertise of medical physicists.

7. Collaborative Projects

Trainees must collaborate with other healthcare professionals, such as radiologists, dosimetrists, medical engineers, and technologists, to work on interdisciplinary projects. This collaboration promotes teamwork, thereby enhancing the understanding of different perspectives and fostering the integration of medical physics into the broader healthcare context.

X. ASSESSMENT AND EVALUATION

The mapping between assessment and the curriculum content is a vital process in the formulation of the curriculum. Thus, the early involvement of the FA team will facilitate the attainment of a good assessment and evaluation plan, i.e., help align the learning outcomes of the rotation, as well as teaching and learning, with formative assessment. Furthermore, reliable and valid assessments play an essential role in assessing curriculum alignment with respect to its objectives, learning methods, and assessment tools.

1. Purpose of Assessment

Assessment plays a vital role in the success of postgraduate training. Assessments guide trainees and trainers to achieve defined standards, learning outcomes, and competencies. Furthermore, assessments provide trainers with an opportunity to provide feedback to learners and faculty regarding curriculum development and implementation, teaching methods, and the quality of the learning environment. Reliable and valid assessments play an essential role in assessing whether the curriculum aligns with its objectives, learning methods, and assessment tools. Lastly, assessment assures patients and the public that health professionals are safe and competent to practice.

Assessment can serve the following purposes:

1. **Assessment for learning**: Trainers will use information from performance assessment to help trainees achieve continuous improvement. It enables educators to use information about the knowledge, understanding, and skills of the trainees to provide feedback regarding learning and how to improve.
2. **Assessment of learning** can be used to demonstrate achievement of learning. This is a graded assessment that usually counts towards the end-of-training degree.
3. **Feedback and evaluation** as assessment outcomes represent quality metrics that can improve the learning experience and help trainers focus on the areas that require further attention in the future.

Miller's Pyramid of Assessment provides a framework for assessing the clinical competencies of the trainees. It acts as a guide to select the assessment

methods to target different clinical competencies including “knows,” “knows how,” “shows how,” and “does” (please refer to the checklist in Appendix A).

Miller’s Pyramid of Assessment provides a framework for assessing the different clinical competencies of the trainees including “knows,” “knows how,” “shows how,” and “does.

However, a list of guidelines that are readily available to assist with the proper execution of the necessary steps has been provided to understand the process of the formative assessment approach. Please refer to the electronic version posted online for the most updated edition at www.scfhs.org.sa.

Assessments will be further classified into two main categories for the sake of organization: *Formative* and *Summative*.

2. Formative Assessment

2.1 General Principles

Purpose of formative assessment:

- Enhance learning by providing formative assessment, thereby enabling the resident to receive immediate feedback, measure their performance, and identify areas for development and improvement
- Drive learning and enhance the training process by clarifying the specific requirements of the residents and motivating them to ensure they receive suitable training and experience
- Provide robust and summative evidence that the residents are meeting the curriculum standards during the training program
- Ensure that the residents are acquiring competencies within the domains of good medical practice
- Ensure that the residents possess the essential underlying knowledge, skills, and attitude required for their specialty

Trainees, as adult learners, should strive to seek and develop their performance based on feedback throughout their journey of gaining competency from “novice” to “mastery” levels. Formative assessment (also referred to as continuous assessment), the component of assessment that is distributed throughout the academic year, aims primarily to provide trainees with effective feedback.

At least 1 hour should be assigned every two weeks for trainees to meet with their program director or equivalent to review performance reports (e.g., ITER,

logbook, workplace-based assessment tools, etc.). Input from the overall formative assessment tools will be utilized to determine whether individual trainees will be promoted from the current to subsequent training level at the end of the year. Formative assessment tools will be defined based on the scientific (committee) recommendations, usually updated, and announced for each individual program at the start of the academic year.

Formative assessment will have the following features that will be used based on targeted competencies according to the executive policy on formative assessment (available online: www.scfhs.org):

1. Multisource: minimum of three tools including a relevant workplace-based tool
2. Comprehensive: covering all learning domains (knowledge, skills, and attitude)
3. Relevant: focusing on workplace-based observations
4. Competency milestone-oriented: reflecting the expected competencies of the trainees that match their developmental level

2.2 Formative assessment tools

Trainees must play an active role in seeking feedback during their training. Trainers are expected to provide timely and formative assessments. The SCFHS will provide an e-portfolio system to enhance communication and analysis of the data acquired through formative assessment.

Trainers and trainees must follow the recommendations of the scientific council regarding the updated forms, frequency, distribution, and deadlines related to the implementation of evaluation forms.

The candidate must complete the compulsory requisition of all selected formative assessment tools to attain the optimum training-level outcome.

2.2.1 Workplace based assessment

Workplace based assessment (WBA) tools: compliance must be ≥75% of each tool of repetitive nature. Compliance will be calculated based on the following equation:

The percentage of compliance of executing a single WBA tool = number of performed encounters by the trainee/the total number that must be completed for the tool

2.2.2 Educational Activity (Non-WBA assessment)

Educational Activities (EA) are part of the training program that involves teaching and learning activities to acquire their specialties competencies. Examples of contribution to educational activities include but are not limited to Presenting in journal clubs, lectures, morbidity and mortality rounds, grand rounds, and research and scholarly activities.

All formative assessment tools used for formative assessment purposes MUST abide by the Scoring Categories and Scaling Definitions in the SCFHS policies.

Doesn't Meet Expectations	Borderline	Meets Expectation	Exceeds Expectation
(<50%)	(50–69.99%)	(>70–89.99%)	(>90%)

The candidate must complete the compulsory requisition of all selected formative assessment tools to attain the optimum training level outcome.

Summary table of the required assessment tools for all stages and levels:

Gen./Sub.	Level	Knowledge Skills Attitude												
		SOE	EYPT-n't	Academic Activities	CBD	EYPT-Local	OSCE/ OSPE	Research	DOPS	Logbook	Volunteering	Other	mini-CEX	Evaluation – ITERS
Diagnostic Radiology Medical Physics board	R1	√		√	√	√		√	√	√				√
	R2	√		√	√	√		√	√	√				√
	R3	√		√	√			√	√	√				√

SOE: Structured Oral Exam, **CBD**: Case-based Discussion, **DOPS**: Direct observation of procedural skills, **Mini-CEX:** Mini-Clinical Evaluation exercise, **EYPT-Local:** End of year promotion exam or progress test, **EYPT-n't:** End of year International Exams, **ITER**: In-Training Evaluation Report

Description Table of Formative Assessment Tools (R1, R2, and R3)

performance evaluation and requirements	Formative assessment tools	Targeted competencies & learning domain			Important details (description and frequency related to the tool/ academic year)
		Knowledge (K)	Skills (S)	Attitude (A)	
Workplace-Based Assessment (WBA)	CBD	- Diagnostic imaging safety. - Artifacts identification - System components and technology	- Measurement of patient radiation dose. - Perform System QC - Perform System calibration and testing - Identify image artifacts and remove them - Verify radiation protection fulfillment.	- Professionalism - Critical thinking - Effective communication - Attention to detail - Empathy and compassion	1. Trainees (all level) are required to complete 1-5 CBD/Rotation 2. Total of (13-18) per Academic Year per level 3. The results are for formative feedback purposes. 4. Please refer to Appendix-G for rotation involved & frequency per level
	DOPS	- System quality assurance procedures step. - Radiation measurement techniques - System calibration and maintenance requirements	- Perform system quality assurance and analysis - Perform radiation measurement and verify the safety requirement of protection - Verify system compliance following maintenance	- Professionalism - Critical thinking. - Effective communication. - Attention to detail - Empathy and compassion	1. Trainees (all level) are required to complete a minimum of 1–5 DOPS/Rotation 2. Total of (9–14) per academic year per level 3. The results are for formative feedback purposes. 4. Please refer to Appendix-G for which rotations & procedures are required per level and frequency.
Non-WBA (each tool must be described separately, including details	SOE	- Radiation units and tools - Safety Regulatory criteria. - Image artifacts - System performance test.	- Able to use the tools to measure radiation - Apply safety regulatory criteria - Identify image artifacts. - Perform system checks	- Professionalism - Critical thinking - Effective communication - Attention to detail - Empathy and compassion	1. All trainees must attend (1) SOE session. 2. The minimum number of SOE station(s): is (4) stations. 3. The results are used for formative feedback. 4. Please refer to Appendix-G for which rotation and description.

