RADIATION ONCOLOGY RESIDENCY PROGRAM
Competency Evaluation of Resident

Resident's Name:	
Rotation:	PHYS 705: Clinical Rotation 3
Inclusive dates of rotation:	Aug. 25, 2015 – Feb. 25, 2016
Director or Associate Director:	

Evaluation criteria	Not Competent	Marginally Competent	Fully Competent	Explanatory Notes & Mentor Signature
Computed Tomography (CT) Simulators - General				
a. Demonstrates understanding of the nuances of CT simulators with those of diagnostic CT scanners (e.g., in terms of lasers, table top indexing, localization software, bore size)				
b. Demonstrates an understanding of the theory of CT imaging reconstruction and of the operation of a CT simulator				
c. Demonstrates an understanding of the major subsystems and components of a CT simulator				
d. Demonstrates an understanding of the room shielding and other radiation protection requirements of a CT simulator				
Computed Tomography (CT) Simulators - Selection				
a. Reviews the steps required to select a new CT simulator, including performance specification and feature comparison				
b. Reviews and understands the mechanical/architectural considerations relevant to installing a new CT simulator in both new and existing rooms				

Computed Tomography (CT) Simulators – Acceptance Testing & Quality Control				
a. Demonstrates an understanding of the mechanical tests performed during a CT simulator acceptance procedure				
b. Demonstrates an understanding of the tests of image quality and characteristics for a CT image and DRR for a CT simulator				
c. Demonstrates an understanding of the measurement of dose and the computed tomography dose index (CTDI) from a CT simulator for different body sites				
d. Demonstrates an understanding of the measurement of CT number as opposed to density calibration with kVp and CT number used in treatment planning systems				
e. Demonstrates an understanding of the alignment of internal and external laser systems in a CT simulator				
f. Demonstrates an understanding of network connectivity tests between other systems used in the radiation oncology process (e.g., treatment planning systems, treatment verification systems, PAC system)				
g. Demonstrates an understanding of the validation tests related to the transfer of CT-imaged objects to treatment planning systems				
Computed Tomography (CT) Simulators – Radiation Safety				
a. Demonstrates an understanding of state/provincial licensing of x-ray producing devices				
b. Explains the principles behind a radiation protection program, including the rationale for the dose limits for radiation workers and members of the public				
c. Describes the key parameters necessary to perform a shielding calculation				

d. Describes the significance of an isodose distribution plot for a CT simulator				
e. Demonstrates an understanding of structural shielding designs for a CT simulator and performs a shielding calculation (walls, ceilings, floor, and control area)				
f. Demonstrates an understanding of film processing and darkroom design				
Computed Tomography (CT) Simulators – Dose Calculations				
a. Understands the physical basis for the use of CT-simulator images in treatment planning as the current standard for dose calculations				
b. Understands the calibration of these CT-simulator images for computing radiation dose deposition in different tissues				
Computed Tomography (CT) Simulators – Quality Assurance				
a. Competently performs routine QA test processes for CT simulators and understands the QA test processes relationship to acceptance testing and commissioning measurements				
b. Understands the bases of recommended measurements for CT-simulators and the measurements tolerances specified by the AAPM, ACR, and other professional bodies				
c. Understands and competently determines the geometric accuracy of laser alignment, couch motion, gantry motion, and CT-simulator images for both static and moving objects				
d. Understands and competently assesses the quality of images produced by CT-simulators in any mode of operation and image reconstruction, and is able to discuss the impact of image artifacts and distortion on treatment planning				
e. Understands the connectivity requirements of a CT simulator to other computer systems that form				

part of a modern radiation therapy treatment process, including being familiar with Internet and DICOM-RT image data transfer protocols				
Computed Tomography (CT) Simulators – CT Protocols				
a. Demonstrates an understanding of the following parameters, their typical values, and how they are combined in CT protocols: slice thickness, pitch, kV, mAs, FOV, and scan length				
b. Demonstrates an understanding of how CT protocols consider multi-slice capabilities, tube heating, and maximum scan time				
c. Demonstrates an understanding of the relationship between image quality and patient dose from examination				
d. Demonstrates an understanding of the need to define dose-optimized imaging protocols for various body parts and sizes of patient				
e. Demonstrates an understanding of image artifacts that may arise in CT images, while being able to identify their causes and assess or mitigate their impact on radiation treatment planning				
f. Understands the different imaging protocols used in tumor motion management (e.g., voluntary breath hold, active breathing control, shallow breathing by compression, free breathing helical CT, 4D-CT)				
g. Understands the different CT image acquisition modes available with a modern CT simulator (e.g., prospective, retrospective, cine, helical, 4D, and image sorting based on breathing phase and breathing amplitude)				
Magnetic Resonance Imaging (MRI) - General				
a. Demonstrates an understanding of the basic imaging principles behind MRI				

