

**TENTATIVE**  
**McGill University**  
**Medical Physics Unit**  
**Radiotherapy Physics: MDPH 602 (3 credits)**  
**Winter 2021**

- Lecturers:** Part 1: Jan Seuntjens, Ph.D.  
McGill University Health Centre (Glen site), DS1.7133, (514) 934-1934 x44124
- Part 2: Piotr Pater, Ph.D. and Monica Serban, M.Sc.  
McGill University Health Centre (Glen site), DS1.5116, (514) 934-1934 x45303
- Teaching assistant:** Federico Keszti, Veng Jean Heng  
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- Time:** Monday/Wednesday 09:00-10:30 (**TO BE CONFIRMED**)
- Place:** McGill University Health Centre (Glen site), DS1.7001
- Office hours:** J.S. by email ([jan.seuntjens@mcgill.ca](mailto:jan.seuntjens@mcgill.ca)), or DS1.7133  
P.P. by email ([piotr.pater@mcgill.ca](mailto:piotr.pater@mcgill.ca)) or DS1.5116  
M.S. by email ([monica.serban@mcgill.ca](mailto:monica.serban@mcgill.ca))
- Textbook:** E. B. Podgorsak (editor), *Radiation Oncology Physics: A Handbook for Teachers and Students* (16 chapters, 696 pages), International Atomic Energy Agency; Vienna, Austria, 2005, STI/PUB/1196 (ISBN 92-0-107304-6). Also available online at:  
<http://www-naweb.iaea.org/nahu/DMRP/syllabus.html>  
(Note: this material gives you a general overview but is on certain subjects too superficial or dated, follow notes given by instructor).
- Also available online in a set of 2600 slides prepared by E. B. Podgorsak and G. Hartmann at:  
<http://www-naweb.iaea.org/nahu/DMRP/slides.html>
- P. Andreo et al *Fundamentals of Ionizing Radiation Dosimetry*, Wiley, New York, 2017 (for the measurement dosimetry part of the course)
- Reference books:** Faiz M. Khan, *The Physics of Radiation Therapy*, Lippincott Williams & Wilkins, Baltimore, Maryland.
- William R. Hendee, Geoffrey S. Ibbott, and Eric G. Hendee, *Radiation Therapy Physics*, John Wiley & Sons, Inc., Hoboken, New Jersey.

H.E. Johns and J.R. Cunningham, The Physics of Radiology (4th Edition, 1983) (Historical reference book)

**Examinations:**           **Quizzes** every 1–3 weeks

**Midterm written examination** TBD

**Final examination** (written and oral)

**Grading:**               Written component: 100%

- Assignments: 25%
- Quizzes: 12%
- Midterm examination: 30%
- Final examination (written): 33%

\*Bonus Final examination (oral): 10%

\*Only students achieving at least 65% on the written component qualify for the oral examination, which can potentially add up to 10% bonus points.

**Assignments:**

All assignments are posted on MyCourses before the semester starts. They are to be submitted through MyCourses. Failing to hand the assignment on time will result in a grade of 0% for that assignment as well as no possibility of getting it corrected by the TA. Assignments will be corrected **within one week** of submission and handed back to the students by the TA.

**Quizzes:**

Quizzes are going to be given during some lectures. The length of each quiz is at the discretion of the teacher but should not exceed 20 minutes. Questions are not available in advance. Quizzes will be corrected and handed back to the students at the beginning of the next lecture. Failure to be present on a quiz without justification will result in a grade of 0% for that quiz. Quizzes will be given at the end of the class. The material covered in the quizzes is that of the classes preceding the quiz, since the previous quiz or since the beginning of the course for the first quiz.

**Midterm written examination:**

The Midterm will be on **TBD**. Room and time will be confirmed. The material evaluated will cover **lectures 1 to 13**. Typically, the exam lasts 3 hours, but extra time might be given.

**Final written examination:**

The Final written exam will be held during the official exam period in April. It will cover all the material from lectures 1-26, with emphasis on lectures **14-26**.

**Bonus Final examination (oral):**

Students achieving at least 65% on the written component (including the final exam) will be invited for the bonus oral exam. The date and time of each student's oral examination will be determined after corrections of the final exam. The oral examination covers all the material from lectures 1 to 26, but mainly focuses on areas that were missed in the final exam. The oral examination is meant to help students increase their overall grade. Therefore, all points are bonus points. However, simply being present at the oral exam, is not enough to guarantee obtention of any bonus points.

“In the event of extraordinary circumstances beyond the University’s control, the content and/or evaluation scheme in this course is subject to change.”

“McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see [www.mcgill.ca/students/srr/honest/](http://www.mcgill.ca/students/srr/honest/) for more information).”

“In accord with McGill University’s Charter of Students’ Rights, students in this course have the right to submit in English or in French any written work that is to be graded.”

