Clinical Rotation 4: PHYS 707
Spring (3rd Week of Feb. – 3rd Week of Aug.)
COURSE INFORMATION

Days: Monday-Friday
Times: Full Time
Location: One of the participating cancer clinics

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1. Course Overview

Description from the Official Course Catalog:
On-site, full-day clinical training in intensity modulated radiation therapy (IMRT), volumetric modulated radiation therapy (VMAT), and brachytherapy. Training in quality assurance, calibration, inverse planning, IMRT/VMAT delivery, and radiation safety. Radionuclides and sealed sources in brachytherapy, clinical applications of the sources, treatment planning, and quality assurance. Special procedures with small fields (i.e., stereotactic radiation therapy and stereotactic body radiation therapy) will also be covered.

Description of the Purpose and Course Content:
This course is a clinical rotation that comprises an integral part of the residency training for radiation oncology physics. It is designed to be in accordance with American Association of Physicists in Medicine (AAPM) Task Group 249, 'Essential and

Guidelines for Hospital based Medical Physics Residency Training Programs', and the Commission on Accreditation of Medical Physics Educational Programs (CAMPEP). The course will also include didactic coverage of the topics during biweekly resident sessions at SDSU.

This clinical rotation course extends over the fourth-sixth months of the certificate program and consists of rotations through areas of external beam, intensity-modulated radiation therapy (IMRT), brachytherapy, and associated radiation safety under the supervision of Medical Physicists at one of the participating cancer centers. Objectives are established at the commencement of the course. The student's performance is evaluated by direct observation, a project/progress report, and bimonthly oral examinations administered by the supervising Medical Physicist including a final oral examination by the Advisory Committee. The work at the clinic, including self-study of reading material and contact hours of the Resident with the clinic team (i.e., Medical Physicists, Dosimetrists, Radiation Oncologists, Radiation Therapists) and chart rounds/tumor board meetings will be full time.

Note: The proposed course requires access to external beam radiotherapy equipment, brachytherapy equipment, and quality assurance equipment that are only available at community/academic cancer centers. Arrangements will be made to have board certified Clinical Medical Physicists at the hospitals train the residence in all aspects of the physics of external beam radiation therapy including equipment usage and quality assurance. Once trained, the Resident will be expected to perform routine quality control of the equipment available at the assigned cancer center under the supervision of a qualified Medical Physicist.

In addition to the clinical activities below, the resident is expected to attend one medical physics conference per year and the following activities at SDSU:

- Biweekly didactic resident sessions covering the clinical topics below and resident progress/concerns (~2 hours/session)
- Medical physics seminars (~ 4 per rotation).

I. Intensity Modulated Modalities in Radiation Therapy – Total 8 weeks

A. Inverse planning (Refs. 1 & 2) – 1 weeks
1. Objective functions
2. Optimization

B. IMRT and VMAT delivery (Refs. 1-3) – 3 weeks
1. Tomotherapy
2. MLC sliding window
3. MLC step and shoot
4. Volumetric modulated arc therapy (VMAT)

C. IMRT and VMAT quality assurance (Refs.1-3 & 9-11) – 3 weeks
1. Field fluence maps
2. MLC positioning accuracy
3. Phantom plan and delivery
4. Isodose verification
5. Dose delivery verification

D. Radiation safety (Refs. 1&2) –1 week
1. Leakage radiation
2. Vault shielding

II. Brachytherapy (Refs. 1-8) – Total 9 weeks

A. Radionuclides – 1 week
1. Sealed sources
2. Unsealed sources

B. Sealed sources – 2 weeks
1. Form/construction
2. Activities
3. Protection/storage/handling
4. Standardization/calibration
5. Activity check

6. Leak checks
7. Licensing
8. Most appropriate survey instrument

C. Radiation protection – 1.5 weeks
   1. Shielding design
   2. Surveys
   3. Personal radiation safety badges
   4. Shipping and receiving
   5. Patients with implanted radioactive material

D. Clinical applications – 1.5 weeks
   1. Radionuclide selection
   2. Applicator choice
      a. Low dose-rate (LDR)
      b. High dose-rate (HDR)
   3. Activity considerations
   4. Protection (staff, visitors)
   5. Procedure requirements