performance evaluation and requirements	Formative assessment tools	Targeted competencies & learning domain			Important details (description and frequency related to the tool/ academic year)
		Knowledge (K)	Skills (S)	Attitude (A)	
about the level of trainees, frequency, and grading method)		- Dose measurement and analysis - System components and imaging techniques	- Perform Dose measurement and analysis		
	Annual Written Progress Test (Promotion exam)	- Diagnostic imaging safety - Image artifact - System components and scanning technology - Radiation units and tools - Image quality parameters and optimization techniques - QC procedure requirements and tools - Radiation protection and dose management techniques	- Apply imaging safety policies and regulations - Recognize imaging system components and the technology used in each system - Able to measure the radiation dose and use appropriate units - Able to manipulate imaging parameters to optimize system performance. - Perform QC analysis and discuss the results	NA	1. End of the year for R1 and R2 trainees 2. The questions will be a mix of MCQs and essays 3. Consisting of a minimum of (70) MCQs and a minimum of three assay questions. Scores expressed in numbers will be translated into SCFHS categories.

performance evaluation and requirements	Formative assessment tools	Targeted competencies & learning domain			Important details (description and frequency related to the tool/ academic year)
		Knowledge (K)	Skills (S)	Attitude (A)	
	Research Activities	- Recognize research methodology - research ethics and regulatory requirements - Research project planning. - Thesis and paper writing - Data collection - Statistical analysis - Results and discussion writing	- Choose and apply the appropriate Research methodology. - Fulfil ethics and regulatory requirements - Provide research project planning - Manage Thesis and paper writing. - Start data collection - Perform statistical analysis - Write results and discussion.	- Follow the timely plan - Critical thinking - Follow ethics and regulations	Required Activities the trainee must complete: 1. All level trainees 2. End of each academic year 3. Please refer to Appendix-D for details about the research progress requirements.
		Please refer to Appendix-E	Please refer to Appendix-E		Assesses the trainee's enrolment and daily activity. Should be inspected weekly and at the end of rotation. Procedures required by the R1, R2 & R3 trainees to complete **Appendix-E**.
	Educational activity (journal club, morning meeting, oral presentation, and participation in	- Diagnostic imaging safety - Artifacts identification - System components and technology - Safety regulatory criteria	- Dose measurement and analysis - Diagnostic systems QC, performance, calibration, and testing	- Ethics and regulatory requirements - Interpersonal and effective communication skills. - Professionalism - Critical thinking - Attention to detail	Each trainee level must complete/present at least one EA per rotation. The trainee will be evaluated after each EA session by training supervisor/attending by an evaluation form. (Please refer to Appendix-**H**)

performance evaluation and requirements	Formative assessment tools	Targeted competencies & learning domain			Important details (description and frequency related to the tool/ academic year)
		Knowledge (K)	Skills (S)	Attitude (A)	
	clinical conferences)				
	ITER	- Patient care - Medical knowledge and applications. - Imaging modality knowledge and applications. - Safety requirements and regulations. - Quality assurance and quality control Image optimization and artifacts reduction techniques - - New advances and technology in the specialty	- Professionalism - Procedural skills. - Practice-based learning and improvement. - Systems-based practice. - Presentations at conferences or meetings. - Attendance and participation in educational activities (e.g., lectures, workshops, and journal clubs). - Leadership roles and involvement in professional organizations	- Time and work management efficiency - Interpersonal and communication skills.	ITER are related to the rotation's objectives and the level of training. ITER report must be completed after repeated observations and feedback on the trainee's performance, within two weeks after the end of each rotation.

Refer to the SCFHS “Formative Assessment Tools List” for the description and conduction instructions of each Tool at www.scfhs.org.sa

2.3 Promotion of the trainee

The trainee must demonstrate compliance by completing the necessary WBA and EA on time and in accordance with the curriculum requirements. Furthermore, failure to comply with this will result in disciplinary consequences for the trainee, including repeating the entire academic year or a portion of it.

The trainee shall be promoted from one level to the next if they comply with the following requirements:

1. Achievement of the minimally required compliance of selected WBA and EA
2. Annual in-training evaluation report (AITER) to be completed by the Program Director which incorporates the complaints of the WBAs and EA as well as the collected comments and feedback made by concerned educators. It should include the recommendations from the program director. Furthermore, the program training committee will vote on the decision regarding the promotion with one of the following options:
3. Unconditional promotion to the next level
4. Conditional promotion to the next level with a remediation program during the promoted year
5. Not endorsed for promotion with the recommendation of repeating the current year along with a remediation program

2.4 Final In-training Evaluation Report (FITER)

This report will be the basis for obtaining the Certificate of Training Program Completion and the qualification to appear for the Final Specialty Exams.

In addition to other requirements of the completion of training and registration for the final board examination by the supervisory training committee, a final in-training evaluation report (FITER) is prepared by Program Directors for each trainee during the final year in training.

Furthermore, a recommendation by the program training committee shall be issued based on the FITER report during the last month of the final training year, offering one of the following options:

1. Approved and finished the training requirement.
2. Partially approved and completed the training requirements after successful achievement of no more than a three-month remediation program

3. Not approved and incomplete training requirements with the recommendation of remediation program of an extra training year.

Summative Assessment

1. General Principles

Summative assessment is the component of assessment that aims primarily to make informed decisions on trainees' competency. Compared with formative assessment, *summative assessment* does not aim to provide constructive feedback. For further details on this section, please refer to the General Bylaws of Training in Postgraduate Programs and General Assessment Bylaws (available online: www.scfhs.org). To be eligible to sit for the final exams, trainees will be granted "Certification of Training Completion" upon successful completion of all training rotations.

2. First Part Examination

The First Part Examination is a written exam that permits the trainee to be promoted from "junior" to "senior" level of training. Please refer to the General Bylaws of Training in Postgraduate Programs and General Assessment Bylaws (available online: www.scfhs.org) for further details.

Blueprint Outlines: **The content of the following table is for demonstration only**. Please refer to the most updated version published on the SCFHS website.

Example of Written Exam Blueprint

Evaluation Item	Section	Percentage (%)
(150 MCQs)	1. Types of medical imaging	10
	2. Radiological anatomy and physiology	10
	3. Dosimetry methods, quantities, units, and regulations	10
	4. Radiation protection and safety	15
	5. Radiation survey equipment	10
	6. Physics of medical imaging	15

	7. Medical imaging instrumentation	10
	8. Performance testing of imaging equipment	10
	9. Medical imaging department design	5
	10. Ethics and patient care	5
Total		100

3.3 Certification of Training Completion

Each trainee must obtain a "*Certification of Training Completion"* to be eligible to appear for the final specialty examinations. Based on the General Bylaws of Training in Postgraduate Programs and executive policy (please refer to www.scfhs.org) trainees will be granted "Certification of Training-Completion" once the following criteria are fulfilled:

1. Successful completion of all training rotations.
2. Completion of training requirements (e.g., logbook, research, and others) as outlined in FITER that is approved by a scientific council/committee of specialty.
3. Clearance from the SCFHS training affairs that ensures compliance with tuition payment and completion of universal topics.
4. Pass the first part of the examination.

"Certification of Training Completion" must be issued and approved by the supervisory committee or its equivalent in accordance with the SCFHS policies.

3.4 Final Examinations

The final specialty examination comprises a summative assessment component that grants trainees a certificate for the specialty. It has two elements:

1. Final written exam: trainees must obtain "Certification of Training Completion" to be eligible for this exam.
2. Final clinical/practical exam: trainees must pass the final written examination to be eligible to appear for the final clinical/practical examination.

Please refer to the most updated version published on the SCFHS website for the blueprint of the final written and clinical/practical exams that are updated frequently.

Please refer to the General Bylaws of Training in Postgraduate Programs and General Assessment Bylaws for further details on final exams (available online: www.scfhs.org).