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Lecture #	Date (may be subject to amendment)	Topic
1	Mon Jan 4	Overview of nomenclature and basic concepts of radiotherapy physics and dosimetry; percent depth dose curves; brief overview of therapy devices; SSD vs. SAD setup; beam quality; basic properties of detectors used in RT
2	Wed Jan 6	<b>Measurement dosimetry 1:</b> Overview of most commonly used detectors in clinical dosimetry. Ionization chambers: functioning, properties, polarity & recombination
	Mon Jan 8	Assignments for this course are posted before this day- Note that modifications to assignment 2,3,4 still possible
3	Mon Jan 11	<b>Measurement dosimetry 2:</b> Recap cavity theory, small and large cavities, link to calibration chain, traceability to national absorbed dose standards
4	Wed Jan 13	<b>Measurement dosimetry 3:</b> Absorbed dose to water-based dosimetry in clinic: TG-51 and Addendum
5	Mon Jan 18	<b>QUIZ 1</b> <b>Measurement dosimetry 4:</b> Small and nonstandard field dosimetry in clinic: TRS-483
6	Wed Jan 20	<b>Measurement dosimetry 5:</b> Air kerma based dosimetry in clinic: AAPM TG-61. Kilovoltage radiotherapy, historical applications and current clinical applications
	Fri Jan 22	Assignment 1 due (6 pm): content Measurement dosimetry
7	Mon Jan 25	<b>Radiation therapy equipment 1:</b> Therapy devices; Co-60, X-ray, linear accelerator components: overview
8	Wed Jan 27	<b>Radiation therapy equipment 2:</b> Linear accelerator components; other medical accelerators; beam quality revisited
9	Mon. Feb. 1	<b>QUIZ 2</b> <b>Radiation therapy equipment 3:</b> Waveguide theory
10	Wed. Feb. 3	<b>Dosimetric functions 1:</b> Equivalent field size; inverse-square law; collimator factor; scatter factor; relative dose factor; peak scatter factor; Output at reference conditions; tissue-air ratio; scatter-air ratio; relationship between PDD and TAR; Mayneord factor; Tissue-phantom ratio; tissue-maximum ratio; relationship between PDD and TPR
11	Mon. Feb. 8	<b>Dosimetric functions 2:</b> Calculation of dose to water under changing conditions (field size, SSD, depth) using PDD and TPR methods; exercise session.

12	Wed. Feb 10	<b>Dosimetric functions 3:</b> Monitor Unit calculations for SSD and SAD setups, examples and exercises. Brief review of material for mid-term.
	<b>Fri Feb 12</b>	<b>Assignment 2 due (6 pm) - content: Accelerators and Dosimetric functions, MU calculations</b>
13	Mon Feb 15	<b>QUIZ 3</b> Introduction to proton therapy, accelerators, PDD and Bragg peak modulation, range uncertainty, margins
14	Wed Feb 17	<b>Treatment planning 1:</b> Off-axis ratios; beam profiles; flatness and symmetry; isodose lines; dose distributions for single and multiple fields, Missing tissue compensation; wedges; bolus; compensators.
15	Mon. Feb. 22	<b>Treatment planning 2:</b> Dose-volume histograms; beam weighting; dose normalization; radiotherapy prescription
16	Wed. Feb. 24	<b>Treatment planning 3:</b> CT simulation; 4DCT; digitally-reconstructed radiographs, Image guidance and verification in radiotherapy; image registration; re-irradiation and EQD2 maps.
	<b>Thurs Feb. 25</b>	<b>Midterm examination</b>
17	Mon. Mar 29	<b>QUIZ 4</b> <b>Treatment planning 4:</b> Photons; 3DCRT; Forward vs. inverse IMRT planning; optimization; use of arcs. adaptive radiotherapy
18	Wed. Mar 31	<b>Dose-calculation algorithms 1:</b> Heterogeneity corrections; Clarkson integration.
	Mar 5 - 9	McGill study break
	<b>Fri Mar 13</b>	<b>Assignment 3 due</b>
19	Mon. Mar. 12	<b>Dose-calculation algorithms 2:</b> Model based algorithms for external beam dose calculations. Convolution-superposition, collapsed cone convolution.
20	Wed. Mar. 14	<b>Dose-calculation algorithms 3:</b> Monte Carlo applications in fundamental dosimetry and EBRT.
21	Mon. Mar 19	<b>QUIZ 5a</b> <b>Special techniques in RT 1a:</b> Electron therapy: PDD; beam quality; practical range; low vs. high energies, Effect of obliquity; electron cutouts; shielding; bolus.
22	Wed. Mar. 21	<b>Special techniques in RT 1b:</b> Electron therapy: electron prescriptions; virtual source; field matching; electron arc therapy, clinical applications
23	Mon. Mar 26	<b>QUIZ 5b</b> <b>Special techniques in RT 2a:</b> Brachytherapy Definitions; typical sources; calibration of brachytherapy sources, BT dose calculations (TG43)
24	Wed. Mar 28	<b>Special techniques in RT 2b:</b> Brachytherapy clinical applications
	<b>Fri Mar 30</b>	<b>Assignment 4 due – content: dose calculation algorithms, Electron therapy, brachytherapy</b>

25	Mon. Apr. 3	<b>QUIZ 6</b> <b>Special Techniques in RT 3:</b> SRS, CSI, SBRT. Discussion of physical aspects.
26	Wed. Apr. 5	<b>Special techniques in RT 4:</b> Selected tricky clinical cases, breast IMN, TBI, TSEI, nasopharynx. Discussion of physical aspects.
	<b>TBD</b>	<b>Final examination (written) DATE TO BE CONFIRMED</b>
	<b>TBD</b>	<b>Final examination (oral) DATE TO BE CONFIRMED</b>