E. Treatment planning – 2 weeks
   1. Source spacing
   2. Activities
   3. Dose rates and dose calculation formalisms
   4. Source localization
   5. Computerized planning

F. Brachytherapy quality assurance (QA) – 1 week

III. Special Procedures:
   a. Stereotactic radiosurgery (SRS) – 1.5 weeks
   b. Stereotactic body radiation therapy (SBRT) – 1.5 weeks

2. Student Learning Outcomes & Competency Evaluation Metrics

All of the outcomes listed in Appendix 1 of Clinical Rotation 4 below will be assessed by measurable competencies in clinical measurements and practice, oral evaluations, written reports and a final oral exam. Many of the objectives, learning outcomes, and competency evaluation metrics given in Appendix 1 of this syllabus have been adapted from AAPM Report Task Group 249.

A competency of "Meets Expectations" (i.e.,score ≥ 3) is required on all oral examinations and competency checklist to pass the rotation.

Real Life Relevance:
This clinical rotation course provides practical hands on clinical training in radiation oncology physics.

Relation to Other Courses:
This is the second clinical rotation course in the Advanced Certificate of Medical Physics Residency Program. The topics covered in this and the other clinical rotations are core requirements for the Commission on Accreditation of Medical Physics Education Programs (CAMPEP).

3. Enrollment Information

Prerequisites:
Clinical Rotation 3 (PHYS- 705)

Adding/Dropping Procedures:

The course must be added before the end of the second week of the semester. Dropping procedures will follow the Physics Department guidelines. Note: Dropping a clinical rotation course is effectively equivalent to withdrawing from the residency program.

4. Course Materials (References)

Required & Recommended Materials:

The following task group publications available at http://www.aapm.org/pubs/reports/ from the American Association of Physicists in Medicine (AAPM) and books and will be the references for the course:

1. Radiation Oncology Physics: A Handbook for Teachers and Students, by E. B. Podgorsak. International Atomic Energy Agency, Vienna, Austria. Date Published: 2005. PDF available for free download at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1196_web.pdf

2. The Modern Technology of Radiation Oncology: A Compendium for Medical Physicists and Radiation Oncologists, Volume 1, Editor: Jacob Van Dyk, Medical Physics Publishing Corporation, 1999.

3. The Modern Technology of Radiation Oncology: A Compendium for Medical Physicists and Radiation Oncologists, Volume 2, Editor: Jacob Van Dyk, Medical Physics Publishing Corporation, 2005.

4. High dose-rate brachytherapy treatment delivery: Report of the AAPM Radiation Therapy Committee Task Group No. 59, Med. Phys. 31 .3., March 2004.

5. Update of AAPM Report of Task Group 43: A revised AAPM protocol for brachytherapy dose calculations, Med. Phys. 26 (10), 1999.

6. AAPM Task Group 41: Remote afterloading technology, Published by the American Institute of Physics, Inc., 1993.

7. Recommendations of the American Association of Physicists in Medicine regarding the Impact of Implementing the 2004 Task Group 43 Report on Dose Specification for 103 Pd and 125 I Interstitial Brachytherapy, Med. Phys. 32 .5., May 2005.

8. AAPM Report of Task Group 137. AAPM recommendations on dose prescription and reporting methods for permanent interstitial brachytherapy for prostate cancer, Med. Phys. 36 (11), November 2009.

9. AAPM Report of Task Group 120. Dosimetry tools and techniques for IMRT, Med. Phys. 38 (3), March 2011.

10. IMRT commissioning: Multiple institution planning and dosimetry comparisons, a report from AAPM Task Group 119, Med. Phys. 36 (11), November 2009.

11. AAPM Report of Task Group 82. Guidance document on delivery, treatment planning, and clinical implementation of IMRT: Report of the IMRT subcommittee of the AAPM radiation therapy committee. Medical Physics, Vol. 30, Issue 8.

12. ICRU Report 62. Prescribing, Recording and Reporting Photon Beam Therapy. Supplement to ICRU Report 50 (1993). Bethesda, MD: International Commission on Radiation Units and Measurements, 1999.