Learning Domain	Summative Assessment Tools	Passing Score
Knowledge	1. Final Written Examination	At least a borderline pass for each tool in accordance with the standard setting method used by the executive administration of assessment
Skills	2. Structured Oral Examinations (SOE)	At least a borderline pass for each tool in accordance with the standard setting method used by the executive administration of assessment
Attitude	FITER: In-Training Evaluation Report	FITER passed successfully

XI. PROGRAM AND COURSE EVALUATION

SCFHS will apply variable measures to evaluate the implementation of this curriculum. Training outcomes of this program will assessed according to the quality assurance framework endorsed by the Central Training Committee at SCFHS. Trainee assessment (formative and summative) results will be analyzed and mapped to the curriculum content. Other indicators that will be incorporated are:

1. Report of the satisfaction survey of the annual trainees.
2. Report the evaluation of rotations of the annual trainees.
3. Report from the annual survey of Program Directors.
4. Data available from program accreditations.

Goal-Based Evaluation: the achievement of the intended milestones will be evaluated at the end of each stage to assess the progress of the curriculum delivery. Any deficiencies will be addressed during the following stage using the time devoted for the trainee-selected topics and professional session.

In addition to subject-matter opinion and best practices from benchmarked international programs, SCFHS will implement a robust method to ensure that the curriculum utilizes all data available at the time of revising the curriculum in the future.

XII. FINAL EXAM BLUEPRINT

Promotion Written Examination

Written Examination Format:

- A written examination shall consist of one paper with not less than 100 MCQs with a single best answer (one correct answer out of four options). Up to 10% unscored items can be added for pretesting purposes.
- The examination shall contain type K2 questions (interpretation, analysis, reasoning and decision making) and type K1 questions (recall and comprehension).
- The examination shall include basic concepts and clinical topics relevant to the specialty.
- Clinical presentation questions include history, clinical finding and patient approach. Diagnosis and investigation questions; include the possible diagnosis and diagnostic methods. Management questions; including treatment and clinical management, either therapeutic or nontherapeutic, and complications of management. Materials and Instruments questions; including material properties, usage, and selection of instruments and equipment used. Health maintenance questions; include health promotion, disease prevention, risk factors assessment, and prognosis.

Passing Score:

The trainee's performance is assessed in each of the evaluation formulas according to the following scoring system:

Score	Less than 50%	50% – 59.4%	60% - 69.4%	More than 70%
Description	Clear Fail	Borderline Fail	Borderline Pass	Clear Pass

1. To upgrade the trainee from a training level to the next level, she/he must obtain at least a **Borderline Pass** in each evaluation form.
2. The program director may recommend to the local supervision committee to request the promotion of the trainee who did not meet the previous promotion requirement according to the following:

A. In case that the trainee gets a **Borderline Fail** result in **one** of the evaluation forms, the remaining evaluation forms must be passed with **Clear Pass** in at least **one** of them.

B. In case that the trainee gets a **Borderline Fail** result in **two** of the evaluation forms to a maximum, provided they do not fall under the same theme (Knowledge, Attitude, Skills). The remaining evaluation forms must be passed with Clear Pass in at least two of them.

C. The promotion must be approved in this case by the scientific council for the specialization.

Suggested References:

1. Bushberg Jr., J, Seibert Jr., J.A., Leidholdt Jr., E.M., Boone, J.M. The Essential Physics of Medical Imaging, 4th Edition, 2020.
2. Huda, W. Review of Radiologic Physics, 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2016.
3. Diagnostic Radiology Physics, IAEA, Dance DR, et al., 2014.
4. Physics in Nuclear Medicine; by Simon Cherry, James Sorenson and Michael Phelps, Fourth Edition.
5. Clinical Imaging Physics: Current and Emerging Practice. (2020). Douglas E. Pfeiffer, Ehsan Samei,
6. STABIN, M.G., Radiation Protection and Dosimetry: An Introduction to Health Physics, Springer, New York, NY (2007).
7. Brown, B.H., Smallwood, R.H., Barber, D.C., Lawford, P.V., & Hose, D.R. (1999). Medical Physics and Biomedical Engineering (1st ed.).
8. Quality and Safety in Imaging. Giles W. L. Boland, Lluís Donoso-Bach (n.d.). Germany: Springer International Publishing.
9. Specification, Acceptance Testing and Quality Control of Diagnostic X-ray Imaging Equipment, Seibert JA, et al. (ed), AAPM Monograph No. 20.
10. AIUM Routine Quality Assurance of Clinical Ultrasound Equipment, Ed.2, (2020). American Institute of Ultrasound in Medicine, 14750Sweitzer Ln, Suite 100, Laurl, MD.
11. ACR MRI Quality Control Manual, 2015 (available from acr.org).
12. AAPM TG-177, Acceptance Testing and Annual Physics Survey. Recommendations for Gamma Camera, SPECT, and SPECT/CT Systems
13. American College of Radiology (ACR). PET Accreditation Program Testing Instructions. Reston, Virginia, USA. 2018.

14. INTERNATIONAL ATOMIC ENERGY AGENCY, Quality Assurance Program for Computed Tomography: Diagnostic and Therapy Applications, IAEA Human Health Series No. 19, IAEA, Vienna (2012)
15. INTERNATIONAL ATOMIC ENERGY AGENCY, Basics of Quality Management for Nuclear Medicine Practices, IAEA Human Health Series No. 43, IAEA, Vienna (2023).

Note:

This list is intended for use as a study aid only. SCFHS does not intend the list to imply endorsement of these specific references, nor are the exam questions necessarily taken solely from these sources.

Blueprint Outlines:

No.	Section	Percentage
1	Types of medical imaging	10%
2	Radiological anatomy and physiology	5%
3	Dosimetry methods, quantities units, and regulations	10%
4	Radiation Protection and safety	10%
5	Radiation survey equipment	10%
6	Physics of medical imaging	15%
7	Medical imaging instrumentation	15%
8	Performance testing of imaging equipment	15%
9	Medical imaging department design	5%
10	General Orientation	5%
Total		**100%**

Notes:

- Blueprint distributions of the examination may differ up to +/-5% in each category.
- Percentages and content are subject to change at any time. See the SCFHS website for the most up-to-date information.
- Research, Ethics, Professionalism, and Patient Safety are incorporated within various domains.
- Results will be published within 14 business days following the last date of your examination.

Part One Examination

Examination Format:

Part I Examination of Saudi board certificate shall consist of one paper with 150 Single Best Answer MCQs. Up to 10% unscored items can be added for pretesting purposes.

Passing Score:

1. The passing score is 65%.
2. If the percentage of candidates passing the exam before final approval is less than 70%, the passing score can be lowered by one mark at a time aiming at achieving 70% passing rate or a score of 60% whichever comes first. Under no circumstances, may the score can be reduced below 60%.

Suggested References:

1. Bushberg Jr., J, Seibert Jr., J.A., Leidholdt Jr., E.M., Boone, J.M. The Essential Physics of Medical Imaging, 4th Edition, 2020.
2. Huda, W. Review of Radiologic Physics, 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2016.
3. Diagnostic Radiology Physics, IAEA, Dance DR, et al., 2014.
4. Physics in Nuclear Medicine; by Simon Cherry, James Sorenson and Michael Phelps, Fourth Edition.
5. Clinical Imaging Physics: Current and Emerging Practice. (2020). Douglas E. Pfeiffer, Ehsan Samei,
6. STABIN, M.G., Radiation Protection and Dosimetry: An Introduction to Health Physics, Springer, New York, NY (2007).
7. Brown, B.H., Smallwood, R.H., Barber, D.C., Lawford, P.V., & Hose, D.R. (1999). Medical Physics and Biomedical Engineering (1st ed.).
8. Quality and Safety in Imaging. Giles W. L. Boland, Lluís Donoso-Bach (n.d.). Germany: Springer International Publishing.
9. Specification, Acceptance Testing and Quality Control of Diagnostic X-ray Imaging Equipment, Seibert JA, et al. (ed), AAPM Monograph No. 20.
10. AIUM Routine Quality Assurance of Clinical Ultrasound Equipment, Ed.2, (2020). American Institute of Ultrasound in Medicine, 14750Sweitzer Ln, Suite 100, Laurl, MD.
11. ACR MRI Quality Control Manual, 2015 (available from acr.org).