b. Compares the treatment planning-related advantages and limitations of MRI with those of CT				
c. Demonstrates an understanding of the role of MRI for radiation therapy applications, providing examples				
Magnetic Resonance Imaging (MRI) - QA				
a. Demonstrates an understanding of the quality assurance processes and frequencies of checks for MR simulators (e.g., image quality, image integrity, safety and mechanical checks, network connectivity)				
Ultrasound (US) - General				
a. Demonstrates an understanding of the basic imaging principles behind US imaging				
b. Demonstrates an understanding of the role of US in external beam and brachytherapy treatments using trans-rectal as opposed to trans-abdominal probes, providing examples				
Ultrasound (US) - QA				
a. Describes methods for QA of US imaging probes prior to clinical uses in procedures such as prostate implants and prostate external beam therapy				
Positron Emission Tomography (PET) - General				
b. Demonstrates an understanding of the basic imaging principles behind PET				
c. Compares the advantages and limitations of PET with those of CT for treatment planning				
d. Demonstrates an understanding of the role of PET for radiation therapy applications, providing examples				

Positron Emission Tomography (PET) - QA				
a. Demonstrates an understanding of the quality assurance processes and frequencies of checks for PET-CT simulators (e.g., image quality, image integrity, safety and mechanical checks, network connectivity)				
SPECT - General				
a. Demonstrates an understanding of the basic imaging principles behind SPECT				
b. Describes the comparative advantages and limitations for treatment planning of SPECT and CT				
c. Demonstrates an understanding of the role of SPECT for external beam and radiopharmaceutical therapy applications, providing examples				
Informatics				
a. Uses information technology to retrieve and store patient demographic, examination, and image information				
b. Understands how image processing is used to create radiographic images for display presentation and depict 3D structures in CT and MR				
c. Uses information technology to investigate clinical, technical, and regulatory questions				
d. Uses and understands common information systems used in radiation oncology (e.g., record and verify, electronic medical records, image handling)				
e. Demonstrates an understanding of the various methods of data transfer, storage, and security, including:				
i. PACS				
ii. DICOM				

iii. DICOM in radiation therapy (DICOM-RT)				
iv. Health Level 7 (HL7)				
v. Integrating the Healthcare Enterprise (IHE)				
vi. IHE Radiation Oncology (IHE-RO)				
f. Understands the roles of physics and information technology staff, including their work in network integration and maintenance				
Image Registration/Fusion				
a. Describes the rationale behind and the advantages/challenges of image registration and image fusion				
b. Defines the image features on which registration can be based (e.g., landmarks, segments, intensities)				
c. Defines the different forms of registration (e.g., rigid, affine, deformable) and Describes their advantages and limitations				
d. Defines similarity metrics used to assess quality of registration (e.g., squared intensity differences, cross-correlation, mutual information)				
e. Describes how to commission imaging modalities such as MRI, PET-CT, and diagnostic CT for the purpose of image registration to a radiation oncology planning CT				
f. Describes issues associated with the transfer of images (e.g., connectivity, image dataset integrity)				
g. Describes issues associated with patient positioning (e.g., bore size, couch top, lasers, compatibility of immobilization devices, differences in patient position/ organ filling, motion)				
h. Describes issues associated with the choice of image acquisition technique (e.g., length of scan, slice thickness, FOV, kV, mAs)				