13. Low, D. A., W. B. Harms, S. Mutic, and J. A. Purdy. (1998). “A technique for the quantitative evaluation of dose distributions.” Med Phys 25:656–661.

14. Code of Practice for the Quality Assurance and Control for Volumetric Modulated Arc Therapy, Report 24 of the Netherlands Commission on Radiation Dosimetry, 2015.

15. AAPM TG-60. (1999). Nath, R, et al. "Intravascular brachytherapy physics: Report of the AAPM Radiation Therapy Committee Task Group No. 60." Med Phys 26(2):119–152. Also available as AAPM Report No. 66.

16. Dose Calculation for Photon-Emitting Brachytherapy Sources with Average Energy Higher than 50 keV: Full Report of the AAPM and ESTRO, 2012.

17. AAPM Report of the Task Group 186: On model-based dose calculation methods in brachytherapy beyond the TG-43 formalism: Current status and recommendations for clinical implementation, Med. Phys. 39 (10), 2012.

18. A dosimetric uncertainty analysis for photon-emitting brachytherapy sources: Report of AAPM Task Group No. 138 and GEC-ESTRO, Med. Phys. 38(2), 2011.

19. NCCN guidelines for treatment of cancer by site: http://www.nccn.org/professionals/physician_gls/f_guidelines.asp#site

5. Course Structure and Conduct

Style of the Clinical Rotation:

- Residents will be trained by the Certified Clinical Medical Physicist to perform hands on clinical duties in the cancer center.
- Once trained the residents will gain practice by preforming routine clinical duties.
- Residents will be responsible for learning the recommended reference materials on their own.

6. Course Assessment and Grading

Grading Scale:

The Resident's performance will be evaluated by direct observation, project/progress reports, and **three** oral evaluations (approximately bimonthly) administered by the supervising Medical Physicist. Note: The final oral examination is cumulative and will be administered by the Steering Committee.
One of the writing components of this course will include a report by the resident that describes all of the clinical activities/projects in which they participated. The report will include the objectives and relevance, description, methods, and discussion/conclusions of each major clinical activity/project. Special assigned clinical project reports may also be included.

The final assessment breaks down as follows:

1. Observation of clinical measurements and practice by supervising Medical Physicist: 10%
2. Bimonthly oral evaluations based on the clinical rotation topics (Approximately ranging from 20 minutes to 1 hour long): 40%
3. Project/progress and reports: 20%
4. Final presentation and oral exam (1 hour): 30%

The following evaluation scheme from 1 to 5 will be used:

1. Unsatisfactory
   - Performance and/or consistency is below standard in most/all areas covered by evaluation
   - Immediate and consistent improvement to "Meets Expectations" rating is required in next evaluation and final oral exam
2. Needs Improvement
   - Performance and/or consistency is below standards in certain areas and improvement is needed
3. Meets Expectations
   - Competent level of performance that consistently meets high standards
4. Above Expectations
   - Examination results exceed expectations
   - Performance is consistently high quality
5. Outstanding
   - Knowledge of evaluation material is exceptional and consistently superior

The resident will be assigned a pass/fail for the course. An overall score of 3 or greater constitutes a pass. If the resident fails one section of the rotation, they will be given one chance to prepare and re-take the oral exam for that section two weeks later. A copy of all evaluations will be sent to the Program Director.

Excused Absence Make-up Policies:
Students should have an extraordinary reason (e.g., illness, death in the family, etc.), with proof, to miss the oral examination or final oral examination. A make-up for such a case will be arranged with the Advisory Committee

7. Other Course Policies

The residents are expected to:

- Engage with supervising Medical Physicist for training.
- Record daily activities and time spent in the clinic. This will be reviewed by regularly the supervising Medical Physicist and quarterly by the Advisory Committee.
- Report for duties at the clinic and meetings on time.
- Perform assigned readings, presentations, lectures, and clinical duties in a timely manner.
- Attend medical physics seminars (approximately 4 per semester) at SDSU.
- Attend all of the biweekly resident sessions at SDSU.
- Attend one Medical Physics Conference each year (e.g., the AAPM, ASTRO, or COMP Annual Meeting).
- Report any QC results that are out of tolerance to the supervising or other qualified Medical Physicist at the clinic as soon as possible.
- Hand in project and progress reports by assigned deadline.
- Dress appropriately in the clinic (e.g., dress shirt and dress pants).
- Interact respectfully with all staff members and patients in the clinic.
- Advise the supervising Medical Physicist and Program Director of planned absences (e.g., vacation time or sick leave). A record of vacation days absent shall be kept by the Associate/Program Director and should not exceed the allotted two weeks per six-month semester. In addition, the holidays allotted to Medical Physicists at the center are applicable to the resident. The resident may also take up to 1.5 days of personal leave per six-month rotation.