12. AAPM TG-177, Acceptance Testing and Annual Physics Survey Recommendations for Gamma Camera, SPECT, and SPECT/CT Systems
13. American College of Radiology (ACR). PET Accreditation Program Testing Instructions. Reston, Virginia, USA. 2018.
14. INTERNATIONAL ATOMIC ENERGY AGENCY, Quality Assurance Program for Computed Tomography: Diagnostic and Therapy Applications, IAEA Human Health Series No. 19, IAEA, Vienna (2012)
15. INTERNATIONAL ATOMIC ENERGY AGENCY, Basics of Quality Management for Nuclear Medicine Practices, IAEA Human Health Series No. 43, IAEA, Vienna (2023).

Note:

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Blueprint Outlines:

No.	Sections	Percentage
1	Types of medical imaging	10%
2	Radiological anatomy and physiology	10%
3	Dosimetry methods, quantities units, and regulations	10%
4	Radiation Protection and safety	10%
5	Radiation survey equipment	10%
6	Physics of medical imaging	15%
7	Medical imaging instrumentation	15%
8	Performance testing of imaging equipment	15%
9	Medical imaging department design	5%
Total		**100%**

Note:

- Blueprint distributions of the examination may differ up to +/-5% in each category.
- Percentages and content are subject to change at any time. See the SCFHS website for the most up-to-date information.
- Research, Ethics, Professionalism and Patient Safety are incorporated
- within various domains.

Final Written Examination

Examination Format:

A Saudi board final specialty written examination shall comprise two papers each with 100–125 single best-answer MCQs. Up to 10% of unscored items can be added for pretesting purposes.

Passing Score:

1. The passing score is 70%.

2. If the percentage of candidates passing the examination before final approval is ≤70%, the passing score must be lowered by one mark at a time aiming to achieve a passing rate of 70% or a passing score of 65% whichever comes first. The passing score cannot be reduced below 65% under any circumstances.

Suggested References:

1. Bushberg Jr., J, Seibert Jr., J.A., Leidholdt Jr., E.M., Boone, J.M. The Essential Physics of Medical Imaging, 4th Edition, 2020.
2. Huda, W. Review of Radiologic Physics, 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2016.
3. Diagnostic Radiology Physics, IAEA, Dance DR, et al., 2014.
4. Physics in Nuclear Medicine; by Simon Cherry, James Sorenson and Michael Phelps, Fourth Edition.
5. Clinical Imaging Physics: Current and Emerging Practice. (2020). Douglas E. Pfeiffer, Ehsan Samei,
6. STABIN, M.G., Radiation Protection and Dosimetry: An Introduction to Health Physics, Springer, New York, NY (2007).
7. Brown, B.H., Smallwood, R.H., Barber, D.C., Lawford, P.V., & Hose, D.R. (1999). Medical Physics and Biomedical Engineering (1st ed.).
8. Quality and Safety in Imaging. Giles W. L. Boland, Lluís Donoso-Bach (n.d.). Germany: Springer International Publishing.
9. Specification, Acceptance Testing and Quality Control of Diagnostic X-ray Imaging Equipment, Seibert JA, et al. (ed), AAPM Monograph No. 20.
10. AIUM Routine Quality Assurance of Clinical Ultrasound Equipment, Ed.2, (2020). American Institute of Ultrasound in Medicine, 14750Sweitzer Ln, Suite 100, Laurl, MD.
11. ACR MRI Quality Control Manual, 2015 (available from acr.org).
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14. INTERNATIONAL ATOMIC ENERGY AGENCY, Quality Assurance Program for Computed Tomography: Diagnostic and Therapy Applications, IAEA Human Health Series No. 19, IAEA, Vienna (2012)
15. INTERNATIONAL ATOMIC ENERGY AGENCY, Basics of Quality Management for Nuclear Medicine Practices, IAEA Human Health Series No. 43, IAEA, Vienna (2023).

Note:

This list is intended for use as a study aid only. SCFHS does not intend the list to imply endorsement of these specific references, nor are the exam questions necessarily taken solely from these sources.

Blueprint Outlines:

No.	Sections	Percentage
1	Types of medical imaging	10%
2	Radiological anatomy and physiology	5%
3	Dosimetry methods, quantities units, and regulations	10%
4	Radiation protection and safety	10%
5	Radiation survey equipment	10%
6	Physics of medical imaging	15%
7	Medical imaging instrumentation	15%
8	Performance testing of imaging equipment	15%
9	Medical imaging department design	5%
10	General informatics	5%
Total		**100%**

Note:

1. Blueprint distribution of the examination may differ up to ±5% in each category.
2. Percentages and content are subject to change at any time. Please refer to the SCFHS website for up-to-date information.
3. Research, Ethics, Professionalism, and Patient Safety are incorporated within various domains.

FINAL CLINICAL EXAMINATION

General Information	
Exam Format	- The final clinical/practical examination shall consist of **(4)** graded stations, each with **(15)** minute encounters. - You will encounter **1-2** examiners in each station.
Conduct of Evaluation	
Station Information	- The 4 stations consist of (4) Structured Oral Exam (SOE) stations. - All stations shall be designed to assess integrated clinical/practical encounters. - Domains and sections may overlap, and more than one category can be evaluated within a station. - Each station may address one or more cases or scenarios. - SOE stations are designed with preset questions and ideal answers. - A scoring rubric for post-encounter questions is also set in advance (if applicable).
Time Management	- The examiner is aware of how much material needs to be covered per station, and it is their responsibility to manage the time accordingly. - The examiner will want to give you every opportunity to address all the questions within the station. - They may indicate that "in the interests of time, you will need to move to the next question." This type of comment has no bearing on your performance. It is simply an effort to ensure that you complete the station. If you are unclear about something during the station, ask the examiner to clarify. - Some stations may finish early – if this occurs, the examiner will end the encounter.
Examiner Professionalism	- The examiners have been instructed to interact with you professionally − don't be put off if they are not as warm and friendly towards you as usual. - We recognize this is a stressful situation, and the examiner is aware that you are nervous. If you need a moment to collect your thoughts before responding, indicate this to the examiner. - The nomination of examiners is based on the principle that candidates are assessed by qualified examiners selected and appointed by

General Information	
	SCFHS. The examiner is not obligated by any means to share their personal information or professional details with the candidate.
Conflicts	- The examiners come from across the country. You will likely recognize some of them and may have worked with some of them in your center's clinical/academic capacity. This is completely acceptable to the SCFHS and is not a conflict unless you or the examiner perceive it as such (i.e., if the examiner had a substantial contribution to your training or evaluation, or if you have another personal relationship with the examiner). - Identify the conflict at the moment of introduction; examiners have been instructed to do the same. Examiners will alert the SCFHS staff, every attempt will be made to find a suitable replacement for the station.
Confidentiality	- Electronic devices are NOT permitted. - Communication with other candidates during the evaluation is prohibited.

Examination Content	
Sections	- The examination will cover **some** of the following sections: 1. Types of medical imaging 2. Radiological anatomy and physiology 3. Dosimetry methods, quantities units, and regulations 4. Radiation Protection and safety 5. Radiation survey equipment 6. Physics of medical imaging 7. Medical imaging instrumentation 8. Performance testing of imaging equipment 9. Medical imaging department design 10. General Informatics

Definition of Clinical/Practical Skill Domains	
Domain	**Definition**
Data-Gathering Skills	- Defined as: the candidates' ability to obtain and identify important information, correlate the clinical data to recommend appropriate testing. - It includes interviewing and history taking.
Reasoning and Analytical Skills	- Defined as: the candidates' ability to rationalize recommended effective management plans, evaluate alternative plans, recognize indicators to different appropriate treatments based on relevant, correct clinical data interpretation .
Decision-Making Skills	- Defined as: the candidates' ability to formulate a logical diagnosis, identify immediate needs, and make accurate inferences regarding the expected outcomes. It includes recognizing potential complications, risks, and benefits.
Professional Attitude	- - Defined as the commitment to deliver the highest standards of ethical and professional behavior in all aspects of health practice, attitudes, knowledge, and skills based on clinical &/or medical administrative competence, ethics, societal, & legal duties resulting in the wise application of behaviors that demonstrate a commitment to excellence, respect, integrity, accountability & altruism (e.g. self-awareness, reflection, life-long learning, scholarly habits, & physician health for sustainable practice).