Imaging Tests				
a. Describes the tests that would be performed to ensure that the imported image data are correct				
b. Demonstrates that images can be imported from CT, MR, and PET or PET/CT scanners				
c. Demonstrates that the above imaging sets can be accurately fused with the primary treatment planning image set				
d. Describes the different image fusion algorithms available on a treatment-planning system (e.g., CT-CT, CT-MR, CT-PET)				
On-Board MV and kV Imaging - General				
a. Describes the different detector technologies that have been used for on-board MV and kV imaging				
b. Describes the imaging dose associated with on-board MV and kV imaging technologies				
c. Understands and performs the different measures of radiographic image quality as part of the routine duties				
On-Board MV and kV Imaging - QA				
a. Understands the QA processes and frequencies of checks for on-board MV and kV imaging, including cone-beam CT (e.g., image quality, image integrity, safety and mechanical checks, network connectivity, imaging dose, and localization software, isocenter calibration) b. Performs the above QA checks as part of the routine duties				
Proton Therapy - Selection				
a. Demonstrates an understanding of the theory of operation of proton accelerators currently used in radiation oncology treatment (e.g., synchrotrons and				

cyclotrons) and their limitations				
b. Demonstrates an understanding of the major subsystems and components of proton accelerators (e.g., synchrotrons and cyclotrons)				
c. Demonstrates an understanding of the various beam line delivery systems used for treatment (e.g., fixed and gantry) and their components				
d. Demonstrates an understanding of proton delivery technologies (e.g., passive scattering and pencil beam scanning), including their limitations				
e. Demonstrates an understanding of the main mechanical and architectural requirements for a building or vault to safely install a new proton accelerator				
f. Demonstrates an understanding of workflow in single- and multi-room proton facilities				
g. Demonstrates an understanding of the underlying principles that guide design of performance tests for a proton accelerator				
Proton Therapy - Calibration				
a. Demonstrates an understanding of the instrumentation and dosimetry protocols (e.g., theory of operation, limitations) employed in the calibrating of megavoltage proton treatment beams				
b. Demonstrates an understanding of how stopping power uncertainty impacts beam calibration and reference conditions				
c. Demonstrates an understanding of the dosimetry correction factors used for proton calibration measurements				
d. Competently calibrates proton beams using a recognized national or international protocol (e.g., International Atomic Energy Organization [IAEA] TRS-398)				
e. Demonstrates an understanding of the differences between various beams (i.e., scattered, uniform				

scanning, and pencil beam)				
f. Demonstrates an understanding of the ramifications of proton beam current and dose				
Proton Therapy - QA				
a. Demonstrates an understanding of the pertinent recommendations for quality assurance of proton units used in radiation therapy				
b. Competently performs routine (daily/weekly/monthly/annual) QA tests of proton treatment units				
c. Competently analyzes routine QA tests for proton treatment units				
d. Demonstrates an understanding of the basis for accepted tolerances for routine QA tests and related required action should any of the checks fall out of tolerance				
e. Demonstrates an understanding of the imaging components used for patient positioning and treatment verification				
Proton Therapy – Treatment Planning				
a. Generates treatment plans for all of the following sites and compares resulting plans with those generated using other modalities (e.g., photons, electrons):				
i. brain				
ii. breast				
iii. prostate				
iv. lung				
v. abdomen				
vi. gastrointestinal system				

vii. craniospinal				
b. Understands beam properties:				
i. Demonstrates an understanding of proton interactions with media				
ii. Demonstrates an understanding of proton percent depth dose in tissue and other media and proton ranges for different energies (e.g., stopping and scattering power, range)				
iii. Demonstrates an understanding of the potential uncertainties of dose deposition in proton radiotherapy				
iv. Demonstrates an understanding of flatness and symmetry requirements for proton beams				
v. Describes the uncertainties related to proton therapy (e.g., in terms of physics, biology, machine, and patient setup accuracy) and how they may be detected and mitigated during the planning and delivery process				
c. Understands beam modifiers:				
i. Demonstrates an understanding of the design and use of tissue compensators				
ii. Demonstrates an understanding of common patient positioning and immobilization devices				
iii. Demonstrates an understanding of the differences in the ICRU structures (e.g., CTV, PTV [as per ICRU 50, 62, and 78]) of proton and photon beams (e.g., dependency on beam orientation and range uncertainty)				
iv. Demonstrates an understanding of how a commercial treatment planning system's computer algorithm calculates dose and monitor units for proton therapy				
Proton Therapy – Radiobiology				

a. Describes the impact of dose and fractionation for normal and tumor tissues				
b. Demonstrates an understanding of the impact of beam quality (e.g., LET) on the RBE of different forms of ionizing radiation (e.g., electrons, photons, charged particles)				
Proton Therapy – Radiation Safety				
a. Demonstrates an understanding of the nuances in the structural and shielding requirements for proton beam facilities				
b. Demonstrates an understanding of neutron activation in proton beam in terms of both safety and utilization for imaging				