Note:
A senior resident will be chosen to be part of the Advisory Committee to provide input on resident issues and concerns.

If you are a student with a disability and believe you will need accommodations for this class, it is your responsibility to contact Student Disability Services at (619) 594-6473. To avoid any delay in the receipt of your accommodations, you should contact Student Disability Services as soon as possible. Please note that accommodations are not retroactive, and that I cannot provide accommodations based upon disability until I have received an accommodation letter from Student Disability Services. Your cooperation is appreciated.

RADIATION ONCOLOGY RESIDENCY PROGRAM Competency Evaluation of Resident	
Resident's Name:	
Rotation:	PHYS 707: Clinical Rotation 4
Inclusive dates of rotation:	
Director or Associate Director:	

Competency Assessment Scheme:

1. Unsatisfactory
   - Performance/Knowledge is below standard
2. Needs Improvement
   - Performance/Knowledge is below standards in certain areas and improvement is needed
3. Meets Expectations
   - Performance/knowledge that consistently meets high standards of competency
4. Above Expectations
   - Performance/Knowledge exceeds expectations
   - Performance/Knowledge is consistently high quality
5. Outstanding
   - Performance/Knowledge is exceptional and consistently superior

Evaluation criteria	Competency (from 1 – 5)	Explanatory Notes & Mentor Signature
Intensity-modulated Radiation Therapy (IMRT) - 1: Review of Inverse Planning		
a. Demonstrates understanding of the use of objective functions for IMRT optimization		
b. Understands the optimization processes involved in inverse planning		
c. Performs inverse planning optimization for a variety of treatment sites in sufficient number to become proficient in the optimization process		
d. Understands commonly used planning procedures and guidelines as well as optimization and dose calculation algorithms		
IMRT/VMAT - Planning		
a. Principles of IMRT/VMAT: The Resident will be familiar with the various commercially available systems for planning and delivery of IMRT/VMAT		

b. Theory of inverse planning: The Resident will learn how the clinical planning system optimizes a treatment plan. He/she will be familiar with the inputs to the cost function, how it is calculated, and be familiar with the interplay between sometimes competing objectives		
c. Special contouring techniques for IMRT/VMAT: The Resident will be able to convert “clinical” contours into inputs suitable for optimization. Target volumes are made unique and sometimes subdivided for various goals. Non-anatomical volumes are added to the patient anatomy, and margins are added to normal tissues		
d. Dose calculation and plan evaluation: The Resident will learn how the planning system calculates dose distributions from optimal fluence maps. He/she will evaluate treatment plans with respect to dose heterogeneity, plan complexity, and susceptibility to setup variations		
e. Practical training: The Resident will plan a number of practice cases under the guidance of a physics mentor (a prostate and a head & neck) and then move to dosimetry to plan/observe a number of live patient cases. The live cases will also involve the development of verification plans, documentation, and import to the record and verify system:		
i. Practice cases: two prostate, two head & neck ii. Live cases: two prostates, two head & neck		
Intensity-modulated Radiation Therapy (IMRT) - 2: IMRT and VMAT Delivery		
a. Understands various IMRT delivery techniques (e.g., compensators, static field IMRT, rotational delivery techniques) and their relative advantages and disadvantages		
b. Describes the differences between dynamic multileaf collimator (DMLC) and segmental multileaf collimator (SMLC) leaf sequencing algorithms in terms of delivery parameters and dose distributions		
c. Participates in IMRT or VMAT delivery for patients with a variety of treatment sites and understands the techniques and requirements for patient setup, immobilization, and localization		
Intensity-modulated Radiation Therapy (IMRT) - 3: IMRT and VMAT Quality Assurance		