Note:

- The content is subject to change at any time. See the SCFHS website for the most up-to-date information.

XIII. POLICIES AND PROCEDURES

In addition to representing the means and materials, this curriculum outlines the learning objectives with which trainees and trainers will interact to achieve the identified educational outcomes. SCFHS has a full set of “General Bylaws of Training in Postgraduate Programs” and “Executive Policies” (published on the official SCFHS website) that regulate all training-related processes. The general bylaws of training, assessment, and accreditation (as well as executive policies on admission, registration, formative assessment and promotion, examination, trainee representation and support, duty hours, and leaves) are examples of regulations that must be implemented. Trainees, trainers, and supervisors must comply with the most updated bylaws and policies under this curriculum, which can be accessed online (via the official SCFHS website).

XIV. APPENDICES

1. Junior-level competency-matrix
2. Senior-level competency-matrix
3. Examples of an academic half-day table
4. Example of research rotation objective
5. Logbook
6. End of the rotation evaluation form
7. Recommended reading
8. Glossary
9. References

Appendix A

Junior-level competency-matrix to map competency, learning domain, and milestones

level	*Competency-Roles* (with annotation of learning domains involved: K: knowledge, S: Skills, A: Attitude)	Activities Related to Specific Rotation				
		Hospital Orientation, clinical awareness, and patient care	**Radiation Protection and Safety**	**General Clinical Radiation Oncology**	**General Clinical Nuclear Medicine**	**General Clinical Diagnostic Imaging Physics**
R1	**Diagnostic Radiology Physicist Expert**	Describe the radiologic anatomy and physiology.- Recognize appropriate clinical dress code. K, S.	Identify regulatory requirements and guidelines.- Identify the radiation dose limits. K.	Recognize the systems in radiation treatment units. K.	Recognize the dosimetry and protection differences between nuclear medicine and radiology. K, S.	Propose actions to improve image quality. S.
	Communicator	Manage the interactions between patients and staff. S, A.	Effectively communicate with patients and team members. S, A.	Effectively communicate with team members and engineers. S, A.	Effectively communicate with team members and engineers. S, A.	Effectively communicate with team members and engineers. S, A.
	Collaborator	Illustrate the interactions, duties, and responsibilities of teams comprising multidisciplinary caregivers. A.	Illustrate the collaboration and teamwork, in addition to distributing awareness and knowledge. S, A.	Demonstrate collaboration and seek consultation from senior physicists when required. A.	Demonstrate collaboration and seek consultation from senior physicists when required. A.	Demonstrate multidisciplinary teamwork. Seek support from senior physicists when needed. S, A.
	Advocate	Ensure good patient experience. S, A.	Define radiation protection principles. K.	Describe the role of radiation	Explain the role of medical physicists in	Explain the role of medical

level	*Competency-Roles* (with annotation of learning domains involved: K: knowledge, S: Skills, A: Attitude)	Activities Related to Specific Rotation				
		Hospital Orientation, clinical awareness, and patient care	**Radiation Protection and Safety**	**General Clinical Radiation Oncology**	**General Clinical Nuclear Medicine**	**General Clinical Diagnostic Imaging Physics**
				oncology physicists. K.	Nuclear Medicine. K.	physicists in diagnostic imaging. K.
	Leader	Manage responsibilities and tasks. S, A.	Manage time, responsibilities, and tasks. S, A.	Manage time, responsibilities, and tasks. S, A.	Manage time, responsibilities, and tasks. S, A.	Manage time, responsibilities, and tasks. S, A.
	Scholar	Identify the types of medical images. K.	Exercise the application of statistics in radiation and medical imaging. K, S.	Demonstrate advanced methods in radiotherapy. K, S.	Define the physics of SPECT, SPECT/CT, and PET/CT equipment. K.	Describe the hardware and software design of the imaging equipment. K, S.
	Professional	Attend to patient needs, privacy, and confidentiality. S, A.	Select appropriate personal protective equipment requirements. S.	Demonstrate quality assurance methods in radiotherapy. K, S.	Demonstrate the QC procedures used in nuclear medicine. K, S.	Demonstrate the QC procedures used in diagnostic imaging modalities. K, S.
R2	***Competency-Roles*** (with annotation of learning domains involved: **K**:	**Professional Activities Related to Specific Rotation**				
		General Radiography	**Angiography and Fluoroscopy**	**Mammography**	**Computed Tomography**	**Nuclear Medicine**	**Other Imaging Modalities**

level	*Competency-Roles* (with annotation of learning domains involved: K: knowledge, S: Skills, A: Attitude)	Activities Related to Specific Rotation					
		Hospital Orientation, clinical awareness, and patient care	**Radiation Protection and Safety**	**General Clinical Radiation Oncology**		**General Clinical Nuclear Medicine**	**General Clinical Diagnostic Imaging Physics**
	knowledge, **S**: Skills, **A**: Attitude)						
	Diagnostic Radiology Physicist Expert	1. Identify radiation exposure control techniques. K, S0 2. Illustrate methods of identifying and isolating common artifacts. K, S.					
	Communicator	1. Communicating effectively with team members, radiographers, and engineers. S, A.					
	Collaborator	1. Demonstrate multidisciplinary teamwork. Seek support from senior physicists when needed. S, A.					
	Advocate	1. Present the advantages and disadvantages of each diagnostic imaging technique based on technical and scientific data to non-physicist healthcare decision-makers and patients. K, S.					
	Leader	1. Manage responsibilities and tasks in an efficient and timely manner. S, A.					
	Scholar	1. Describe the complete radiographic imaging chain. K. 2. Explore new technology and techniques. K. 3. Explain the methods of exposure control. K, S.					
	Professional	1. Perform acceptance and periodical compliance testing for medical imaging devices. K, S. 2. Estimate the radiation dose. K, S.					

Appendix B

Senior-level competency-matrix to map competency, learning domain, and milestones

	Competency-Roles (with annotation of learning domains involved: **K**: knowledge, **S**: Skills, **A**: Attitude)	**Professional Activities Related to Specialty**		
		Ultrasound	**Magnetic resonance imaging**	**Clinical physics practice, clinical project, and final residency report**
R3	**Diagnostic Radiology Physicist Expert**	1. Identify imaging artifacts and challenges. K, S. 2. Propose methods to eliminate image artifacts. K, S.		
	Communicator	3. Demonstrate effective communication with team members, radiographers, and engineers. S, A.		
	Collaborator	4. Work in a multidisciplinary team. Seek support from senior physicists when required. S, A.		
	Advocate	5. Present the advantages and disadvantages of each diagnostic imaging technique based on technical and scientific data to non-physicist healthcare decision-makers and patients. K, S.		
	Leader	6. Manage responsibilities and tasks efficiently and in a timely manner. S, A.		
	Scholar	7. Describe the complete radiographic imaging chain. K. 8. Explore new technology and techniques in medical imaging. K.		
	Professional	9. Perform acceptance and periodical compliance testing for medical imaging devices. K, S.		

Appendix-C

The following table lists topics that illustrate the half-day activities that span over the course of one year (or cycle of teaching if more than one year is required to cover all topics).

Repeating sessions/topics every training year is discouraged. Each half-day is ideally dedicated to one theme.