a. Demonstrates an understanding of the appropriate level of quality control tests for IMRT/VMAT		
b. Demonstrates an understanding of commonly used QA procedures and guidelines, delivery and dosimetry equipment, and QA analysis techniques		
c. Calculates verification plans within the treatment planning system along with independent checks using secondary MU calculation software		
d. Performs IMRT/VMAT delivery QA measurements using 2D/3D array, film, or ion chamber techniques, an activity that includes analysis of results and determination of passing criteria (which will involve familiarity with the concept of gamma analysis)		
e. Performs and analyzes MLC QA measurements designed for accelerators used for IMRT/VMAT		
f. Reviews individual patient-specific QA results with staff physicists and physicians		
IMRT/VMAT QA – 3: Advanced		
a. IMRT/VMAT QA overview: The Resident will be able to describe the elements of systemic and patient-specific IMRT/VMAT QA. He will be able to indicate which features of an IMRT/VMAT plan must be validated before treatment and how they are tested within the clinic's QA program		
b. IMRT/VMAT QA techniques: The Resident will become proficient in each of the IMRT/VMAT QA systems used in the clinic and will be able to describe the strengths and weaknesses of each technique. He/she will be able to cite the specific reason for each test, know its thresholds for passage or failure, and know how to proceed if a plan fails QA:		
i. Ion Chamber Measurements • Selection of dose measurement points • Delivering IMRT/VMAT plan to phantom		
ii. EPID Portal Dosimetry • Generation of portal dose images • Dosimetric calibration of EPID • Measuring portal dose images • Evaluation techniques (profiles, isodose, gamma)		
iii. MU calculation • When MU calculation is appropriate		
iv. Detector array (e.g., MapCHECK, ArcCHECK) • Strengths and weaknesses compared to film and EPID		

c. Practical Experience: Resident will spend at least 2 weeks functioning as an IMRT/VMAT QA physicist, practicing all aspects of routine IMRT/VMAT QA		
Intensity-modulated Radiation Therapy (IMRT) - 4: Radiation Safety		
a. Understands IMRT delivery's effects on leakage radiation and its potential effects on patients and personnel exposure		
b. Understands the effects of different IMRT delivery techniques on the amount of leakage radiation produced		
c. Understands the effects of IMRT delivery on vault shielding requirements		
Brachytherapy – General Aspects		
a. The Resident will be familiar with procedures, hardware, and isotopes used for the treatment of the most common anatomic sites treated with sealed-source radionuclide therapy		
b. The physical characteristics, assay, handling, licensing, and disposal (if applicable) of brachytherapy sources will be learned by the Resident		
c. The Resident must be able to quality assure the computer system used to generate information utilized to plan and treat patients with radionuclide sources		
d. The Resident should be able to show competence in physics and dosimetric services in support of the clinical use of sealed radionuclide sources in the treatment of the following. If a case does not occur or is now extremely uncommon, the Resident should perform a mock treatment; or the requirement may be waived at the discretion of the Rotation Supervisor: • Biliary duct: intraluminal • Eye plaque • Permanent lung implants: planar • Permanent prostate seed implants: volume interstitial		
e. The Resident should be able to show competence in physics and dosimetric services in support of the HDR clinical treatments of the following. If a case does not occur or is now extremely uncommon, then the Resident should perform a mock treatment; or the requirement may be waived at the discretion of the Rotation Supervisor: • Vaginal cylinder HDR. • Tandem and Ring – Fletcher Suit – HDR.		