Academic week	*Section*	*Date*	*Time*	*Sessions*	*Presenters*
1	Introduction to Medical Physics	Oct 5	13:00–14:00	Welcoming trainees to the program	Program director
			14:00–15:00	Case base study**	A
			15:00–16:00	Topic 2: Historical background	B
2	Radiation Safety	Oct 12	13:00–14:00	Topic 3: International bodies in radiation	C
			14:00–15:00	Case base study	D
			15:00–16:00	Topic 5: National agencies and references in radiation	E
3	Medical Physics Tools	Oct 19	13:00–14:00	Topic 6: Phantoms	F
			14:00–15:00	Case base study	B
			15:00–16:00	Topic 8: Device calibration	C
4	Imaging & Health Informatics	Oct 26	13:00–14:00	Journal club*	K
			14:00–15:00	Case base study	B
			15:00–16:00	Topic 10: Basic information systems in radiology	A

1. * Journal club activities can be conducted in the evening or during the half-day
2. ** Case-based study can be conducted in the evening or during the half-day

Appendix D

Timeline for the research projects completed by trainees

9Reporting to the Level of Expected step What to submit research training committee			
R1	- Attend the course - Select a project topic	- Certificate of course attendance	Certificate
R2	- Select a project topic - IRB approval - Proposal writing - Data collection - Data analysis	- Brief description of the project - Final project proposal	Committee approval letter
R3	- Data collection - Data analysis - Manuscript completion - Approach journals - Abstract/poster submission to conferences	- Manuscript - Conference certificate as a speaker or journal citation	Manuscript approval and promotion

Appendix-E

Logbook

OBJECTIVES OF THE LOGBOOK:

The objectives of the logbook include:

1. Maintain records and document all academic activities (e.g., procedures, lectures, meetings, training courses, workshops, symposia, and presentations) undertaken during the training program as required in each rotation.
2. Assist the resident in identifying their deficiencies in specific areas.
3. Assist the program director/evaluator in documenting the contribution and evaluation of residents.
4. Provide the evaluator with guidance regarding appropriate and fair assessment of residents.
5. Provide the Program Director with guidance regarding deficiencies in training.

GUIDELINES FOR RESIDENTS:

1. Residents are required to maintain logbooks throughout the training period.
2. Logbook entries concerning recorded activities should be completed on the day of performing the activity.
3. All entries must be signed by a mentor within one week.
4. Residents must discuss their training progress, as indicated in the logbook, with the mentor and/or Program Director each month.
5. Residents must submit their completed logbooks to the Program Director at the end of rotations and training for subsequent submission to the regional supervisory committee.
6. Residents who do not get their logbooks signed by the Program Director will be ineligible to receive the end-of-training certification or appear for the final examination.

(R1) Logbook			
Date	Activity	Comments	Mentor signature

	Procedures	Frequency		
	1. Perform basic phantom scan using different x-ray machines. 2. Perform dosimetry measurements using ionization chambers and other detectors. 3. Perform patient-specific dose verification measurements. 4. Perform measurement and/or calculation of individual patient dose. 5. Attend procedures and perform dosimetry measurements to calculate and verify the radiation dose to the patient. 6. Attend QC measurements for x-ray equipment	Three for different x-ray equipment. Three for different x-ray equipment. Three for different x-ray procedures. Three for each x-ray procedure. Three for each radiotherapy procedure. Three for different x-ray equipment.		

(R2) Logbook				
Date	Activity		Comments	Mentor signature
	Procedures	Frequency		
	1. Perform an advanced phantom scan and parameters manipulation using different x-ray machines.	Minimum of three times for different x-ray equipment.		
	2. Calibrate and verify the x-ray equipment.	Minimum of three times for different x-ray equipment.		
	3. Perform QC measurements for the x-ray equipment including plan, fluoroscopy, angiography and mammography.	Minimum of three times for different x-ray equipment. Minimum of three times for each x-ray equipment.		
	4. Perform acceptance and commissioning procedures for the x-ray equipment.	Minimum of three times for different x-ray procedures. Minimum of three times for each x-ray procedure.		
	5. Perform preventive and corrective maintenance for the x-ray equipment.	Minimum of three times for each x-ray procedure.		
	6. Perform dosimetry measurements using ionization chambers and other detectors.	Minimum of three times for each CT procedure.		
	7. Perform patient-specific dose verification measurements.	Minimum of three times for the CT equipment.		
	8. Perform measurement and/or calculation of individual patient dose.	Minimum of three times for the CT equipment.		
	Perform a phantom scan and parameters manipulation using different CT scanners.	Minimum of three times for the CT equipment. Minimum of three times.		
	9. Calibrate and verify the CT equipment.	Once for different CT procedures.		
	10. Perform QC measurements for the CT equipment.	Minimum of three times for different CT procedures.		
	11. Perform acceptance and commissioning procedures for the CT equipment.			

(R2) Logbook				
Date	Activity		Comments	Mentor signature
	Procedures	Frequency		
	12. Perform preventive and corrective maintenance for the CT equipment. 13. Perform dosimetry measurements using ionization chambers and other detectors. 14. Perform patient-specific dose verification measurements.			

(R3) Logbook				
Date	Activity		Comments	Mentor signature
	Procedures	Frequency		
	1. Perform basic phantom scan and parameter manipulation in SPECT and gamma camera machines. 2. Calibrate and verify the NM equipment. 3. Perform QC measurements for the NM equipment 4. Perform acceptance and commissioning procedures for the NM equipment. 5. Perform preventive and corrective maintenance for the NM equipment. 6. Perform a phantom scan and parameter manipulation for the US machine. 7. Calibrate and verify the US machine. 8. Perform QC measurements for the US machine. 9. Perform a phantom scan and parameters manipulation for the MRI scanner. 10. Calibrate and verify the MRI scanner. 11. Perform acceptance and commissioning and QC procedures for the MRI equipment.	Minimum of three times for different NM equipment. Minimum of three times for different NM equipment. Minimum of three times for different NM equipment. Minimum of three times for different NM equipment. Minimum of three times for different NM equipment. Minimum of three times for the US machine. Minimum of three times for the US machine. Minimum of three times for the US machine. Minimum of three times for the MRI scanner. Minimum of three times for the MRI scanner. Minimum of three times for the MRI scanner.		

Appendix-F

ITER Rotation-Specific Form

Saudi Commission for Health Specialties 	Diagnostic Radiology Medical Physics Stage & Level of training: (Junior) (R1) Evaluated By: Evaluator's name. Evaluating : Person (role) or moment's name (if applicable) Dates: Start date to end date

* Indicates a mandatory response

In-Training Evaluation Report

ITER Rating scale:

- NA: Not Applicable or no opportunity to evaluate during this rotation.
- Performance that Does not Meet Expectations (<50%): Trainee consistently struggles to meet basic requirements, requires significant development and intervention in various aspects of training and patient care. Performance consistently lags behind the expected competency level.
- Borderline Performance (>50–69.99%): Trainee meets some of the criteria satisfactorily; however, notable deficiencies in their overall performance have been noted that require attention and development. Performance frequently falls below the expected competency level, indicating a need for improvement in some areas.
- Performance that Meets Expectations (>70–89.99%): Trainee fulfills their role competently, meet the required criteria effectively, and contributes to their responsibilities. Performance consistently aligns with the expected competency level.
- Performance that Exceeds Expectations (>90%): Trainee constantly demonstrates exceptional clinical skills, professionalism, and commitment to continuous learning. Performance significantly exceeds the expected competency level.

	NA	Does not Meet Expectations (<50%)	Borderline (≥50–69.99%)	Meets Expectations (≥70–89.99%)	Exceeds Expectations (≥90%)
A. MEDICAL PHYSICS EXPERT					
Understands technical and clinical science					
Demonstrates expertise in all aspects of technical and clinical medical physics, in addition to management of common medical physics					
Avoids unnecessary or harmful investigations or management					
Demonstrates appropriate knowledge, skills, and attitudes					
B. COMMUNICATOR					
Records appropriate progress notes					
Communicate with medical staff in an appropriate manner					
Maintains professional relationships with other healthcare providers					
Maintains clear and complete records, reports, and informed and written informed consent					
C. COLLABORATOR					
Works effectively in a collaborative environment					
Capable of working with allied healthcare staff					
Capable of working with senior and junior staff					
D. HEALTH ADVOCATE					

	NA	Does not Meet Expectations (<50%)	Borderline (≥50–69.99%)	Meets Expectations (≥70–89.99%)	Exceeds Expectations (≥90%)
Is attentive to preventive measures					
Attentive to issues in public health policy					
Recognizes important social, environmental, and biological determinants of health					
Offers advocacy on behalf of patients at practice and general population levels					
E. SCHOLAR					
Attends and contributes to rounds, seminars, and other learning events					
Discusses the selected topics in an appropriate manner, as requested					
Demonstrates adequate ability to search literature					
Demonstrates efforts to increase knowledge base					
Accepts and acts on constructive feedback					
Contributes to the development of new knowledge					
F. LEADER					
Participates in activities that contribute to increasing the effectiveness of healthcare organizations and systems					
Leads their practice and career effectively					
Serves in administrative and leadership roles as appropriate					