• Interstitial HDR. • Planar intraoperative HDR (IOHDR)		
f. The Resident should observe and actively participate in as many brachytherapy cases as reasonably possible such that they gain sufficient experience and confidence to do the case themselves. Because some cases do not occur very often, the Resident is expected to place a higher priority on the attendance of brachytherapy cases		
g. The Resident should be able to perform all aspects of the LDR and HDR QA independently (although the Resident will not be asked to do so if it is not within regulations). The Resident should participate in a minimum of two source exchanges		
h. The Resident will be familiar with federal, state, and local regulatory documents related to sealed-source therapy		
i. The Resident will learn and generate two mock treatment plans for an LDR and HDR case		
Brachytherapy - 1: Sealed Radionuclides Sources		
a. Demonstrates an understanding of how commonly used sources are generated		
b. Describes the decay, decay energies (mean energy), and half-lives of commonly used sources		
c. Describes the form and construction of sealed sources		
d. Describes and defines the different units of source strength that have been used in the past and the present		
e. Performs an example decay calculation of the total dose delivered for temporary and permanent implants		
f. Describes personal protection techniques (involving time, distance, and shielding) and safe handling of sealed sources		
g. Describes the appropriate methods of storing radioactive material (with regard to security and accountability)		
h. Performs routine receipt procedures and both checks into inventory and checks out temporary and permanent sources		
i. Performs a source room survey and a quarterly inventory		
j. Describes and, if possible, performs leak checks on sealed sources		
k. Demonstrates an understanding and gains hands-on experience of radioactive material packaging and transportation requirements,		

e.g., Title 49 of the U.S. Code of Federal Regulations (CFR)		
l. Demonstrates an understanding of the equipment used to calibrate sealed sources		
m. Describes the process by which sealed sources are calibrated		
n. Describes the process by which measurement equipment (e.g., electrometers, well ionization chambers) is calibrated		
o. Explains the theory of operation of a well ionization chamber		
p. Describes and performs an assay for sealed sources		
q. Demonstrates an understanding of licensing issues and requirements (e.g., NUREG 1556)		
r. Describes the operation and appropriateness of different survey instruments (e.g., Geiger–Müller counters, ionization survey meters, scintillation counters)		
s. Demonstrates an understanding of the regulatory requirements pertaining to sealed sources, e.g., state or federal regulations such as Title 10 of the U.S. CFR Part 35 (10CFR35)		
Brachytherapy - 2: Unsealed Radionuclides Sources		
a. Demonstrates an understanding of how commonly used radiopharmaceuticals (e.g., I-131, P-32, Sm-153, Sr-89) are generated		
b. Demonstrates an understanding of the decay, decay energies (mean energy), and half- lives of commonly used radiopharmaceuticals		
c. Describes personal protection techniques (involving time, distance, and shielding) and safe handling of unsealed sources		
d. Describes the process by which unsealed sources are calibrated		
e. Describes the process by which measurement equipment (e.g., dose calibrator) is calibrated		
f. Describes and, if possible, performs an assay for unsealed sources		
g. Demonstrates an understanding of licensing issues and requirements (e.g., NUREG 1556)		
h. Describes the operation and appropriateness of different survey instruments (e.g. Geiger–Müller counters, ionization chambers, scintillation counters)		

i. Demonstrates an understanding of the regulatory requirements for unsealed sources, e.g., state/provincial or federal regulations such as 10 CFR 35		
Brachytherapy - 3: Radiation Protection		
a. Demonstrates an understanding of shielding calculations for primary and secondary barriers (e.g., NCRP 151)		
b. Describes the key parameters necessary to perform a shielding calculation		
c. Describes or performs a shielding calculation for a brachytherapy vault		
d. Describes or performs a radiation survey for a brachytherapy vault		
e. Describes requirements for personal radiation safety badges		
f. Describes labeling, shipping, and receiving requirements for radioactive material		
g. Describes management of an isotope inventory		
h. Describes release criteria for radioactive patients (i.e., patients with temporary or permanent implants and radiopharmaceuticals)		
i. Describes how to handle changes in medical status for radioactive patients (i.e., in cases of medical emergency or death, as per NCRP 155)		
j. Explains the key concepts of state/provincial or federal regulations (e.g., Title 10 of CFR parts 19, 20, and 35)		
k. Demonstrates how to safely operate a remote afterloader unit, including emergency procedures		
Brachytherapy - 4: Clinical Applications		
a. Describes the various brachytherapy sources that have been used clinically in the past and which are used today, as well as the rationale for source selection		
b. Describes how a brachytherapy program is developed		
c. Describes in detail the use and operation of the following different brachytherapy modalities and their advantages and disadvantages: i. Low dose rate (LDR) ii. High dose rate (HDR) iii. Pulsed dose rate (PDR; optional) iv. Electronic (optional)		