	NA	Does not Meet Expectations (<50%)	Borderline (≥50–69.99%)	Meets Expectations (≥70–89.99%)	Exceeds Expectations (≥90%)
G. PROFESSIONAL					
Recognizes their limitations and seeks advice and consultation when necessary					
Delivers evidence-based care with integrity, honesty, and compassion					
Demonstrates appropriate insight into their strengths and weaknesses					
Shows initiative within the limits of knowledge and training					

Workplace- Based Assessment and other Activities	NA	Does not Meet Expectations (<50%)	Borderline (≥50–69.99%)	Meets Expectations (≥70–89.99%)	Exceeds Expectations (≥90%)	Comments
*CBD						
*Mini-CEX						
*DOPs						
Non-WBA activities						

*Did you receive an opportunity to meet with this trainee to discuss their performance and action plan? (for the evaluator)

- Yes
- No

Did you receive an opportunity to discuss your performance and action plan with the preceptor/supervisor? (for the trainee)

- Yes
- No

* Feedback Comments (verbal and written feedback is a mandatory component of this assessment, including areas of strengths/areas for improvement)

……
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……
……

*Agreed upon action plan:

……
……
……
……

Appendix-G

Table of formative assessment requirements for each rotation

Training Year	Rotation name	Duration	CBD	DOPS	SOE
R1	Hospital Orientation and Clinical Awareness	8 weeks	NA	NA	R 1 level will have one SOE/academic year, with a minimum of 4 station SOE`
	Radiation Protection and Safety	12 Weeks	Trainees are required to complete a minimum of four CBDs	Trainees are required to complete a minimum of three DOPS: Calibration and operation of the radiation survey meter Radiation dose optimization in x-ray. Radiation shielding assessment	
	General Clinical Radiation Oncology Physics	4 Weeks	Trainees are required to complete a minimum of two CBDs	Trainees are required to complete a minimum of one DOPS Quality assurance of the treatment planning systems	

Training Year	Rotation name	Duration	CBD	DOPS	SOE
	General Clinical Nuclear Medic ine Physics	4 Weeks	Trainees are required to complete a minimum of two CBDs	Trainees are required to do a minimum of one DOPS Gamma camera quality assurance and performance testing	
	General Clinical Diagnostic and Imaging Physics	20 weeks	Trainees are required to do a minimum of 5 CBDs	Trainees are required to do a minimum of 5 DOPS Image receptor performance evaluation Patient radiation dose assessment and optimization Mobile x-ray quality assurance and performance testing General Radiography quality assurance and performance testing R/F systems quality assurance and performance testing	

Training Year	Rotation name	Duration	CBD	DOPS	SOE
R2	General Radiography	12 Weeks	Trainees are required to do a minimum of 4 CBDs	Trainees are required to do a minimum of 3 DOPS Technique factor selection and optimization Patient radiation dose assessment and optimization Troubleshooting and maintenance of imaging systems	R 2 level will have One SOE//academic year, with a minimum of four station SOE
	Dental Radiography	2 Weeks	Trainees are required to do a minimum of one CBD	Trainees are required to do a minimum of one DOPS Radiation dose optimization in dental radiography	
	Image Displays	2 Weeks	Trainees are required to complete a minimum of one CBD	Trainees are required to complete a minimum of one DOPS Display system performance evaluation	

Training Year	Rotation name	Duration	CBD	DOPS	SOE
	Angiography and Fluoroscopy	8 Weeks	Trainees are required to complete a minimum of three CBDs	Trainees are required to complete a minimum of two DOPS Fluoroscopic equipment quality assurance Radiation dose management and optimization	
	Mammography	8 Weeks	Trainees are required to complete a minimum of three CBDs	Trainees are required to complete a minimum of two DOPS Mammographic equipment quality assurance Breast dose assessment and optimization	
	Computed Tomography	12 Weeks	Trainees are required to complete a minimum of four CBDs	Trainees are required to complete a minimum of three DOPS CT system performance evaluation Radiation dose optimization Image quality assessment and protocol development	

Training Year	Rotation name	Duration	CBD	DOPS	SOE
	Other imaging devices	4 weeks	Trainees are required to complete a minimum of one CBD	Trainees are required to complete a minimum of one DOPS QC for optical systemsimaging	
R3	Nuclear Medicine	8 Weeks	Trainees are required to complete a minimum of four CBDs	Trainees are required to complete a minimum of two DOPS Radionuclide calibrator and dose measurement Image quality optimization and reconstruction	R 3 level will have one SOE/academic year, with a minimum of four station SOE
	Ultrasound (US)	10 Weeks	Trainees are required to complete a minimum of five CBDs	Trainees are required to do a minimum of 3 DOPS Ultrasound system performance evaluation Probe and system calibration Image quality optimization and artifact recognition	

Training Year	Rotation name	Duration	CBD	DOPS	SOE
	Magnetic Resonance Imaging	14 Weeks	Trainees are required to do a minimum of 5 CBDs	Trainees are required to complete a minimum of four DOPS MRI system performance evaluation Radiofrequency (RF) coil quality assurance MRI pulse sequence optimization Geometric distortion and image quality assessment MRI safety and siting	
	Clinical Physics Practice, Clinical Project, and Final Residency Report	16 weeks	The timeline specified in Appendix-D will be followed by the trainees during this rotation The trainees will be assessed based on their progress in the research project		

Appendix-H

Presentation evaluation form

Resident's name: _____

Level: _____

Staff Supervisor: _____

Date of Presentation: _____

Rotation: _____

	Poor (1)	Fair (2)	Good (3)	Excellent (4)	Not applicable
Presentation Content Clarity and organization of the presentation:					
Did the trainee present the information in a clear and organized manner?					
Were the main points communicated effectively?					
Were the ideas logically presented and connected?					
Content knowledge and understanding					

	Poor (1)	Fair (2)	Good (3)	Excellent (4)	Not applicable
Did the trainee demonstrate a thorough understanding of the topic?					
Did the trainee provide accurate and up-to-date information?					
Did the trainee address the key aspects of the topic?					
Use of supporting materials and visuals					
Did the trainee use visuals (e.g., slides, graphs, charts) to enhance the presentation?					
Were the supporting materials relevant, clear, and well-integrated into the presentation?					
Did the visuals aid in understanding the topic?					
Presentation, Delivery, Speaking skills, and Confidence:					
Did the trainee speak clearly and audibly?					

	Poor (1)	Fair (2)	Good (3)	Excellent (4)	Not applicable
Did the trainee maintain a confident and engaging demeanor throughout the presentation?					
Did the trainee engage the audience effectively?					
Time management					
Did the trainee adhere to the allotted presentation time?					
Did the trainee manage time effectively and cover the key points within the given timeframe?					
Body language and non-verbal communication					
Did the trainee maintain appropriate eye contact with the audience?					
Did the trainee use gestures and body language to enhance the presentation?					
Did the trainee exhibit a professional and engaging presence?					

	Poor (1)	Fair (2)	Good (3)	Excellent (4)	Not applicable
Overall Assessment, Overall impression, and effectiveness of the presentation					
Rate the overall effectiveness of the presentation, considering the content, delivery, and engagement with the audience.					
Strengths: **Identify the strengths of the trainee's presentation.**					
Areas for improvement: **Provide constructive feedback on areas where the trainee can improve their presentation skills.**					

Appendix-I

Recommended Readings

1. Hall, Eric, and Giaccia, Amato. Radiobiology for the Radiologist, 7th Edition or later – Or – Similar text
2. Bushberg Jr., J, Seibert Jr., J.A., Leidholdt Jr., E.M., Boone, J.M. The Essential Physics of Medical Imaging, 4th Edition, 2020.
3. Diagnostic Radiology Physics, IAEA, Dance DR, et al., 2014.
4. Imaging Systems for Medical Diagnostics –4th Edition, Oppelt A (ed). 2005.
5. Huda, W. Review of Radiologic Physics, 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2016.
6. Bankman, I., ed. Handbook of Medical Image Processing and Analysis, 2nd ed. Burlington, MA: Academic Press, 2009.
7. Burger, W., Burge, M.J. Digital Image Processing: An Algorithmic Introduction using Java, Springer (2008).
8. Martin, A., Harbison, S.A. An Introduction to Radiation Protection, 5th edn, Oxford University Press (2006).
9. Stabin, M.G. Radiation Protection and Dosimetry: An Introduction to Health Physics, Springer, New York, NY (2007).
10. Martin, C.J., Sutton, D.G. Practical Radiation Protection in Healthcare, Oxford University Press, Oxford (2002).
11. Specification, Acceptance Testing and Quality Control of Diagnostic X-ray Imaging Equipment, Seibert JA, et al. (ed), AAPM Monograph No. 20.
12. Radiation Dose Management for Fluoroscopically-Guided Interventional Medical Procedures, NCRP Report No. 168, 2013
13. Temperton, D.H., Green, S. "Personal Monitoring", Practical Radiation Protection in Healthcare, (MARTIN, C.J.SUTTON, D.G., Eds), Oxford University Press, Oxford, (2002).
14. Essentials of Ultrasound Physics, JA Zagzebski, Mosby, 1996.
15. AIUM Routine Quality Assurance of Clinical Ultrasound Equipment, Ed.2, (2020). American Institute of Ultrasound in Medicine, 14750Sweitzer Ln, Suite 100, Laurl, MD.
16. Physics in Nuclear Medicine, Cherry SR, Sorenson JA, Phelps ME., Grune & Stratton, Orlando, 2003
17. Christian PE, Bernier D, Langan JK, Nuclear Medicine and PET Technology and Techniques, Mosby, St. Louis, 2004.

18. AAPM Report 100 Acceptance Testing and Quality Assurance Procedures for Magnetic Resonance Imaging Facilities, Jackson E, Bronskill M, et al., 2010
19. ACR MRI Quality Control Manual, 2015 (available from acr.org).
20. Dowsett, D.J., Kenny, P.A., Johnston, R.E. The Physics of Diagnostic Imaging, 2nd edn, Oxford University Press (2006).
21. International Atomic Energy AgencY, Fundamental Safety Principles, IAEA Safety Standards Series, SF-1, IAEA, Vienna (2006).
22. Hennekens, C.H., Buring, J.E., Mayrent, S.L. Epidemiology in Medicine, 1st edn, Lippincott Williams & Wilkins (1987).
23. International Atomic Energy Agency, Applying Radiation Safety Standards in Nuclear Medicine, Safety Reports Series No. 40, STI/PUB/1207, IAEA, Vienna (2005). http://wwwpub. iaea.org/MTCD/publications/PDF/Pub1207_web.pdf.
24. Stabin, M.G. Radiation Protection and Dosimetry: An Introduction to Health Physics, Springer, New York, NY (2007). http://opac.library.usyd.edu.au/record=3563832.
25. ARPANSA. Code of Practice for the Exposure of Humans to Ionizing Radiation for Research Purposes, Radiation Protection Series Rep. 8, ARPANSA. http://www.arpansa.gov.au/rps8.htm.
26. American Association Of Physicists In Medicine, A guide to the teaching of clinical radiological physics to residents in diagnostic and therapeutic radiology, AAPM Rep. 64, New York (1999). http://www.aapm.org/pubs/reports/rpt_64.PDF.
27. Gray, J.E., Morin, R.L. Purchasing medical imaging equipment, Radiology 171 1 (1989) 9-16.
28. Gray, J.E., Stears, L.G. "Acceptance testing of diagnostic imaging equipment: considerations and rationale", Specification, Acceptance Testing, and Quality Control of Diagnostic X ray Imaging Equipment, Proceedings of the 1991 AAPM Summer School, University of California, Santa Cruz, CA, (SEIBERT, LA., BARNES, G.T.GOULD, R.G., Eds), American Institute of Physics, (1991) 1-9.

Appendix-J

Glossary

Glossary	
Blueprint	Description correlating educational objectives with assessment contents. For example, a test blueprint defines the proportion of questions allocated to each learning domain and/or content in the test.
Competency	Capability to function within a defined professional role that implies entrustment of a trainee through graduation from the program with the required knowledge, skills, and attitude needed to practice unsupervised.
Specialty Core Content (skills, knowledge, and professional attitude)	Specific knowledge/skill/professional attitude that is specific and integral to the specialty.
Formative assessment	An assessment is used to inform the trainer and learner of the topics that have been taught and learned, respectively, to improve learning. The results of the formative assessment are communicated through feedback to the learner. Formative assessments are not intended to make judgments or decisions (however, they can be considered a secondary gain).
Mastery	Exceeding the minimum level of competency to the proficient level of performance, indicating rich experience and possession of great knowledge, skills, and attitude.
Portfolio	A collection of evidence of progression towards competency. It may include constructed components (defined based on mandatory continuous assessment tools in the curriculum) and unconstructed components (selected by the learner).

Glossary	
Summative assessment	An assessment that describes the composite performance of the development of the learner at a particular point in time. It is used to inform judgment and make decisions about the level of learning and certification.
Universal Topic	Knowledge, skills, or professional behavior that are not specific to the given specialty but universal for the general practice of a given healthcare profession.

Appendix-K

References:

1. Kern DE, Thomas PA, Hughes MT. (2009). Curriculum Development for Medical Education: A Six-Step Approach. Baltimore, MD, USA: Johns Hopkins University Press.
2. Saudi Commission for Health Specialties. Post Graduate Resident Training Curriculum Template. Riyadh, Saudi Arabia: Saudi Commission for Health Specialties.
3. CanMEDS: Better standards, better physicians, better care. Available from: https://www.royalcollege.ca/en/canmeds/canmeds-framework.html
4. The CanMEDS 2014 Objectives of Training in the Specialty of Diagnostic Radiology. Ottawa: The Royal College of Physicians and Surgeons of Canada.
5. Bandiera G, Sherbino J, Frank JR. (2006). The CanMEDS assessment tools handbook. An introductory guide to assessment methods for the CanMEDS competencies. The Royal College of Physicians and Surgeons of Canada, Ottawa.
6. Saudi Commission for Health Specialties. (2014). Introduction to Clinical Research for Residents. Riyadh, Saudi Arabia: Saudi Commission for Health Specialties.
7. Saudi Commission for Health Specialties. (2022). Rules and Regulations. Riyadh, https://scfhs.org.sa/en/regulations-content.
8. Saudi Commission for Health Specialties. (2015). Saudi Board Medical Imaging Curriculum. Riyadh, Saudi Arabia: Saudi Commission for Health Specialties.

9. Prisciandaro JI, Willis CE, Burmeister JW, Clarke GD, et al. (2014). Essentials and guidelines for clinical medical physics residency training programs: executive summary of AAPM Report Number 249. J Appl Clin Med Phys. 2014 May 8;15(3):4763. doi: 10.1120/jacmp.v15i3.4763. PMID: 24892354; PMCID: PMC5711071.
10. Jenny Bertholet, Hania Al Hallaq, Iuliana Toma-Dasu, Paris Ann Ingledew, David J. Carlson. (2023). Medical Physics Training and Education: Learning from the Past and Looking to the Future. International Journal of Radiation Oncology Biology Physics. Volume 117, Issue 5.
11. Commission on Accreditation of Medical Physics Educational Programs, Inc. (Revised February 2023). Standards for Accreditation of Residency Educational Programs in Medical Physics. https://campep.org.
12. International Atomic Energy Agency. (2010). Clinical Training of Medical Physicists Specializing In Diagnostic Radiology. IAEA, VIENNA.
13. The European Federation of Organizations for Medical Physics (EFOMP), Core Curriculum For Medical Physicists In Radiology, Recommendations from an EFOMP/ESR working group, 2011,
14. CanMEDS 2015 Physician Competency Frank JR, Snell L, Sherbino J, editors. *CanMEDS 2015 Physician Competency Framework*. Ottawa: Royal College of Physicians and Surgeons of Canada; 2015.).