d. Describes and performs verifications of source strength (air kerma rate, S_k) and comparisons between measured and vendor's specifications		
e. Describes radiation protection for radiation workers and visitors		
f. Demonstrates an understanding of commissioning and acceptance of remote after- loaders (RALs)		
g. Demonstrates an understanding of gynecologic (GYN) and genitourinary anatomy		
h. Demonstrates an understanding of the treatment of cervical and endometrial cancers with LDR, HDR, and PDR (optional)		
i. Demonstrates an understanding of prostate cancer and its treatment with HDR and LDR		
j. Treatment planning i. Demonstrates an understanding of treatment planning commissioning ii. Performs brachytherapy treatment plans for a cylindrical GYN applicator iii. Performs brachytherapy treatment plans for cervical applicator (e.g., tandem and ovoids, tandem and ring) iv. Describes the differences between point- and volume-based treatment planning as per the ICRU 38 and the Groupe Européen de Curiethérapie (GEC) European Society for Radiotherapy and Oncology (ESTRO) recommendations v. Develops interstitial brachytherapy treatment plans (e.g., prostate cancer, GYN diseases, sarcoma) vi. Develops a brachytherapy treatment plan for an eye plaque (optional) vii. Performs an activity/dose calculation for microsphere therapy (optional)		
k. Demonstrates an understanding of applicator acceptance, commissioning, and the performance of periodic QA		
l. Demonstrates an understanding of and participates in/performs periodic spot checks, safety procedures, and source exchange QA, including source calibration		
m. Describes emergency training requirements for RALs (e.g., as specified in 10 CFR 35)		
n. Demonstrates an understanding of quality management programs as required by federal or state/provincial regulations for auditing		
o. Describes the criteria for recording/reporting and the subsequent handling of reportable events		

Brachytherapy - 4: Treatment Planning		
a. Demonstrates an understanding of the source strength of radioactive sources		
b. Describes dose rates and dose calculation formalisms for high-energy brachytherapy dosimetry (HEBD) and low-energy brachytherapy dosimetry (LEBD)		
c. Demonstrates an understanding of the performance of computerized planning of various imaging modalities of LDR and HDR		
d. Describes in detail the advantages and disadvantages of dose optimization		
e. Describes and performs secondary calculations as QA checks for computerized planning		
Brachytherapy - 5: Quality Assurance		
a. Demonstrates an understanding of and performs comprehensive periodic QA (daily, monthly, annually) of a remote afterloader		
b. Describes and performs periodic treatment planning QA		
c. Demonstrates an understanding of implant-specific QA		
Special Procedures - 1: Stereotactic Radiosurgery (SRS)		
a. Describes rationales for SRS treatments, examples of malignant and non- malignant lesions treated with SRS, and typical dose and fractionation schemes for linac-based and Co-60 SRS techniques		
b. Describes in general terms the components of commissioning an SRS sys- tem (e.g., accurate localization, mechanical precision, accurate and optimal dose distribution, and patient safety)		
c. Describes the stereotactic localization of a target (e.g., on the basis of angiography as opposed to CT and MRI) and how the accuracy of this localization is measured		
d. Describes the alignment of coordinate systems (e.g., target frame of reference with linac frame of reference) and how the mechanical precision of this alignment is measured		
e. Describes issues associated with dosimetry measurements for an SRS system (e.g., choice of dosimeter, phantom geometry, etc.)		
f. Describes the components of pre-treatment QA for an SRS system, including linac-based and		

Co-60 SRS techniques		
Special Procedures - 2: Stereotactic Body Radiation Therapy (SBRT)		
a. Explains the rationale for SBRT treatments, common treatment sites, and typical dose and fractionation schemes		
b. Describes immobilization and localization systems for SBRT treatments		
c. Describes the use of simulation imaging for SBRT target definition, including multi-modality imaging and 4D imaging for cases requiring motion management		
d. Describes treatment planning objectives for SBRT treatments, including dose limits, dose heterogeneity, dose gradient and fall-off, and beam geometry		
e. Describes treatment verification and delivery for SBRT treatments as well as use of in-room imaging		
f. Addresses the need for motion management in lung and abdomen SBRT treatments		
g. Describes treatment planning system validation tests, and in this context, tissue inhomogeneity corrections and small-field dosimetry measurements		